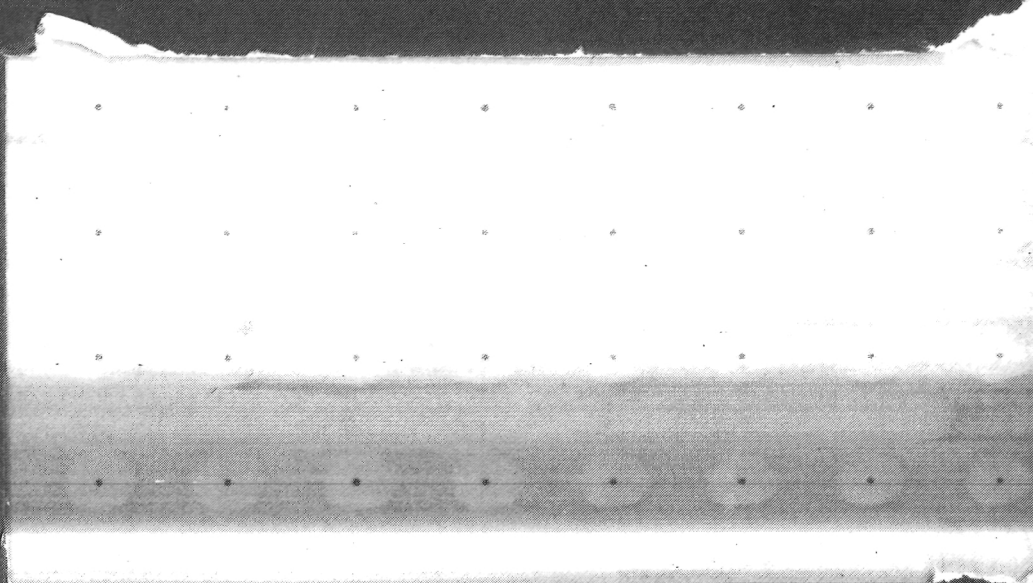


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Research
and
Technology

Objectives

and
Plans



SUMMARY

**FISCAL YEAR 1979
RESEARCH AND
TECHNOLOGY PROGRAM**

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INTRODUCTION

This publication represents the NASA Research and Technology program for FY 1979. It is a compilation of the "Summary" portions of each of the RTOPs (Research and Technology Objectives and Plans) used for management review and control of research currently in progress throughout NASA. The *RTOP Summary* is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities. We believe also that this publication can help to expedite the technology transfer process.

The *RTOP Summary* is arranged in five sections. The first section contains citations and abstracts of the RTOPs. Following this section are four indexes: Subject, Technical Monitor, Responsible NASA Organization, and RTOP Number.

The Subject Index is an alphabetical listing of the main subject headings by which the RTOPs have been identified.

The Technical Monitor Index is an alphabetical listing of the names of individuals responsible for the RTOP.

The Responsible NASA Organization Index is an alphabetical listing of the NASA organizations which developed the RTOPs contained in the Journal.

The RTOP Number Index provides a cross-index from the RTOP number assigned by the NASA responsible organization to the corresponding accession number assigned sequentially to the RTOPs in *RTOP Summary*.

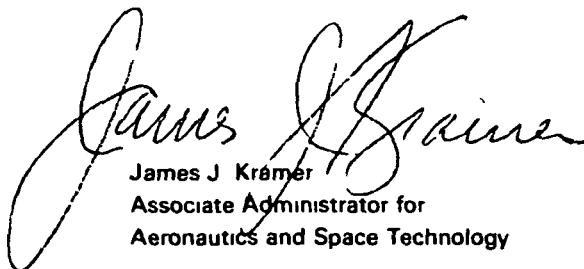
As indicated above, responsible technical monitors are listed on the RTOP summaries. Although personal exchanges of a professional nature are encouraged, your consideration is requested in avoiding excessive contact which might be disruptive to ongoing research and development.

Any comments or suggestions you may have to help us evaluate or improve the effectiveness of the *RTOP Summary* would be appreciated. These should be forwarded to

National Aeronautics and Space Administration
Office of Aeronautics and Space Technology
Washington, D C 20546

Attn: Travis Ives

Resources and Management Systems Division (RM-2)



James J. Kramer
Associate Administrator for
Aeronautics and Space Technology

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TYPICAL CITATION AND TECHNICAL SUMMARY

RTOP ACCESSION NUMBER → **W79-70213** **506-20-55** ← CURRENT RTOP NUMBER

RESPONSIBLE NASA ORGANIZATION → Jet Propulsion Lab Calif Inst of Tech Pasadena

TITLE → **HIGH CAPACITY DATA STORAGE AND DISPLAY FIBER OPTICS DATA LINKS** TELEPHONE NUMBER
RELATED RTOPS

TECHNICAL MONITOR → A R Johnston 213-354-4054
(506-18-21 180-24-51) ← TECHNICAL SUMMARY

The goal of the proposed effort is to apply the emerging technology of fiber optic data links to NASA needs and to contribute to the advancement of the technology in selected areas. Development of fiber optic data transmission will support OAST goals both in terms of a great increase in mission capability and a decrease in mission costs. The principal benefits to be expected from the use of fiber optics are the EMI immunity of the transmission line, its small size and weight, wide bandwidth, and ultimately lower cost than copper equivalents. Two long-term objectives will focus the work: (1) development of a space data bus capability, and (2) development of a high capacity data distribution capability. During FY-79 a breadboard of a spacecraft data bus will be evaluated. A high data rate application related to requirements of future NASA data distribution will be identified and a link conceptual design developed. Technology limitations and needed single-mode component development consistent with a 1 G bit/sec data rate will be identified. Applications will be sought for quantitative evaluation and to help identify limiting technology. New effort is needed in the area of wave guiding components including bus couplers, directional couplers, and sources and detectors. An appropriate mix of evaluation of available devices with development of selected concepts is planned.

RESEARCH AND TECHNOLOGY OBJECTIVES AND PLANS

a summary

FISCAL YEAR 1979

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Aeronautics Research and Technology Base

W79-70001

505-01-12

Lewis Research Center Cleveland Ohio

ADVANCED PROPULSION MATERIALS - HOT SECTION

H B Probst 216-433-4000

(510-53-01 506-16-12)

The objective of this RTOP is to provide improved materials (metallic and non-metallic) and processes for use in advanced air-breathing propulsion systems particularly for aeronautical applications. Materials are sought that offer improvements not only in technical performance but also in economy in terms of total life cycle costs. The classes of materials being investigated include directionally solidified eutectics dispersion strengthened alloys fiber reinforced superalloys protective coatings and ceramics. Basic research both inhouse and by university grants relevant to the high temperature behavior of engine materials is conducted. Results of this basic effort then supply guidance for the more applications oriented program conducted in-house and by industrial contract. Material improvements are judged by mechanical and physical properties as well as quantitative evaluations of microstructural features and performance in simulated-engine environments. Ultimately highly promising materials and processes that result from this program become candidates for the MATE program to accomplish scale-up and full scale engine testing. Emphasis is on advanced materials for aircraft gas turbine blades, vanes disks and seals. Specific phenomena encountered in the gas turbine are also studied e.g., oxidation hot corrosion, creep and fatigue.

W79-70002

505-01-21

Ames Research Center Moffett Field, Calif

FATIGUE DAMAGE IN STEELS AND COMPOSITES

H G Nelson 415-965-6137

(505-02-41)

Both experimental and analytical research will be continued to understand the fatigue and fracture behavior of metallic and composite materials. In metallic materials emphasis will be continued on the development of an improved understanding of environmental degradation to ductile low strength materials. The hydrogen-metal interaction will be studied through the identification of chemisorption rate kinetics from hydrogen and hydrogen containing complex molecules. By the use of elastic-plastic fracture mechanics in mode I loading and possibly under combined mode loading knowledge of the hydrogen-dislocation interaction and its influence on the mode of deformation and plastic zone size will be used to better predict fatigue crack growth behavior of ductile materials. Studies will be initiated to establish the influence of microstructure on the resistance of low strength

materials to gas-phase hydrogen degradation in an effort to identify the least susceptible microstructure which can be obtained commercially through thermal mechanical or thermomechanical processing. In composite materials studies will be continued to develop an accelerated testing procedure for graphite/epoxy under conditions of fatigue loading. Variation of fatigue life and endurance limit will be established as a function of cyclic frequency cyclic amplitude and temperature. Through relevant shifting procedures based on both theory and experiment procedures will be developed to predict service fatigue durability of composite materials.

W79-70003

505-01-22

Lewis Research Center Cleveland Ohio

FATIGUE, LIFE PREDICTION METHODS AND FRACTURE CONTROL

M H Hirschberg 216-433-4000

(778-32-01 505-02-12)

The major objective is to obtain a better understanding of the failure mechanisms that are involved in the application of conventional as well as composite materials to aeronautical propulsion systems so that presently available and advanced materials can be used more efficiently. A second major objective is to develop methods for predicting the life of specimens as well as propulsion system components when they are subjected to constant temperature and monotonic loads or to complex patterns of temperatures and cyclic loads as a function of time. To achieve these objectives, research is underway to extend existing life prediction techniques and analyses to develop new methods for determining the stress and strain distributions in the vicinity of discontinuities such as flaws or cracks. In addition microstructure as determined by composition and processing is being studied as an influence on the fracture properties of high strength alloys. Various approaches are also being examined for predicting the time to initiation of the first detectable cracks resulting from mechanical and thermal fatigue. Standard test methods are being developed to properly characterize the fatigue and fracture behavior of materials and to provide economical methods for alloy product quality control.

W79-70004

505-01-31

Ames Research Center Moffett Field Calif

FIRE RESISTANT MATERIALS

A H Heimbuch 415-965-6274

(505-08-21, 510-56-01 734-01-11)

Polymer research will be performed to provide material support for fire safety improvement in both domestic and military aircraft. Synthesis, chemical modifications and characterizations will be performed mainly on "high char yield" polymer types of potential cost benefit to the development of lightweight aircraft structures. Polymers will be selected for potential evaluation as resin matrix binders film formers adhesives, foams, transparencies and modified carbon fibers. Selection will be made on the basis of reduced flammability smoke and toxic gas emissions fire resistance fire impact stability and controlled electrical properties to support both the Firemen and Composite Wing programs. Molecular, chemical and physical properties will be determined.

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on new and advanced state-of-the-art polymers. Correlations of structure-property relationships will be sought. A data base for the combustion characteristics, the thermochemical, thermophysical and photochemical properties of these materials will be developed which will serve as inputs for analytical studies to predict fire endurance, toxic threat levels and carbon fiber release rates. Candidate polymers and processes will be provided for evaluation as prototype subsystem components for testing.

W79-70006

505-01-32

Lewis Research Center, Cleveland, Ohio

COMPOSITES FOR PROPULSION COMPONENTS

T. T. Serafini and R. A. Signorelli, 216-433-4000
(743-03-22, 510-57-02, 505-02-12, 734-01-02)

The overall objective of this research is to develop metal matrix and polymer matrix composite materials with improved properties and processing characteristics for use in fabricating various aeronautical propulsion structural components. Recent cost-benefit studies show that the use of fiber reinforced composites in turbofan engines can provide significantly improved performance resulting in reduced fuel consumption and operating costs. Composites being considered include resin matrices reinforced with boron, Kevlar, glass fiber and graphite as well as aluminum matrices reinforced with boron and SiC fibers. In the metal matrix work, emphasis is placed on the development of fabrication processes and the improvement of impact resistance and correlating nondestructive evaluation measurements with mechanical properties. In the area of polymer matrix composites, emphasis is given to developing processable high temperature resins, low cost fabrication methods and correlating nondestructive evaluation (NDE) measurements with mechanical properties. Emphasis will also be placed on establishing the fundamental concepts necessary to provide quality assurance procedures and materials specifications for PMR Polyimide and epoxy matrix composites.

W79-70006

505-01-33

Langley Research Center, Hampton, Va.

STRUCTURAL COMPOSITES AND ADHESIVES

N. J. Johnston and R. R. Heldenfels, 804-827-2042

The objective is to develop new or improved lightweight polymeric composite and metallic materials that have longer lifetimes, greater reliability and improved structural efficiency in aeronautical structures. Research will be aimed at improvement of structural resins and adhesives through systematic variation in polymer molecular structure and development of new or improved joining and fabrication methods for both metallic and composite materials. Research will also be directed at repair technology of composites including development of appropriate repair procedures and evaluation of their effectiveness and the development of quantitative NDE methods. Studies of interfacial reactions and diffusion processes in advanced metal-matrix composites and structural alloys will also be made. Emphasis will be on relating service environments such as temperature and stress to corrosion behavior and developing treatments which will substantially improve corrosion resistance. An additional objective is to quantify and study with the aim to alleviate, moisture effects on polymer matrix composites and adhesive joints. These studies will help to identify new or advanced materials and processes for aeronautical structural applications and will provide important data on the behavior, capabilities and limitation of such materials.

W79-70007

505-02-13

Langley Research Center, Hampton, Va.

ADVANCED AIRCRAFT STRUCTURES

R. A. Pride and R. R. Heldenfels, 804-827-2869
(505-02-43, 505-01-33)

The objective is to develop the technology required for obtaining improved efficiency and reduced costs in aircraft structures by the application of advanced composite materials and composite design concepts to commercial aircraft. Research and development is being carried out to establish a technology base of advanced analytical methods for predicting the strength, stiffness and stability of composite laminates, stiffened cover panels and shear webs. An adequate test data base is being

established for substantiation. Effects of flaws and damage on composite component strength are being investigated. Confidence is being built in the use of composite aircraft components through longtime flight service programs on both commercial and military transport aircraft and helicopters. Outdoor environmental degradation of both materials coupons and structural components is being studied over ten-year exposure periods.

W79-70008

505-02-21

Ames Research Center, Moffett Field, Calif.

ROTORCRAFT AEROELASTICITY AND STRUCTURAL DYNAMICS

M. Kelly and W. R. Johnson, 415-965-5033

The objective of this research is to improve the predictive capability for rotorcraft loads, vibration, aeroelastic stability and performance, and where possible to develop rotors with improved dynamic characteristics. This will be accomplished by developing and verifying advanced analytical models for rotorcraft with particular emphasis on the structural dynamics and aeroelasticity. It is important to note that the level of predictive capability required depends on the type of aircraft considered as well as on the technology level. For some simple, well-understood rotor systems, a satisfactory predictive capability may have already been achieved for new rotor systems and rotorcraft configurations; additional work will always be required. The accuracy of current and improved models of rotor dynamics must be assessed by comparison with experimental data. As appropriate, small scale and large scale wind tunnel tests will be conducted in order to define dynamics problems and verify and improve advanced analytical models. This research will also involve the development of data reduction and data management techniques to allow the best use of the experimental data. The prior objective of this RTOP was to develop experimental and analytical techniques for predicting unsteady aerodynamic loads on fixed wing aircraft. This objective has been shifted to RTOP 505-05-31 and RTOP 505-10-21. However, progress against this objective is reported here for accounting purposes.

W79-70009

505-02-23

Langley Research Center, Hampton, Va.

LOADS, AEROELASTICITY, AND STRUCTURAL DYNAMICS

W. H. Reed III and R. R. Heldenfels, 804-827-2265
(517-53-13)

The objective is to develop and validate improved methods for the analytical determination of loads, structural response and structural stability of aerospace systems considering the dynamic and aeroelastic characteristics of the systems and structural interactions with flight control subsystems, and to use these methods in the development and evaluation of techniques for eliminating or minimizing flutter, buffet and other undesirable response phenomena and for the enhancement of performance, ride quality, safety, and service life. Research will be conducted to provide more accurate unsteady aerodynamic theories, particularly in the transonic range. Advanced aeroelastic analysis methods will be evaluated and validated by both wind tunnel tests and flight tests using the DAST concept (Drones for Aerodynamic and Structural Testing). Emphasis will be on measurements of transonic aerodynamic loads and flight validation of active control systems for load alleviation and flutter suppression. Basic wind tunnel flutter studies will be used to gain a better understanding of the flutter characteristics of advanced aerodynamic configurations. Analysis/synthesis methods will be developed for use in design support of future aircraft with advanced features such as active controls and aeroelastically-tailored wings and empennage. Methods will be developed and compared with experiment for predicting noise transmission through aircraft structures. Methods and analyses will be developed in-house and with contract support to minimize rotorcraft vibration levels.

W79-70010

505-02-24

Hugh L. Dryden Flight Research Center, Edwards, Calif.

FLIGHT LOADS AND AEROELASTICITY

J. M. Jenkins, 805-258-3311

This RTOP has three primary purposes: (1) to study unsteady

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aerodynamic loads and flutter suppression at transonic speeds using an RPRV aircraft (2) to evaluate the state of the art in prediction techniques of aerothermoelasticity dynamic response and structural mode control of the B-1 aircraft and (3) to study airload measurement techniques on large flexible aircraft

W79-70011

505-02-33

Langley Research Center Hampton, Va
AERONAUTICAL STRUCTURAL DESIGN METHODS
R C Goetz and R R Heldenfels 804-827-3451
(506-17-23, 516-53-03 517-53-13)

The objectives are to provide advanced analysis and synthesis capability for predicting and improving aircraft crashworthiness for multidisciplinary evaluation and design of control configured structurally and aerodynamically advanced aerospace vehicles and to exploit advances in computer-aided design hardware and methodology to develop and demonstrate energy-absorbing concepts for general aviation aircraft structures to provide significantly improved crashworthiness and to assess the crash response behavior of composite structures, to develop integrated multidisciplinary analysis and synthesis methodology with emphasis on applications of advanced technologies including composite structures, configuration aerodynamics and active controls, and to define and demonstrate microprocessor and minicomputer hardware configurations to improve the efficiency for structural calculations

W79-70012

505-02-41

Ames Research Center Moffett Field, Calif
ENVIRONMENTAL EXPOSURE EFFECTS IN COMPOSITES
H G Nelson 415-965-6137
(505-01-21)

Experimental and analytical programs will continue to be directed toward the development of accelerated test and analysis methods required to reliably predict long-term performance of advanced graphite/resin matrix composite materials from short-term tests. A number of material properties will be studied as a function of selected applied variables. Through identified and quantifiable interrelationships between a property and the applied variables, correspondence functions will be developed which will be used as the basis for the design of accelerated test methods. The form of such correspondence functions is anticipated to be straightforward one- and two-parameter shifts. A mechanistic understanding of property-variable interactions will also be developed in an attempt to justify the correspondence functions and more fully understand their limits of applicability. The as-developed accelerated test methods will be verified by long-term testing. Eventually complex laminates and other composite systems will be considered, as well as potential synergistic interactions as a result of more complex loadings etc

W79-70013

505-02-43

Langley Research Center Hampton Va
RELIABILITY AND DURABILITY
E E Mathauser and R R Heldenfels 804-827-2036
(505-02-13)

The objective is to develop and demonstrate methods for relating composite materials characteristics to the lifetime performance of airframe components under operating load and environments. Included are studies to develop fundamental understanding of environmental effects to develop improved design concepts, and to develop criteria that will assure long-term service life. Emphasis will be directed at identification of significant parameters and development of procedures for quality control of graphite/epoxy composites. Studies will be made to develop reliable composite materials test methods and to establish accelerated test and analysis methods to predict long-term performance. Composite materials will be exposed in the flight environment to determine effects of moisture and other degradation mechanisms on mechanical properties. In-service inspection methods for composite structures will be assessed. Fatigue tests will be undertaken to evaluate performance of materials exposed to outdoor environment and to identify failure modes in typical wing-type composite structures. Compressive strength tests of structural panels will be made to provide a

data base for composite structures and to indicate failure modes give added confidence in structural design by providing information on the durability and long-term service life of composite structures

W79-70014

505-02-53

Langley Research Center Hampton Va
HIGH TEMPERATURE AERONAUTICAL STRUCTURES
S C Dixon and R R Heldenfels 804-827-3423
(506-17-43)

The objectives are to develop structural concepts for future hypersonic aircraft, verify promising concepts by fabrication and tests of realistic structures, and to devise analysis and design methods applicable to such concepts. Research and development is being carried out to establish a technology base from which the structures and thermal control systems for hypersonic vehicles can be designed. Included in the program are fabrication, experimental and analytical efforts on both a airframe and supersonic combustion ramjet (scramjet) structural concepts which will withstand the rigors of extended and repeated use in a hypersonic environment. Research data obtained from both laboratory and wind tunnel experiments will serve to verify analysis and design methods, identify promising concepts and provide guidance for future research efforts. The effort is focused primarily on convectively cooled concepts. An actively-cooled panel program has been underway for several years and is in the final phase of fabrication and testing. Testing of three panel concepts and documentation of results should be complete by mid-FY 1980. Design studies of scramjet structural concepts are nearing completion and development and verification of fabrication techniques of various components will constitute the future major effort under this RTOP.

W79-70015

505-02-54

Hugh L. Dryden Flight Research Center, Edwards Calif
HYPERSONIC AIRCRAFT STRUCTURES TECHNOLOGY
J M Jenkins and R A Fields 805-258-3311

The objective of this RTOP is to maintain a continuous line of research in the area of hot radiating structures for hypersonic flight application. Using the heating and loading capabilities of the Flight Loads Research Facility (FLRF) heating and loading tests will be completed on a laboratory test structure which represents a significant portion of a hot, radiating wing structure. Test results will provide information on design parameters, high temperature instrumentation, load calibration criteria and performance data on beaded and tubular panels. Documentation and reporting activities will be emphasized.

W79-70016

505-03-11

Ames Research Center Moffett Field, Calif
NOISE REDUCTION TECHNOLOGY FOR SHORT-HAUL AIRCRAFT
C T Snyder and D H Hickey 415-965-5567

The work described in this RTOP will provide the technology for the reduction of noise of short-haul aircraft, and will provide through wind tunnel measurements large-scale data on the relative velocity effects on noise of modern turbofan and turbojet engines. The FY 1979 jet noise program includes the testing and reporting of a small scale (6 in dia) nozzle in an open throat wind tunnel for comparison with similar results in the 40- by 80-foot wind tunnel, and the measurement of flight effects on the jet noise of a modified viper engine with mechanical suppressors. In addition, a joint program with the RAE and ONERA on the development of wind tunnels for noise testing will continue. Work on flight effects on fan noise will continue with the completion of testing and reporting of tests of a JT15D engine with hybrid inlet in the 40- by 80-foot wind tunnel, tests of a JT15D engine with conventional inlet and modified stator, and finally tests of a JT15D engine with instrumented fan rotor. Work on flow visualization and diagnostic techniques for jet noise measurements in the 40- by 80-foot wind tunnel will be initiated.

W79-70017

505-03-12

Lewis Research Center, Cleveland, Ohio
NOISE REDUCTION TECHNOLOGY
C. E. Feiler and U. H. von Glahn 216-433-4000

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

The objectives of this RTOP are to provide data and a technology base for reducing aircraft propulsion generated and associated noise with minimum weight performance, and economic penalties and to develop techniques for accurate prediction of noise levels of operating and future aircraft. The generation and propagation of noise from all engine sources, both internal and external are addressed. These include the turbomachinery (fan compressor, turbine), core engine (combustor, internal surfaces) and the jet noise. Acoustic suppression (duct treatment) is a major element of the work. The work is distributed among basic research that provides knowledge of the fundamental principles and phenomena present in noise generation and propagation, applied research that explores concepts and provides a data base and demonstration of technology on full-scale engine systems. In-house activities are balanced by a number of contractual programs including university grants. In-house facilities include the Engine Fan and Jet Noise Facility (W-2) for model fan and jet experiments, several hot and cold flow jet rigs and two outdoor engine stands capable of full-scale engine tests including thrust performance. Forward velocity experiments are conducted in the 9X15 low-speed wind tunnel and a free jet

W79-70018

505-03-13

Langley Research Center, Hampton, Va

PROPULSION NOISE RESEARCH

H H Hubbard and R R Heldenfels 804-827-2042
(505-09-13 511-57-03, 505-10-23 505-09-23)

The objective of this research is to provide data and technology base for reducing aircraft propulsion generated noise with minimum weight, performance and economic penalties and to develop techniques for accurate prediction of ground noise levels of operating and future aircraft. Both theoretical and experimental noise reduction and control studies are involved and work will be accomplished in-house and by grants and contracts. Emphasis in the experimental portion of the program is on laboratory and scale model experiments under closely controlled conditions with supplemental acoustic range and flight vehicle studies for validating theoretical methods and concepts. Included are the following specialty areas: precision measurements and calculations of the sound fields inside ducts with airflow with varying geometry and with and without acoustic liners, advanced acoustic materials technology, optimization exhaust noise identification and location of sound sources in flow fields, noise generation by viscous flow fields, atmospheric propagation including refraction and scattering, generation and prediction of propeller noise, design of quiet and efficient propellers for general aviation aircraft development and validation of procedures for predicting single event flyover noise exposures from general aviation and CTOL aircraft and helicopters, and development of advanced methods of noise measurement and analysis.

W79-70019

505-03-15

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

BASIC NOISE RESEARCH

Paul F Massier 213-354-3549

The general objectives of this RTOP are (1) to find methods of reducing jet noise by controlling the noise sources (2) to determine how core flow disturbances increase the radiated noise from jets with the ultimate goal of developing efficient means of reducing jet noise emission by reducing core flow disturbances (3) to develop prediction models based on experiments for evaluating forward flight effects on jet noise and on core noise, (4) to develop and evaluate methods of reducing jet noise for aircraft in flight, (5) to determine the source of jet crackle and possible methods of reducing this source of noise, (6) to determine the role of large scale turbulent structures on jet noise production, (7) to determine the mechanisms that cause noise reduction for 'inverted' velocity profile jets, (8) to search for 'inverted' velocity profiles which will optimize noise reduction and (9) to determine the potential for noise reduction with the use of slotted nozzles. Experiments of supersonic, subsonic and coannular jets over a temperature range up to about 2000 F are conducted in an anechoic chamber. Fluctuating quantities are measured with hot wire probes, crossed laser beams and microphones. Shadowgraph and Schlieren techniques are used for flow visualization. High-speed Schlieren movies are also obtained and synchronized

with signals from instruments that are used to measure the fluctuating quantities.

W79-70020

505-03-22

Lewis Research Center, Cleveland, Ohio

PROPULSION POLLUTION REDUCTION RESEARCH

Donald A Petrash and E A Willis 216-433-4000
(505-05-62, 505-04-32 511-55-02 517-53-02)

The objectives of the programs conducted under this RTOP are to develop, evaluate and demonstrate technology that will significantly reduce gas turbine engine emissions without adversely affecting efficiency, operating range, durability, and temperature distribution and that will significantly reduce emissions, increase fuel efficiency, and broaden the range of usable fuels for general aviation intermittent combustion engines. Fundamental combustion studies and analytical modeling will be conducted to gain a better understanding of and to develop analytical models for the fundamental combustion processes and the factors which affect pollutant formation. Investigations in combustor sector and full scale facilities will be aimed at providing the technology base for the design of advanced combustor concepts to meet 1981 and future aircraft emission standards. Coordinated areas of research will provide a greater understanding of the processes that control the efficiency, emissions and fuel requirements of intermittent combustion engines. Intensified experimental and analytical programs will be conducted in Otto cycle and stratified charge techniques, advanced cooling techniques, advanced fuel injection and ignition concepts, alternative fuels capability and electronic engine controls.

W79-70021

505-03-23

Langley Research Center, Hampton, Va

BASIC COMBUSTION AND POLLUTION RESEARCH

C J Jachimowski 804-827-2065

The objectives of this research are the following: (1) to develop a chemical kinetic model that describes the combustion of a jet fuel and the formation of nitric oxide by the systematic study of the combustion mechanisms, reaction kinetics, and nitric-oxide formation kinetics for increasingly complex hydrocarbon fuels, and (2) to experimentally investigate the effect of fuel structure and composition on the optical properties of flame-generated soot. The facilities used in these studies include a chemical shock tube, a jet-stirred combustor and a high-pressure burner.

W79-70022

505-03-25

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

GAS TURBINE ENGINE POLLUTION REDUCTION TECHNOLOGY

R M Clayton 213-354-6659

Unconventional combustor design concepts for application to aircraft gas turbines are being evaluated for their potential for providing significantly reduced emissions of oxides of nitrogen while maintaining efficient combustion. The central conceptual approach is to minimize NO formation rates by reducing flame temperature with off-stoichiometric burning. Under continuing evaluation is the feasibility of implementing the H₂-enrichment concept to provide for ultralean burning in the primary heat release zone of the combustor. Emphasis is placed on establishing an experimental burner configuration that demonstrates stable, high efficiency combustion with low pollutant emissions over a range of inlet air state conditions typical of contemporary, high performance turbine engines. The objective for FY 1979 is to extend previous work which progressed from using neat H₂ to using simulated fuel-generated H₂, to the final step of incorporating a fuel-rich precombustion stage in a two-stage combustion system. The precombustion reaction stage will provide an H₂-bearing fuel gas stream to the final reaction stage where combustion is completed at a lean overall equivalence ratio. Combustion and pollutant emissions of the two-stage system will be evaluated under typical subsonic cruise power air inlet conditions.

W79-70023

505-04-12

Lewis Research Center, Cleveland, Ohio

INLET AND NOZZLE RESEARCH

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

D N Bowditch 216-433-4000

Improved analytical and experimental design methodology for inlets and nozzles will be generated to achieve higher performance with increased propulsion system stability. Computer analysis programs for predicting internal flows will be synthesized in-house and by contracts and grants. These programs will make it possible to analyze viscous and inviscid flows in two and three dimensions. Inlet and nozzle hardware will be tested to guide and verify the analysis and to conduct exploratory research in areas that are not presently amenable to analysis. Also, benchmark testing will be done to define detailed flow phenomena. Analysis will be used to design components for focused applications such as SCR or military applications which will be tested in 10x10 SWT, 8x6 SWT, CE22 1x1 SWT, or 10x10 coannular hot flow rig.

W79-70024

505-04-13

Langley Research Center Hampton Va
PROPULSION SYSTEM INTEGRATION

W P Henderson and R E Bower 804-827-2676

Fundamental studies will be conducted to develop an improved understanding of the flow phenomena associated with the integration of the propulsion system into advanced aircraft concepts. Through this research, propulsion system integration concepts will be studied that are designed to exploit favorable interference effects which may enhance the wing lift, performance efficiency, reduce drag or permit thrust reversing of the exhaust system to improve performance of the aircraft. For the exhaust nozzle, investigations will be made to determine means of improving the internal and external performance of both uninstalled and installed nozzles and to explore the integration procedures for incorporating the exhaust system into the fuselage, wing or pods. General experimental and theoretical research studies will be conducted to improve the understanding of the flow phenomena associated with nozzle/boattail/jet and jet/wing/airframe empennage interference. Advanced analytical methods capable of predicting the propulsion system integration effects will be developed. These methods will vary from the simpler, faster patched methods to the more complex Navier-Stokes solutions. Experimental research on axisymmetric and nonaxisymmetric nozzles will be conducted for correlation with analytical results and design procedures will be developed from this information.

W79-70025

505-04-22

Lewis Research Center, Cleveland Ohio

FAN, COMPRESSOR AND TURBINE RESEARCH

M J Hartmann and H E Rohlik 216-433-4000
(510-55-02 716-01-02)

Approaches to improve efficiency, operating range, distortion tolerance, durability and reliability and to reduce weight, volume, and cost of the wide variety of fans and compressors required for advanced propulsion systems will be investigated. Experimental studies provide a data base of detailed performance characteristics and matching characteristics of advanced stages. The objective of the turbine program is the attainment of increased life and improved performance through improved design methods for both axial and radial flow turbines. Transient heat transfer studies and analysis of stress and deformation of metals and ceramics are made for cooled turbine parts to identify critical areas and thereby improve life prediction techniques. Increased emphasis is placed on analytical methods. Accuracy and reliability of design systems and performance prediction methods are improved through more accurate modeling of stage internal flows. The advanced analytical methods will result in large cost savings by reducing both the time required and the risk involved in incorporating advanced components into future engine development programs. Flutter characteristics of selected current and advanced fan and compressor blading systems will be evaluated in the full-scale engine environment. Advanced analytical techniques for predicting flutter will be generated and evaluated. The work is conducted through in-house, contract, and university grant efforts.

W79-70026

505-04-32

Lewis Research Center, Cleveland Ohio

COMBUSTION AND AUGMENTATION SYSTEMS TECHNOLOGY

D A Petrash and R E Jones 216-433-6860
(505-03-32, 505-04-52, 511-55-02)

This RTOP covers base technology for combustors and augmentors to achieve high performance, low emissions and good durability at operating conditions typical of advanced commercial and military gas turbine engines. A swirl-can combustor will be developed for use in the high pressure facility (HPF) both as a heat source for the turbine rig and also as a research combustor for studies of high pressure combustion. A variety of new, staged combustor concepts will be investigated in sector rigs at low pressure and in annular test facilities at 120 psia. Developed versions of these combustors will be tested in HPF at 580 psia. Combustion studies at high pressure will emphasize measurements of flame radiation, liner heat flux, NOx pressure relationships, smoke pressure relationships and combustor space rate. Conventionally designed combustors will be tested at high pressure to obtain these data. Advanced combustor performance improvements will be measured against this baseline. In addition, small reverse flow combustors will be studied to improve fuel injection, liner cooling, durability and emissions. Laser analysis of fuel sprays from advanced injectors will be conducted at ambient and high (400 psia) pressures.

W79-70027

505-04-42

Lewis Research Center Cleveland, Ohio

POWER TRANSFER RESEARCH

W J Anderson 216-433-4000

(506-16-22, 511-54-02, 511-58-02)

The objective of this work is to advance the technology for bearings, shaft seals, gas path seals, gears, shafts, lubricants, lubrication systems and mechanical power transmissions to achieve improved performance, life, reliability, efficiency and reduced weight in the high temperature, high pressure, and high speed environments of turbojet and turbopropeller engines and mechanical power transmission systems. Improved bearing, gear and seal materials and designs, improved lubricants and lubrication systems will be developed for the extreme conditions of advanced aircraft turbojet and turbo-propeller engines and mechanical power transmission systems. Emphasis will be given to a fundamental and basic approach to lubrication and wear technology (TRIBOLOGY) to create far-term opportunities as well as satisfy near-term goals for improved durability and performance of gas turbine engines and power transfer systems. Analytical techniques for balancing, determining and controlling the dynamic behavior of shafts and rotors will be developed and corroborated experimentally to provide better design tools for high-speed turbomachinery, shafting and transmissions.

W79-70028

505-04-52

Lewis Research Center Cleveland, Ohio

FUELS RESEARCH

J Grobman and Gregory Reck 216-433-4000

(505-04-32, 505-03-22, 511-55-02)

The potential properties of future aviation turbine fuels derived from nonpetroleum sources such as oil shale and coal will be determined by synthesis and characterization techniques. The effects of these fuels, as well as petroleum-based fuels synthesized to broader specifications than currently required, on the performance and durability of jet engine components and materials will be determined. Sufficient quantities of these fuels must be procured and/or simulated by blending of petroleum-based fuels and will be used to conduct research tests required to evolve the technology that may be needed to use these fuels in current and future jet aircraft engines. A joint program has been developed with the AFAPL and Lewis to implement an overall integrated effort to best utilize the technical capabilities of the AFAPL and Lewis to conduct the various activities necessary in conducting this program. Cooperative efforts on contract funding and management and in-house test activities are currently underway and will be used throughout the planned life of this program. Overall coordination with other government agencies, such as the USN, ERDA, and EPA, and with industry will also be maintained in order to provide proper direction and scope to the program as it develops and proceeds.

“PAGE MISSING FROM AVAILABLE VERSION”

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

studies is to determine desirable engine component and system design characteristics for future aircraft and to identify technology deficiencies and profitable areas for research. The studies will explore the opportunities for satisfying environmental and natural resource constraints and their related impact on propulsion system selection and aircraft performance. Supporting efforts will be included to develop new or improved techniques for estimating the cycle performance, weight and other characteristics of advanced engine concepts.

W79-70037

505-06-62

Lewis Research Center, Cleveland, Ohio

ADVANCED GENERAL AVIATION PROPULSION RESEARCH

E. A. Willis 216-433-4000
(505-03-22)

The objectives are to define the technology base for, and promote the development of the most promising alternative engine(s) for general aviation use in the late 1980s. The specific improvements and/or capabilities sought are multifuel, lower BSFC, weight cost and maintenance, and improved reliability -- while still meeting the 1979 emission requirements. Alternative engines are being defined through studies and experimental engine tests, supplemented by experimental investigations in key technology areas. The specific work in this program is supported by contracts, grants, and Lewis in-house studies and experimental programs.

W79-70038

505-06-11

Ames Research Center, Moffett Field, Calif.

ANALYTICAL FLUID DYNAMICS

V. L. Peterson 415-965-5265
(505-15-31 506-26-11)

The specific objective is to develop the capability for calculating complete aerodynamic characteristics of given complex aircraft shapes such that new configurations, optimized for specific missions, can be designed to a degree that new concepts can be evaluated and screened with reduced testing time, and cost. Efficient codes will be developed to solve fluid dynamics problems on large serial, parallel, and vector processing computers for the complete spectrum of flight speeds from low subsonic to transonic to supersonic and for steady and unsteady, inviscid and viscous flow over two- and three-dimensional configurations. Fundamental experiments will be performed to verify these codes and to provide the necessary modeling of turbulence. The Reynolds number domain will extend from the relatively low values existing in conventional wind tunnels up to the practical range for existing and future aircraft. Feasibility studies will be performed for the Numerical Aerodynamic Simulation Facility, which will have the capability for solving the equations of fluid dynamics at speeds two to three orders of magnitude faster than possible now with general purpose computers. The proposed facility is to serve as an engineering tool for obtaining numerical simulation in ten minutes for time-averaged viscous flows over three-dimensional configurations at flight Reynolds numbers. The feasibility study for this facility will provide sufficient information to assess logic and hardware design requirements as well as to determine cost performance, and reliability.

W79-70039

505-06-13

Langley Research Center, Hampton, Va.

COMPUTATIONAL AERODYNAMICS

J. C. South Jr. and R. E. Bower 804-827-2627
(505-06-23 505-06-33 505-06-53)

The purpose of this research is to develop the capability for calculating complete aerodynamic characteristics of given complex aircraft shapes and for defining new aircraft shapes aerodynamically optimized by numerical methods for various mission scenarios to a degree that preliminary aerodynamic concepts can be developed, evaluated and screened with reduced test time and cost. Analytical and numerical procedures will be developed for the prediction of flow fields, pressure distributions, aerodynamic characteristics, skin friction and heat transfer for inviscid, viscous and coupled inviscid-viscous flows with attached and separated boundary layers, detached lee side flows with vortex formation and other interactions. Both linear and nonlinear, exact and

approximate flow equations will be applied as appropriate. Mathematical techniques required typically depend on the problem; however, finite-element, finite-difference, relaxation, time-asymptotic characteristics, and integral methods are the most commonly used for solving nonlinear problems. Linear problems will generally be solved by the distribution of various types of singularities whose strengths are determined by the solution of a matrix equation. Several viscous and inviscid problems requiring large computer storage and/or time will be programmed for the STAR with particular emphasis on efficient explicit solution algorithms. Research on inviscid-flow methods will concentrate on subsonic and transonic flows, while viscous techniques will also involve supersonic flows.

W79-70040

505-06-21

Ames Research Center, Moffett Field, Calif.

TURBULENCE AND MODELING

L. Roberts, G. T. Chapman and W. F. Ahtye 415-965-5066
(505-06-41 505-06-31 505-06-51)

The objective is to conduct analytical and experimental investigations into complex turbulent flow fields. Three specific tasks are considered: (1) aerodynamics of turbulent flows interacting with shock waves, highly curved bodies and general three-dimensional surfaces; (2) the interaction of electromagnetic waves and complex turbulent flow fields; and (3) the reduction of aerodynamic noise on short-haul aircraft. In the study of interacting turbulent flow fields, the emphasis is placed on obtaining detailed, accurate experimental data that may be used to mathematically model the turbulence structure together with the generation of efficient prediction methods in which various models may be tested. The electromagnetic wave/turbulence interaction study consists of both theoretical and experimental efforts aimed at predicting the distortions of visible and near infrared radiation and includes the use of advanced aerodynamic instrumentation on a full-scale flight test to observe turbulence at actual flight conditions. Special emphasis on airframe noise reduction is being placed on flap noise, since this high-lift device is paramount for short field performance, and on bluff-body components such as landing gear struts and wheels. A parallel theoretical effort for the prediction of noise generated by flaps and landing-gear components is also underway.

W79-70041

505-06-23

Langley Research Center, Hampton, Va.

TURBULENCE DRAG AND NOISE REDUCTION

D. M. Bushnell and R. E. Bower 804-827-4546
(516-53-03 505-06-13 514-55-03)

Research will be done to significantly improve our ability to predict and control the behavior of turbulent shear flows including boundary layers, free shear layers and recirculating/vortex flows. Theoretical and experimental research to: (1) reduce turbulent skin friction drag; (2) identify sources of and minimize airframe noise; (3) control stream disturbances in transonic/supersonic/hypersonic tunnels; and (4) improve understanding of physics/structure of turbulent shear flows and turbulence modeling for computational fluid dynamics will also be done. Drag reduction research investigates moving/compliant walls, fixed transverse and longitudinal surface waves and large eddy breakup devices primarily for eventual CTOL transport application. Airframe aerodynamic noise effort determines acoustic characteristics of turbulent flows generated by components such as slats, landing gear, wheel wells and flaps, and investigates noise reduction methods for these flows and their interactions. Free stream turbulence research develops stagnation chamber treatments, laminar flow nozzles and noise shields to improve validity of wind tunnel measurements, especially for data where transition and flow separation are present. Detailed experiments using hot wires and LV/Raman systems provide data for development and validation of turbulence closure models in three-dimensional boundary layers, three-dimensional free mixing and corner/recirculating/vortex flows.

W79-70042

505-06-31

Ames Research Center, Moffett Field, Calif.

AIRFOIL AND WING DEVELOPMENT

L. Roberts 415-965-5066

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

The objective of this RTOP is to develop analytical, numerical and experimental procedures to assist in the design of advanced airfoils and multi-element airfoils and wings. A key element of this program consists of a research project into the unsteady aerodynamics of pitching and plunging airfoils in subsonic and transonic flows. To validate the prediction methods an oscillating apparatus is to be used for testing 2-D wings in the Ames 11-foot transonic wind tunnel at Reynolds numbers up to 12,000,000. Research is underway on wind tunnel wall effects in unsteady flow, unsteady flow visualization, and unsteady flow field measurements, as well as conventional unsteady pressure measurements. Computer codes are under development for predicting steady and unsteady flows about airfoil sections and complete wings. Coordinated experimental studies will provide data required for guidance and verification of the theoretical work directed toward multi-element airfoils and wings. Emphasis will be placed on improved turbulence models for high lift configurations, improved multi-element drag analysis, and the analysis of three-dimensional flows over finite wings with high lift devices.

W79-70043

505-06-33

Langley Research Center, Hampton, Va

AIRFOIL ANALYSIS AND DESIGN

P. K. Pierpont and R. E. Bower 804-827-4517

The Advanced Technology Airfoil Research (ATAR) Program is to provide analytical methods and computer codes coupled with experimental procedures and test facilities for the design and development of airfoils and airfoil systems in both steady and nonsteady flows and to employ these tools to design, develop and evaluate new airfoils, wing profiles and blade sections to extend and demonstrate the technology needed for all types of aircraft. These include both fixed- and rotary-wing aircraft and range from large commercial passenger and cargo transports and transonic military aircraft then down in speed through business and recreational aircraft, and finally down in size to miniature remotely piloted vehicles. The program includes (1) the application of both precise theoretical as well as rapid engineering analysis and optimal design methods to devise practical computational aerodynamic codes which can account for most aerodynamic phenomena (2) the development of experimental test facilities and techniques which can provide high-quality experimental data over the entire necessary range of aerodynamic parameters (3) the establishment and demonstration of advanced airfoil design criteria for various aircraft types and (4) the application of the new airfoil technology by focusing on supplying the needs of the user, the aircraft designer.

W79-70044

505-06-41

Ames Research Center, Moffett Field, Calif

AERODYNAMIC TEST METHODS AND INSTRUMENTATION

L. Roberts 415-965-5066

The general objective of this research is to develop by FY-81, the technology for increased ground-based aerodynamic experimental research capability required to improve prediction of performance and flight characteristics of conceptual or new aircraft designs and the exploration of advanced aerodynamic concepts. Tunnel wall constraints, flow quality and means for simulating higher Reynolds number flows will be investigated analytically and experimentally to improve the quality of test results. To improve the state of the art in nonintrusive measurement capability, advanced laser velocimetric and holographic instrumentation systems will be developed to obtain fundamental fluid mechanic measurements, such as mean velocities, turbulence intensities and Reynolds stress components. Infrared camera technology will be explored as a means of locating shock waves and regions of separation on wind tunnel models.

W79-70045

505-06-43

Langley Research Center, Hampton, Va

TRANSONIC TEST TECHNIQUES AND INSTRUMENTATION

E. C. Polhamus 804-827-3711

(505-06-42, 505-06-43)

The technical objective is to provide the technology for

improved wind-tunnel test capability for experimental prediction of performance and flight characteristics of conceptual or new aircraft designs and basic aerodynamic research in the critical high subsonic and transonic speed regimes. In-house contract and grant research both analytical and experimental will be utilized to (1) advance cryogenic wind-tunnel technology in the areas of test techniques, operating envelopes and operating techniques to assure efficient and maximum utilization of the unique research capabilities (2) provide the techniques for a quantitative assessment of wall interference and for its minimization by combined data corrections and advanced wall test section designs (3) develop the technology needed for the design of superconducting magnetic suspension and balance systems in the size range from 0.3 to 1.0 meter for support interference free testing including high angle of attack dynamics (4) perform research required to assess and improve the flow quality in transonic wind tunnels and perform design analysis to assure sound design of cryogenic tunnels (5) develop design criteria for models to be tested under high pressure and cryogenic conditions and (6) develop instrumentation and measuring techniques for a wide range of aerodynamic testing requirements.

W79-70046

505-06-44

Hugh L. Dryden Flight Research Center, Edwards, Calif

FLIGHT RESEARCH INSTRUMENTATION DEVELOPMENT

K. C. Sanderson 805-258-3311

The objective of this program will be to investigate and develop new methods of acquiring improved flight research data. The lack of these improved data will seriously impact the quality of future flight research programs. Initial efforts will include an Advanced Wing and Body Distortion Sensing System, an Integrated Sensor System, a Miniature Multi-Channel Pressure Sensor System, a Simultaneous Sampling System, a Small Precision Pressure Sensor, a High Accuracy Flow Meter, a Digital Dynamic Data acquisition System, a High Temperature Strain Sensing System, a Precision High Temperature Pressure Sensor, and a Zero Base Data System. An on-going intercenter development with Dryden Flight Research Center serving as lead Center will be conducted to achieve the objective of this project.

W79-70047

505-06-51

Ames Research Center, Moffett Field, Calif

AERODYNAMIC THEORY/EXPERIMENTAL INTEGRATION

R. H. Petersen 415-965-5859

(505-06-21, 505-06-61)

The objective of this research is to expand the aerodynamic technology base and provide a basic understanding of the aerodynamic flow fields about complete wing-body-tail configurations as well as individual components through the useful angle-of-attack range and from subsonic through supersonic Mach numbers. This is being accomplished in two ways: (1) the development of new theoretical methods and (2) the integration of theory and experiment to yield a more complete understanding of the aerodynamic phenomena. The primary theoretical methods under development include a transonic wing-body-tail code using the full potential equations and an advanced linear panel code applicable to both subsonic and supersonic flow. In addition, methods will be developed to combine various calculation techniques to predict more complex flows such as jet-induced effects or to numerically optimize aircraft components. The integration of theory and experiment includes the development of techniques to rapidly compare calculated and measured results and to integrate theoretical and experimental procedures to provide a more complete definition of the aerodynamic characteristics.

W79-70048

505-06-53

Langley Research Center, Hampton, Va

WING/BODY AERODYNAMICS

E. C. Polhamus and R. E. Bower 804-827-3711

The technical objective is to increase the aerodynamic technology base for the design of wings, wing/bodies and generalized aircraft configurations through the generation and application of an expanded experimental data base and the development and evaluation of improved theoretical and empirical design and analysis methods. The expansion of the experimental data base will be accomplished through parametric wind tunnel

tests guided by theoretical analysis, with emphasis on favorable interference of multiple lifting surfaces interacting vortex flows and vortex lift optimization supercritical flow investigation of swept forward wings and application of variable geometry concepts. The two dimensional body crossflow data base will be expanded by extension to full scale Reynolds number and high Mach number. Included will be the development of improved analysis methods for either attached flow or vortex flow concepts. Methods of predicting the complete surface aerodynamic load distribution with emphasis on the critical aerodynamic and structural design conditions involving edge separation induced vortex flows will be developed.

W79-70049**505-06-54**

Hugh L. Dryden Flight Research Center Edwards, Calif
AERONAUTICS FLIGHT EXPERIMENTS
 T G Ayers 805-258-3311

The objective of this RTOP is to provide a continuing research and development effort into the problems associated with the fundamental understanding of fluid and flight mechanics with special emphasis on the relationship to large scale vehicles operating in a real-world environment free of interference effects. These efforts include experimental aerodynamic studies to improve our ability to predict the efficiency of vehicles moving through the atmosphere and to define the effects of Reynolds number, surface condition, excrescences and local and freestream flow conditions on lifting surfaces and complete configurations. Also included will be investigations in support of or verification of wind tunnel studies. Experimental research pertaining to laminar and turbulent boundary layer phenomena and on the separation characteristics of turbulent flow over afterbodies will also be conducted as will analytical studies appropriate to support the fluid mechanics disciplines.

W79-70050**505-06-61**

Ames Research Center Moffett Field Calif
FLIGHT DYNAMICS
 G N Malcolm and Richard H Petersen 415-965-6266
 (505-06-51)

The objective is to provide a basic understanding of the aerodynamic and flight dynamic characteristics of highly maneuverable aircraft through the development and utilization of improved wind tunnel measurement techniques including both static and dynamic methods. Ultimately, through application of improved methods of testing and application of the test results, including better simulations resulting from improved aerodynamic mathematical models, new criteria can be established for designing vehicles capable of performing controlled maneuvers over an expanded angle-of-attack envelope. Investigations are in progress to evaluate various experimental methods for determining dynamic characteristics of aircraft and experimental capabilities are being upgraded for testing at high angles of attack and high Reynolds numbers, both for static and dynamic characteristics. Dynamic apparatus are being investigated or constructed to evaluate aerodynamic coefficients which are pertinent to all phases of high maneuver flight from controlled motions to fully developed spins. Basic fluid mechanics investigations are in progress to provide fundamental understanding of fuselage aerodynamics at high angles of attack.

W79-70051**505-06-63**

Langley Research Center, Hampton, Va
ADVANCED FLIGHT DYNAMICS RESEARCH
 R E Bower and J R Chambers 804-827-3285

The broad objective is to develop a better understanding of basic phenomena, improved analytical and experimental techniques, and new concepts related to dynamic and handling qualities characteristics of aircraft in all flight regimes. Specifically, the effort is directed at (1) analytical techniques for extracting stability and control parameters from flight tests (2) theoretical and experimental studies to determine stall/spin behavior, for establishing fundamental aerodynamic phenomena and for achieving spin resistance (3) approaches for analysis of handling qualities and for achieving specified aircraft response. The approach includes static and dynamic wind tunnel force tests,

dynamic model flight tests, piloted simulator studies and theoretical analyses.

W79-70052**505-06-64**

Hugh L. Dryden Flight Research Center Edwards, Calif
AIRCRAFT HANDLING QUALITIES
 E E Kordes 805-258-3311

The overall objective of this effort is to develop a better understanding of the basic phenomena, improved analytical and experimental techniques and new concepts related to dynamic and handling quality characteristics of aircraft in all flight regimes. Studies will be conducted to develop analytical techniques for determining stability and control derivatives from flight data and to develop new techniques for evaluating handling qualities and for achieving desired aircraft responses. Analytical studies, computer algorithm development and programming and flight tests will be performed both in-house and under contract and grants to meet these objectives. Improved techniques for estimating the unknown parameters of the math model and for improving the identifiability of the systems will be studied on flight test data. The stochastic control based on the estimates will then be tested in flight to assess the improvement of the system. Also the range of command responses of augmented vehicles that optimizes pilot-vehicle performance for a specific mission or task within a mission will be investigated. Emphasis will be on criteria for command responses that are meaningful to system designers.

W79-70053**505-07-11**

Ames Research Center Moffett Field, Calif
DIGITAL OPERATIONS ROTORCRAFT AND V/STOL
 H Erzberger and B Y Creer 415-965-5450
 (513-54-11 516-58-01)

The objective of this research is to apply and when necessary extend modern guidance and navigation theory to optimize rotorcraft, VTOL and STOL aircraft operations within their respective air traffic control environments. Research toward this objective involves two related tasks. The first is to develop methodology and onboard computer algorithms for efficiently synthesizing time-constrained or 4D trajectories that minimize fuel use, direct operating costs, and noise. In order to fly the aircraft accurately along these trajectories, techniques from optimal control and estimation theory will be applied to synthesize automatic control laws that correct guidance errors due to errors in modeling navigation and knowledge of wind and temperature profiles. The various elements of the design will be implemented on an available experimental avionics system and evaluated in piloted simulations and flight tests of representative rotorcraft, VTOL, and STOL vehicles. The purpose of the second task is to investigate, jointly with the FAA, ATC concepts for effectively integrating the rotorcraft, VTOL, and STOL aircraft in the various ATC environments where these vehicles are operated. The goals are to minimize the impact of ATC on the operating costs of these vehicles and to avoid undesirable interactions between CTOL and rotorcraft traffic. Concepts to be investigated in this task include time controlled (4D) guidance and cockpit display of traffic information (CDTI). The Ames Air Traffic Control Simulation Facility, along with several piloted simulators will be used to evaluate such concepts.

W79-70054**505-07-13**

Langley Research Center, Hampton, Va
DIGITAL OPERATIONS GENERIC
 J E Stitt and H J E Reid Jr 804-827-3745
 (512-52-02)

Development of advanced systems such as NAVSTAR/GPS, coupled with the rapid advances in electronics and R F technology can have tremendous impact on future aircraft and ATC operations. Work done under this RTOP will, in conjunction with FAA and DOD, identify potential candidate concepts for such future systems, develop the technology required for and perform proof-of-concept experiments to develop the data base required for future aircraft and ATC system planning. The technology will also be developed for special applications such as multi-purpose radars for weather and turbulence detection and weather penetrating mapping functions. Studies will be performed to define

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user-class requirements for GPS equipment, and to develop low-cost technology for implementation of L-band spread-spectrum user equipment. Experiments will be performed to validate user-class capabilities and to develop dual-fail-operational redundancy techniques which will be required in future systems. Digital data link technology will be extended to use with the GPS system, and combined experiments run in conjunction with FAA.

W79-70055

505-07-18

Wallops Station Wallops Island Va

DIGITAL OPERATIONS

Loyd C Parker 804-824-3411

The objective is to demonstrate systems feasibility of utilizing advanced low cost digital systems technology to provide: (1) automatic voice airport advisory information at uncontrolled airports of weather conditions, active runway and existing hazardous conditions for VFR & IFR traffic (2) automatic voice air traffic and mid-air collision advisories to traffic at uncontrolled airports using standard NAV-COM frequencies without transponder requirements (3) a solid-state Gen Aviation crash recorder having critical accident investigation parameters retained in non-volatile storage and (4) an advanced general aviation pilot training system for single and twin engine aircraft which provides inflight simulation and evaluation of piloting procedures for private commercial multiengine and instrument training (5) synthetic voice response digital technology as means of increased ground to air communications capacities. Approach includes studies of systems concepts, systems definition, engineering model development, evaluation and demonstration of technology improvements achieved.

W79-70056

505-07-21

Ames Research Center Moffett Field, Calif

COCKPIT AVIONICS: AUTOMATED R/C AND V/STOL AVIONICS

H C Lessing and G Meyer 415-965-5444
(505-07-31)

The objective of this program is to develop and assess information/display concepts for use with integrated flight control/avionics systems for R/V and V/STOL aircraft and rotorcraft. Display concepts will be defined, developed and assessed through in-house and contract studies to provide display information required with integrated flight control/avionics concepts developed under RTOP 505-07-31.

W79-70057

505-07-23

Langley Research Center Hampton Va

COCKPIT AVIONICS GENERIC

J J Hatfield and J E Stitt 804-827-3745
(505-07-33 513-52-03 512-52-03)

Development of advanced cockpit avionics technology (such as electronic display generators and media, input/output techniques and systems integration techniques) coupled with advances in flight management technology can greatly improve the flight deck of advanced jet transport aircraft and the cockpits of general aviation aircraft. This technology has the potential to reduce clutter and associated workload and to improve performance, safety and flexibility while reducing avionics life-cycle cost. Work done under this RTOP will develop cockpit requirements for future civil missions, identify candidate concepts for future cockpit systems, develop the technology for implementation of these concepts and perform proof-of-concept experiments using hot bench simulator, and flight testing. Technology developments will be focused on electronic display media such as the CRT, electroluminescent, and liquid crystal panels, on microprocessor display generation, multifunction switching and voice processing techniques and on subsystem/system integration techniques. Experimental testing will be performed in the early phases of the program on laboratory and engineering models. Testing will then progress to prototypes and subsystems testing and culminate in the testing, validation and demonstration of an integrated cockpit system.

W79-70058

505-07-31

Ames Research Center, Moffett Field, Calif

INTEGRATED CONTROL ROTORCRAFT AND V/STOL

C T Snyder, B E Tinling and J S White 415-965-5826
(513-50-11)

Advanced control technology will be developed to provide effective integration of airframe propulsion and subsystem control functions to enhance the performance, economic viability and safety of future V/STOL aircraft and rotorcraft. A simulation study of the digital full flight envelope autopilot (FFEAP) applied to the Augmentor Wing Jet STOL Research Aircraft will be reported. This system uses corrective closed loop control sequences to follow and regulate air traffic control commands. Studies of integrated control will continue with the total automatic flight control system (TAF COS) which adds to the FFEAP provision for inputs by the pilot, stability and control augmentation and active controls. This system will be first applied to helicopters and then to all flight modes of tilt rotor aircraft. Integrated control will require advanced concepts for design, integration and verification of complex software. A program will be initiated with the goal of transforming operational requirements into specifications for the total avionics system and of assessing cost/benefit/configuration trade-offs in the application of integrated systems to short-haul aircraft. Redundancy management techniques associated with sensors, computers, and actuators will be studied. University grants will be pursued to examine questions associated with exploiting functional redundancy to enhance the reliable operations of flight systems.

W79-70059

505-07-33

Langley Research Center, Hampton Va

INTEGRATED CONTROL GENERIC

W E Howell 804-827-3745
(505-07-13 505-07-23)

Future avionics systems will have to work in a complex environment and under stringent economic drivers. These competing requirements can best be met through more effective integration of the avionics system. The objective of this effort is to develop advanced avionics technology (internal to the aircraft) to provide effective integration of airframe propulsion and subsystem control functions through theoretical developments and the development of techniques to implement the technology. The first of these will address synthesis techniques for integrated systems which allow consideration of the various factors (controls, guidance, trajectory following, etc.) which contribute to an integrated design. Based upon foreseeable concepts the second area will emphasize methods to realistically implement these concepts. This will include system functional integration studies and evaluation of selected hardware concepts to study advanced fault detection and isolation techniques in integrated systems. Extensions will be made of conventional reliability techniques to include additional factors such as software transient and latent faults to provide adequate reliability assessments of these new concepts.

W79-70060

505-07-34

Hugh L. Dryden Flight Research Center, Edwards, Calif

INTEGRATED CONTROLS FLIGHT RESEARCH

C R Jarvis 805-258-3311
(512-51-04)

The objective is to study and develop cost effective methods for implementing advanced, reliable flight control systems that will permit greater operational capability and increased performance of future aircraft. Initial emphasis will be toward developing an analytical redundancy management algorithm for sensor fault detection using software techniques to minimize hardware requirements in redundant fly-by-wire system applications. The concept will be developed for and flight-tested using the F-8 DFBW research aircraft. This approach will be instrumental in integrating several sensors to be used in providing parameter information for analytically computing data that in turn can be used to replace actual hardware sensor outputs should they fail in a redundant set. Other efforts involve the development of concepts providing substantial improvements in reliability of digital control systems such as dual-fail-operation schemes and resident backup software to protect against generic errors.

W79-70061**505-08-11**

Ames Research Center, Moffett Field Calif
IN-FLIGHT CAT AND WIND SHEAR DETECTION
 C T Snyder and R L Kurkowski 415-965-6219
 (505-08-21)

The objective of this RTOP is to improve aviation safety by providing onboard detectors of upstream atmospheric disturbances. The tasks are to investigate the potential of an onboard infrared sensor system to provide an in-flight cockpit alert warning of upcoming clear-air-turbulence (CAT) encounters during cruise phases of flight and of wind shear encounters during the terminal area operations and landing approach phase of flight. Various filter systems will be analyzed and calibrated in order to optimize the sensor output for a desired alert lead-time. Various algorithms will be studied for use as signal analyzers and cockpit alert signal drivers. Flight testing will include dedicated aircraft testing on a NASA Learjet and piggyback experiment testing onboard the NASA C-141 and CV-990 flying laboratories. The total program is a joint study between NASA-Ames and NOAA-Environmental Research Labs.

W79-70062**505-08-13**

Langley Research Center, Hampton, Va
AVIATION METEOROLOGY RESEARCH
 A W Hall and R E Bower 804-827-3285
 (175-10-30)

A technology base will be developed to improve the knowledge and understanding of atmospheric processes as they affect the design and safe and efficient operation of aircraft and aircraft systems. This will be accomplished by experimental and analytical programs aimed at providing an understanding of the predictability and the detectability and avoidance of hazards of severe storms to aircraft operations. These hazards include wind shear, turbulence, lightning, precipitation and icing. Protection against direct lightning strikes will be studied.

W79-70063**505-08-14**

Hugh L. Dryden Flight Research Center, Edwards, Calif
KNOWLEDGE OF HIGH ALTITUDE ATMOSPHERIC PROCESSES
 E E Kordes and L J Ehernberger 805-258-3311

The objective of this work is to measure and mathematically model environmental and behavioral characteristics of the atmosphere required for improved understanding superior aircraft design and more efficient operations. Data from instrumented aircraft flight tests will be used to update models of turbulence and provide basis for definition of atmospheric conditions in which turbulence, temperature transients, pressure altimetry problems and excessive wind shear occur. Development and acquisition of sensors needed to measure atmospheric phenomena are also included in this effort. The math modeling and analysis of associated meteorological condition will be studied both in-house and on contracts or grants. Results of this work will be applicable to aircraft system design and flight test activities and flight operations routing and scheduling.

W79-70064**505-08-15**

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
CLEAR AIR TURBULENCE STUDIES WITH PASSIVE MICROWAVE RADIOMETERS
 B L Gary 213-354-3198

The objectives of this RTOP are contained in three phases. Phase A will be a demonstration of the concept that lapse rate at an aircraft's altitude can be measured by performing vertical scans of the horizon with a passive microwave radiometer operating at approximately 55 GHz. Phase B will be a test of the postulate that the severity of CAT (Clear Air Turbulence) is related to lapse rate and that CAT is often associated with the base of inversion layers. Phase C will consist of flight tests of an existing 183 GHz microwave radiometer that measures line-of-sight water vapor content for the purpose of evaluating its usefulness for CAT encounter forecasting. The Phase A demonstration will consist of theoretical simulations aimed at optimizing observing strategy and a later flight in a Learjet with a portion of the protoflight model of the SCAMS (Scanning Microwave Spectrometer), on loan from the Nimbus program.

The retrieval of lapse rate and lapse rate structure will be performed using theoretically derived algorithms, and comparisons will be made with Learjet-derived air truth. Phase B will make use of a demonstrated lapse rate observing and retrieval capability to check three postulates: (1) That CAT never occurs where the lapse rate is adiabatic (where shear cannot grow); (2) that is often associated with the base of inversion layers; and (3) that the severity of CAT is proportional to the stability of the lapse rate. This will be done with Learjet flights in locations where CAT is likely to be encountered. Phase C will consist of flight test evaluations of the usefulness of monitoring spatial and temporal variations of line-of-sight water vapor content with a 183 GHz microwave radiometer for CAT encounter forecasting. The motivation for this study is that currently-used IR techniques for predicting CAT encounters respond to cirrus clouds whereas a microwave sensor would not give cirrus-related false alarms.

W79-70065**505-08-18**

Wallops Station, Wallops Island, Va
KNOWLEDGE OF THE ATMOSPHERE -- ADVANCED MEASUREMENT TECHNIQUES
 Loyd C Parker 804-824-3411

The objectives of this RTOP are to collect, analyze and model severe low-altitude wind shear, turbulence and storm outflow dynamics data as they apply to the safe and efficient operations of aircraft and aircraft systems, and to identify and test advanced sensors for automatic measurement of prevailing visibility, ceiling heights and wind shear. The comprehensive meteorological measuring systems existing at Wallops Flight Center will be utilized to collect data associated with significant meteorological phenomenon related to aircraft operating safety. Systems applicable to this research include two meteorological towers (250 ft and 300 ft) instrumented with two and three dimensional anemometers and other sensors, precision wind profile balloons and radiosondes, precision video and Doppler radars, lidars, a fully equipped NWS observation service and equipments and instrumented test aircraft. Experiments will be configured to provide intense coordinated measurements during severe and/or significant meteorological events. Emphasis will be placed on low-altitude spatial changes as related to the specific aircraft operating problem during approach and departure flight phases and in identification of advanced meteorological sensor characteristics to meet current operational needs.

W79-70066**505-08-19**

Marshall Space Flight Center, Huntsville, Ala
KNOWLEDGE OF ATMOSPHERIC PROCESSES
 Dennis W Camp 205-453-2087

The objectives are: (1) the definition, modeling, and simulation of steady-state wind and turbulence environments for aircraft accident investigation; (2) the definition and investigation of severe environments relative to the identification of aircraft operating hazards; and (3) research relative to the development of techniques, procedures, and the need for new and/or improved meteorological instrumentation whereby the knowledge gained of the natural environment can be better utilized for the safe operation of aeronautical systems. To accomplish these objectives, the following approach will be used to continue: (1) the development of models of atmospheric boundary layer properties; (2) the development of probabilistic models of turbulence and the conditions which lead to turbulence; (3) performing analytical, laboratory, and field tasks relative to the life cycle of fog; and (4) the development and/or modification of meteorological instruments as needed to meet the requirements of this approach. To accomplish the three objectives stated, the following six tasks are to be performed: (1) the correlation of lateral and longitudinal gusts and their effects on aeronautical systems; (2) natural environment reconstruction of aircraft operating hazard investigations; (3) definition of free atmosphere perturbations, turbulence studies and thunderstorm investigations; (4) fog modification program (field tests, laboratory efforts, and analytical studies); (5) development of new (or improved) meteorological instrumentation needed for use relative to the safe operation of aeronautical systems; (6) to conduct an aviation meteorology workshop, develop a meteorological data retrieval system, and to develop an atmospheric turbulence field program.

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W79-70067

505-08-21

Ames Research Center, Moffett Field, Calif

AVIATION SAFETY TECHNOLOGY - OPERATIONAL PROBLEMS AND SURVIVABILITY

Leonard Roberts 415-965-5225

(505-01-31 510-56-01 505-09-03 505-08-01)

The objective of this RTOP is to improve aviation safety by increasing the understanding of the causes of accidents, by developing piloting techniques for avoiding accidents, and by increasing the probability of survival of accidents when they occur. The approach to operations studies will include developing new techniques for sensing and displaying wind shear. Additionally, as part of a joint NASA/FAA program, simulator investigations will be conducted on the effectiveness of integrated head-up displays (HUD) on reducing hazards associated with wind shear and low visibility in the landing approach. Test methodology and criteria will be developed for assessing flame propagation and other flammability parameters in aircraft and correlating this data both with laboratory test results and fire modeling studies. The technology base for fire-safe aircraft systems will be developed utilizing the outputs of the R & T programs on fire-resistant materials and fire control systems such as fire extinguishants. Laboratory and sub-scale tests will be conducted to assess the flammability, smoke, and other properties of state-of-the-art and advanced cabin materials which have a potential for increasing the fire-hardening of aircraft. Fire-resistant structural panels and windows will be evaluated for post-crash fire protection. Research on post-accident analysis techniques is a cooperative program with the National Transportation Board Bureau of Aviation Safety (NTSB-BAS). The general objectives are to develop improved data processing techniques for analyzing aircraft accident recordings.

W79-70068

505-08-22

Lewis Research Center, Cleveland, Ohio

AIRCRAFT PROPULSION SYSTEM SAFETY TECHNOLOGY

S Weiss 216-433-4000

The objectives are to provide a broad base of safety oriented technology for identifying, defining and dealing with hazards associated with aeronautical propulsion systems, establish criteria for systems design and operating techniques leading to reduction in accidents, loss of life and injuries, and loss of equipment, support and perform research and technology activities that lead to solutions of problems impacting on aviation safety with particular emphasis on propulsion systems and coordinate activity results with the FAA, NTSB, DOD, other interested government agencies and the aviation community. Specific areas of current activities include rotor burst protection, general aviation engine tolerance to substitute fuels, crash fire prevention, systems safety analyses, and aircraft ice protection.

W79-70069

505-08-23

Langley Research Center, Hampton, Va

AVIATION SAFETY TECHNOLOGY

A W Hall and R E Bower 804-827-3285

(505-08-13)

A technology base will be developed which can be used to reduce the number of aviation accident opportunities and to minimize the fatalities and damage resulting from accidents. This will be accomplished by programs aimed at providing a data base for continued knowledge of the usage of various types of general aviation and transport aircraft relative to their original design criteria. Research on equipment and systems will be undertaken to improve the accuracy and reliability of operational information relative to visibility and meteorological phenomena. Research will also be conducted to provide improved protection of the aircraft and its systems from hazards such as lightning, turbulence, and wind shear.

W79-70070

505-08-25

Jet Propulsion Lab., Calif Inst of Tech., Pasadena

AVIATION SAFETY TECHNOLOGY - APPLIED FLUID MECHANICS

Paul F Massier 213-354-3549

The overall objective of this effort is directed toward improving aircraft safety. The studies include those aspects of safety

associated with (1) the reduction of fire hazard by modification of the fuel to prevent mist formation during a crash, (2) the development of an enclosure fire modeling methodology for the prediction of aircraft fire characteristics and the associated dynamic response of materials in an accidental fire environment, (3) the modification of existing polymeric materials by investigating additives, fillers and compositional changes that will reduce flammability and smoke and toxic gases during combustion, (4) the thermochemical modeling of fire and smoke/toxic gas evolution in aircraft interior fires including ignition delay and burn rates, and (5) the development of a new technique for improving the fire safety of filled polymer systems with a small departure from the cost/materials-optimized state-of-the-art constructions.

W79-70071

505-08-27

Lyndon B Johnson Space Center, Houston, Tex

AIRCRAFT FIRE SAFETY AND TESTING

R W Bricker 713-483-3166

(510-56-07)

The effort defined in this RTOP consists of a continuation of work originally started in FY-75. The RTOP provides for screening of aircraft fuselage sections composed of newly developed materials, testing functional size components in the JSC 737 fuselage, procurement of manpower for fitting the 737 fuselage with instrumentation in preparation for conducting the full-scale flammability test scheduled for CY-80, computer support, and evaluation, analysis and delivery of technical data and reports.

W79-70072

505-08-28

Wallops Station, Wallops Island, Va

AVIATION SAFETY TECHNOLOGY - WIND SHEAR TECHNOLOGY

Lloyd C Parker 804-824-3411

The objective is to determine the feasibility of utilizing existing weather radars or other aircraft equipments to provide aircraft ground speed information necessary for detection of hazardous wind shear conditions during flight below 1500-foot altitude. State-of-the-Art pulse solid state CW coded CW and pulse-Doppler radar technology will be evaluated and tested as a means of determining aircraft ground speed, wind shear profile in rain, and as a possible means of ground wind speed uplink to aircraft.

W79-70073

505-08-29

Marshall Space Flight Center, Huntsville, Ala

AVIATION SAFETY TECHNOLOGY--APPLIED LASER TECHNOLOGY

E A Weaver 205-453-1597

The objective of this RTOP is to develop electro-optic remote sensors using lasers. These sensors will be used to measure both natural and induced atmospheric flow phenomena emphasizing those that are hazardous to aircraft operations both in the terminal area and those encountered along an airframe. The objective also covers the development of laser sensors needed for nonatmospheric flow aviation safety problems. The primary objective for FY-79 will be the flight test of the Clear Air Turbulence (CAT) Detection System in a final feasibility demonstration test. There are four major tasks: (1) Pulsed CO2 Laser Doppler Clear Air Turbulence Detection System development, (2) CW laser Doppler system development, (3) laser Doppler technology development, and (4) wind shear system study and development.

W79-70074

505-08-31

Ames Research Center, Moffett Field, Calif

AIRCRAFT SYSTEMS OPERATIONAL SAFETY AND EFFICIENCY IMPROVEMENT

P M Sawko 415-965-5954

The objective of this program is to improve aircraft safety and efficiency through the use of advanced materials in aircraft tires. This involves the evaluation of new tire formulations having wear characteristics superior to state-of-the-art tires. The evaluation sample for this test comprises a sixty (60) tire set that will compare the latest baseline tire to two experimental tire formulations. This tire test will be conducted at the Langley

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Research Center to identify the relationship between runway surface conditions and tire composition

W79-70075 **505-08-33**

Langley Research Center Hampton, Va
AIRCRAFT LANDING SYSTEMS EFFICIENCY IMPROVEMENTS

J L McCarty and R R Heldenfels 804-827-2042

The specific objective is to examine new concepts and techniques which offer potential for reducing both operational complexities and costs of aircraft landing systems with a view toward use of the improved systems by large and small civil aircraft. Aircraft operations on prepared runways under adverse weather conditions and on certain unprepared surfaces present requirements of braking and steering systems, tires and the runway that are vital to aircraft safety and passenger comfort. The objectives of programs covered by this RTOP are (1) to improve the performance of braking systems, (2) to improve the wet traction and lifetime of pneumatic tires (3) to develop new landing gear systems that would permit operations on unprepared fields including water and permit continuous use of prime runways for all-weather operations (4) to evaluate tire cornering behavior with and without braking such that high-speed turnoffs can be designed to increase the flow of traffic at congested airports, and (5) to relate the character of the runway surface to aircraft braking and steering performance. Research to meet these objectives will employ full-scale aircraft landing gear systems and subsystems, and scaled pneumatic tires. The landing loads track will be the primary test facility.

W79-70076 **505-09-13**

Langley Research Center Hampton, Va

HUMAN RESPONSE TO NOISE

D G Stephens and R R Heldenfels 804-827-2042

The objective of this research is to define and quantify stimulus environmental and human factors responsible for affecting individual and community response to aircraft noise and operations. Research studies will include laboratory tests to subjectively evaluate the properties of aircraft-generated noise that are responsible for causing individual annoyance and field surveys to study the broader problems of community acceptability including psychological and sociological factors. The laboratory program is aimed at developing criteria for evaluating the noise from single aircraft events as well as evaluating the response to longer term multiple aircraft exposures. Subjects will experience the recorded noise of aircraft or the synthesized noise of future systems under simulated indoor and/or outdoor conditions. Various psychophysical measures such as annoyance and speech interference will be used by the subjects to judge or rate the noise. The resulting single-event dose-response relationships will be directly applicable to the engineering assessment of source noise modifications and to aircraft certification procedures whereas the multievent results will be applicable to the evaluation of aircraft/airport operations. The community acceptance studies are directed toward the development of a predictive model of community acceptance which includes, in addition to the details of each noise level, the frequency of events, the time of day/night, and community attitudes. The model will be formulated such that it can be used to assess the noise abatement resulting from A/C modifications, A/C operations, and land use strategies.

W79-70077 **505-09-23**

Langley Research Center Hampton, Va

AIRCRAFT INTERIOR NOISE REDUCTION

D G Stephens and R R Heldenfels 804-827-2042

The objective of this research is to provide design guidelines for reduction of aircraft interior noise by attenuation of noise and vibration transmitted via air and structural paths. The design criteria are to be based on consideration of human response. Interior noise research will concentrate on improved noise control for aircraft including STOL, helicopter, general aviation and turboprop aircraft where levels are particularly high. The technology base will include results from studies being conducted with STOL (AMST) vehicles, helicopters, and general aviation aircraft to identify noise source/path relationships. The development of structural noise transmission prediction methods is

fundamental to this program and includes the definition of the near field noise inputs in terms of spatial distribution, frequency content and correlations the response of structural panels individually and in combination, and the coupling of the structural modes with the interior cavity modes over a range of forward speed, curvature, and pressurization. The results will be included in a prediction program capable of minimizing the interior noise within the practical constraints of cost, weight and operations. Finally, acceptable levels (criteria) of interior noise will be established for the safety and comfort of crew and passengers. Safety considerations will include speech intelligibility and auditory effects whereas the comfort studies will emphasize passenger acceptability and speech interference.

W79-70078 **505-09-31**

Ames Research Center Moffett Field, Calif

FLIGHT MANAGEMENT SYSTEMS

H P Klein, Lauber J K and Wempe T E 415-965-5094

(515-51-11, 505-08-21)

This program will investigate flight management and crew/system interaction mechanisms and requirements for current and advanced aircraft. Specific objectives are to develop (1) procedures for the measurement and assessment of aircrew performance for current and future systems under varied conditions of automation, ground authority traffic complexity and environmental conditions, (2) new technology and methodology for training and (3) principles of optimal crew utilization. The research will include exploration of (1) new technology for improved current and future man-system information interfaces such as navigation charts, operating manuals, warning and status annunciator systems, pilot input systems, head-up displays, and panel displays and (2) the fundamental characteristics of human cognitive and decision-making behavior and their relationships to pilot performance. To accomplish these objectives, manned full-mission and part-task simulations will be conducted to evaluate performance and workload measurement methodology and aircrew perception and decision-making functions in a variety of tasks and mission scenarios. These in-house studies in conjunction with those supported by university grants, will be used to develop principles of optimal crew utilization and to evaluate training effectiveness. Collaborative studies with the FAA, industry and the military will be pursued to evaluate specific subsystems such as speech synthesis and recognition systems, head-up displays and crew procedures.

W79-70079 **505-09-33**

Langley Research Center Hampton, Va

FLIGHT MANAGEMENT

M C Kurbjun and J E Stitt 804-827-3745

(513-52-03)

The objectives of this effort are to define crew responsibilities and interactions flight procedures and control and display requirements for the future civil air transportation system of the 1980-1990's. These tasks will be accomplished by taking the following approach: (1) continue to develop tools and techniques that will define the crew responsibilities and interactions and measure their workload, (2) apply these tools and techniques to assess current and contemplated flight systems, and (3) develop analytical techniques that will assess advanced system requirements and human operation and define cockpit displays and controls needed for a satisfactory flight management system. This concerted effort should result in improving the safety and efficiency of advanced transport systems and will require research in hardware, software and human elements to systematically carry out the program objectives.

W79-70080 **505-09-41**

Ames Research Center Moffett Field, Calif

SIMULATION TECHNOLOGY FOR AERONAUTICS

L Roberts, W B Cleveland, H P Klein and D C Nagel

415-965-5094

(505-09-31, 515-51-11)

The general objective of this research and development activity is to provide a scientific and technical base that can be used as a resource to develop valid, reliable and economical simulators for aeronautical research, development and crew training. General

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objectives are (1) to develop advanced hardware and software concepts for high fidelity simulation of vision and motion systems (2) to evaluate existing and prototype simulator systems using comprehensive assessment techniques (3) to develop task related fidelity criteria for simulators based on a detailed analysis of human operator requirements and engineering principles and (4) to develop computer systems appropriate for simulation of advanced aircraft. These objectives will be accomplished by (1) continuing study of advanced perception and performance with an emphasis on developing task related fidelity criteria and associated fidelity measurement techniques (2) evaluating existing simulators using both traditional assessment methods and new methods developed in (1) above (3) continuing development of new visual scene technology with an emphasis on reduced visibility scenes and (4) studying improved simulation computing techniques and hardware system concepts.

W79-70081

505-09-43

Langley Research Center Hampton Va

APPLICATION OF FLIGHT SIMULATION TECHNOLOGY

R L Bowles 804-827-3304

The objective of this RTOP is to apply simulation technology to existing flight simulators to support Langley's research programs. This RTOP will cover both in-house and contractual studies which address current constraints in Langley simulator equipment in the formulation and validation of simulation math models and in the linkage of the hardware/software systems to provide in the closed-loop pilot/simulator environment effective simulations. Principal tasks for FY 1979 include studies of simulation requirements for directional control on runways, evaluation of kinesthetic cues for DMS and VMS development of improved real-time simulation computing techniques for the Real-Time Simulation System, extension of and validation of the man-machine systems model for analysis of flight simulator engineering requirements and development and application of improved interactive performance assessment techniques. A new start in FY 1979 will be the development and analysis of large-scale mission oriented terminal area simulation techniques. Results of this effort will be documented in NASA technical papers and contractor reports and will be applied to simulations of interest to Langley Research Center.

W79-70082

505-09-53

Langley Research Center Hampton Va

GENERAL AVIATION - SINGLE PILOT IFR SYSTEMS

J D Shaughnessy and J E Stitt 804-827-3917
(512-52-01 512-52-03)

This effort will provide the background research and develop the technology required to improve the safety and utility of single-pilot general aviation (GA) aircraft operating under instrument flight rules (IFR). The specific objectives of this research are to (1) define and characterize the pilot environment, psychological state workload and required actions, and the interrelationship between these factors, (2) evaluate advanced navigation and flight control systems concepts for GA aircraft in order to advance the performance and capability of the GA aircraft/pilot system, (3) evaluate new air traffic control (ATC) concepts (working with the FAA) and determine optimal usage of the evolving ATC system to significantly aid the single-pilot operating under IFR in the national ATC airspace. The approach to this research will be to (1) determine the critical problem areas by analyzing past years of NTSB single-pilot IFR accident data, the FAA/NASA Aviation Safety Reporting Program data and by simulation and flight research (2) apply the disciplines of aircraft dynamics and aerodynamics, avionics and automatic control and human factors to alleviate the problems and (3) use simulation and flight research tools to verify and demonstrate the technological and system improvements.

W79-70083

505-10-11

Ames Research Center, Moffett Field, Calif

GENERAL AVIATION AERODYNAMIC PERFORMANCE TECHNOLOGY

L Roberts and S Anderson 415-965-5066
(505-06-51)

The objectives of this program are to provide an advanced

technology base for the design of future aircraft that are safer, more productive, and clearly superior to foreign competition including the development of advanced techniques and design data to improve aerodynamic performance, stability and control and handling qualities. The approach is to use analytical predicted methods and analyze wind-tunnel and flight tests of optimized airfoils and wings to develop techniques for reducing aerodynamic drag associated with engine-cooling to develop techniques for improving stall/spin characteristics to obtain a data base with which mission-related stability, control and handling qualities criteria may be established and to optimize procedures for improving configuration design. In order for the results of this research program to be valid and meaningful, full-scale tests need to be conducted in the Ames 40- by 80-Foot Wind Tunnel. This will assure the user that scale effects have been thoroughly investigated and that proper generalization can be made to new designs.

W79-70084

505-10-13

Langley Research Center Hampton Va

GENERAL AVIATION AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS

A W Hall and R E Bower 804-827-3274

An advanced technology base will be developed to permit the design of general aviation aircraft that are safer, more productive and clearly superior to foreign competition. This technology includes aerodynamic and propulsive performance, stability and control and handling qualities. The work will be accomplished by computer analysis and techniques, simulator studies and wind-tunnel and flight tests of models and full-scale aircraft. The work will involve tests and analysis for interference and design optimization, drag reduction, engine cooling, drag, improved airfoil design capability, mission related stability, control and handling qualities criteria, improved stall/spin characteristics, propeller/nacelle or fuselage integration and airplane response to turbulence.

W79-70085

505-10-14

Hugh L Dryden Flight Research Center Edwards, Calif

GENERAL AVIATION MANEUVERABILITY, SAFETY AND PERFORMANCE IMPROVEMENTS

S W Gee 805-258-3311

Experiments and studies are being conducted to identify and demonstrate optimum levels of performance, stability and control and handling qualities for general aviation that can be achieved through the application of advanced technology. Studies are being conducted of the free-wing concept showing improvements over conventional designs in ride quality, performance, maneuverability, and safety. Two director display concepts capable of providing curved approaches to landing are planned to be flight evaluated. The improved tracking performance and reduced pilot workload is expected to improve the safety of flight operations.

W79-70086

505-10-18

Wallops Station, Wallops Island Va

GENERAL AVIATION AIR TRAFFIC FLOW DYNAMICS

W Edward Melson, Jr 804-824-3411

The objectives of this RTOP are to collect and analyze general aviation piloting procedures and aircraft flight dynamics data to provide insight to future light aircraft which are designed to be safer and in keeping with pilot operating procedures. Various data collection techniques are utilized to obtain data on aircraft flight dynamics and piloting procedures in the operating environment. These include single and multiple radar tracks in various environments, pilot questionnaires, photographic data and other techniques. Data are analyzed, integrated into simulation models and simulations conducted to assess various design or operating alternatives. Current applications of this technology include operating stall-spin margins, mid-air collision parameters, cockpit vision envelope restrictions, automatic air traffic monitoring and control systems, and community noise exposure.

W79-70087

505-10-21

Ames Research Center, Moffett Field, Calif

ROTORCRAFT AERODYNAMIC PERFORMANCE, DYNAM-

ICS, AND HANDLING QUALITIES

L Roberts W Johnson L Presley and B Tinling 415-965-5066

(505-02-21 505-02-22 518-51-01)

This RTOP covers research on all aspects of rotor aeromechanics (aerodynamics dynamic loads and stability performance and noise characteristics) and rotorcraft flight dynamics. Flight dynamics research will be conducted to provide handling qualities and design criteria which permit cost effective design decisions to be made for helicopters for specific missions. The research will be conducted through analysis including math model improvement and development of advanced techniques of control system implementation ground bases piloted simulation and flight research with the UH-1H (with V/STOLAND) CH-47 XV-15 and CH-53 aircraft. The understanding and predictive capability of the aerodynamic and dynamic phenomena of advanced rotorcraft will be improved by conducting analytical small scale and full scale experimental investigations of helicopter performance and noise rotor aerodynamics and wake characteristics drag and aerodynamic interference and rotor loads vibration and vibration reduction systems. Specific advanced rotor configurations will be tested in the full-scale wind tunnel. Theoretical and experimental research will be conducted to develop techniques to design optimum airfoils for rotary wing applications and to predict their dynamic performance particularly at high subsonic and transonic speeds. The benefits of optimum airfoil sections upon complete rotor performance will be studied, and methods for predicting optimum tip shapes will be developed.

W79-70088**506-10-23**

Langley Research Center, Hampton Va

ADVANCED ROTORCRAFT AEROELASTICITY AND ACOUSTICS

W H Reed III and R R Heldenfels 804-827-2265

Analytical and experimental studies will be made to identify factors contributing to the aerodynamic acoustic, and aeroelastic characteristics of rotors. University grants and contracted studies will be continued to define wake geometry and analytical procedures for predicting unsteady airloads aerodynamic interference structural response and acoustic signatures. In-house experimental studies will be continued to better define possible vibratory load reductions with higher harmonic control and to define unsteady local-flow parameters significant in the prediction of rotor blade unsteady air loads. Analytical, wind tunnel and flight investigations will be made to determine performance flow interference and acoustic characteristics of current and advanced rotorcraft configurations. These efforts will, in general be carried out jointly with the Structures Laboratory U S Army Research and Technology Laboratories.

W79-70089**506-10-51**

Ames Research Center, Moffett Field Calif

HYBRID ROTOR/AIRSHIP FLIGHT CONTROLS AND AERODYNAMIC PERFORMANCE

M D Ardema 415-965-5888

(505-10-21, 791-49-30)

The objective of this RTOP is to provide aerodynamics flight dynamics and control systems technology development for promising modern airship concepts. Emphasis will be on the flight dynamics simulation of an airship concept employing substantial amounts of rotor lift and designed for transporting heavy payloads over short ranges. The program is currently concentrating on areas known to have the greatest uncertainties modeling and control of interconnected rotors and aerodynamic interactions of rotors and envelopes. Later efforts will concentrate on gust and turbulence modeling effects of structural flexibility, and control law development. The work to be done includes analytical studies, computer simulation and wind tunnel testing. Because of military interest in the heavy-lift/short-haul airship concept close coordination will be maintained with the Airship Project Office at Naval Air Development Center and it is anticipated that some of the technology development for this concept will be jointly supported by NASA and the Navy.

W79-70090**506-11-11**

Ames Research Center, Moffett Field Calif

OBLIQUE WING AERODYNAMICS

Richard H Petersen and Ronald C Smith 415-965-6133 (505-06-51)

The primary objective of this research will be to support the aerodynamic design of the low-cost oblique wing demonstrator (AD-1) proposed by the Dryden Flight Research Center. This support shall include analytical wind tunnel and simulation studies to define the aerodynamic configuration with a specific emphasis on identifying the wing geometry and its aeroelastic characteristics.

W79-70091**506-11-13**

Langley Research Center Hampton Va

MEDIUM AND LONG-HAUL CRUISE AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS

R T Whitcomb 804-827-2252

(516-53-03)

The objective of this research is to develop practical means for improving the aerodynamic performance of high subsonic and supersonic cruise aircraft. Innovative configurations with improved cruise efficiency will be investigated analytically and experimentally. For the most promising of the proposed new configurations both theory and wind tunnel tests will be used to assure that the performance buffet loads stability and controllability are acceptable over their entire flight envelopes. Further theory and experiments will be used to investigate advanced high lift systems for landing and takeoff and means for increasing the off-design performance of configurations with high cruise efficiency. Work will be conducted in-house and by contracts and grants.

W79-70092**506-11-21**

Ames Research Center Moffett Field Calif

HIGH PERFORMANCE AIRCRAFT AIRFRAME-PROPULSION INTEGRATION

Daniel P Bencze 415-965-5879

(505-10-31)

The objective of this RTOP is to investigate airframe/propulsion system integration for advanced combat aircraft. Conceptual designs of such aircraft have incorporated a number of new features that potentially impact the integration of the airframe and propulsion system. Among these include the use of canards and strakes in close proximity to or even in front of the inlet. This especially is true in the case of top mounted inlets which are presently being considered by industry. With the demanding maneuvering requirements associated with these vehicles there will be a significant interaction between these components leading to potentially severe integration problems. To investigate these interactions analytical techniques presently being developed to analyze canard/wing flow fields will be extended to handle the canard/strake/inlet problem. Furthermore, one of the available VSTOL fighter configurations presently scheduled for wind tunnel testing will be selected and appropriately modified to investigate the canard/strake/inlet interactions in more detail. Comparisons will be made between the analytical and experimental results.

W79-70093**506-11-22**

Lewis Research Center, Cleveland, Ohio

NONAXISYMMETRIC NOZZLE AERODYNAMICS

Ross G Willoh 216-433-4000

The objective of this program is to establish through analytical studies, system design efforts and full-scale test programs the technology base required for the application of unique configurations to future combat aircraft. Current activities are specifically directed toward providing the technology required for the design of nonaxisymmetric exhaust nozzles for turbine engines. The high maneuverability requirements anticipated in future aircraft designs lead to the application of non-axisymmetric nozzles capable of thrust vectoring and reversing. Experimental and analytical efforts will be undertaken to improve the technology available for the design of non axisymmetric exhaust systems. Principal areas of concern will include cooling heat transfer structural design, weight and internal aerodynamics. The objectives will be accomplished through contract studies, nozzle design fabrication and altitude testing. Particular emphasis will be placed on solutions to the complex cooling structural

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and internal aerodynamic problems associated with non-axisymmetric nozzles. Close coordination will be maintained with Langley Research Center and the Air Force to assure that work in the propulsion area appropriately supports Air Force requirements and the aerodynamic work at Langley.

W79-70094

505-11-23

Langley Research Center Hampton Va

COMBAT VEHICLE AND MISSILE AERODYNAMICS AND FLIGHT DYNAMICS

C M Jackson and R E Bower 804-827-3285

The technical objective of this work is to develop the aerodynamic technology base for the design of future military aircraft and missile concepts. Analytical and experimental studies will be made to develop aircraft design rationale and evaluate advanced aerodynamic concepts such as supercritical aerodynamics, wing warp, maneuver devices, thrust-induced lift, nonaxisymmetric nozzles and component interference. Similar studies will be made to expand the aerodynamic technology base for missile systems including conventional cruciform stability and control concepts, air-breathing propulsion integration and monoplane concepts. Studies will also be made to provide a technology base for evaluation of missile carriage and separation aerodynamics.

W79-70095

505-11-24

Hugh L Dryden Flight Research Center, Edwards Calif

HIGH SPEED AIRCRAFT AERODYNAMICS

T G Ayers 805-258-3311

The broad objectives of this RTOP are to (1) develop an integrated digital engine inlet flight control facility with the F-15 airplane, (2) conduct flight research for the SCR program with the YF-12 airplane, (3) provide a sound technology base for the application of new and innovative nonaxisymmetrical nozzle designs to future aircraft, and (4) continue the development of new methods and techniques for investigating fluid flows and for evaluating the performance of flight test vehicles.

W79-70096

505-11-33

Langley Research Center Hampton Va

HYPersonic AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS

F S Kirkham and R E Bower 804-827-3285

The primary objective of this effort is to provide an aerodynamics technology base for future airbreathing hypersonic aircraft through theoretical analysis and experimental investigations of configuration aerodynamics, stability and control, aerodynamic heating, and propulsion system integration. Areas to be emphasized are those which hold the highest potential for future payoffs such as deriving benefits in vehicle performance from mutual interactions of the aircraft and its propulsion system and the development of configurations which minimize areas of interference heating. Many aspects of this program such as the advanced analysis and design techniques are generally applicable to supersonic aircraft and future space transportation systems as well as to hypersonic vehicles. The approach to be used will emphasize the development and application of advanced analytical and experimental methods which are capable of addressing complex flow phenomena such as the propulsion system exhaust. Analysis methods will include such effects as viscous flows, inlet spillage, embedded shocks and finite rate chemistry. Experimental methods will include provisions for making force measurements in conventional wind tunnels of models with simulated exhaust flows. A systematic conceptual design and evaluation procedure will be implemented with which meaningful trade studies can be made and the conceptual design work will be used to guide future technology development.

W79-70097

505-11-41

Ames Research Center Moffett Field Calif

INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING

L Roberts and J W Davis 415-965-5848

Technical assistance, consultative services and support, through the use of NASA facilities will be provided to outside agencies and the aircraft industry. Principal assistance is to the Department

of Defense (DOD) for aircraft and missile systems development programs. Additionally joint activities will be conducted with other government agencies and industry on a fee or reimbursable basis. Areas of support include research activities to aid in assuring satisfactory aerodynamic and handling qualities of piloted aircraft in routine operational flight and in advanced weapon delivery tasks and in assuring satisfactory flight path and attitude control of these aircraft in given automatic flight modes such as radar-guided approaches and landings on an aircraft carrier. Also included are efforts to define and develop techniques for improvement on marginal or unsatisfactory characteristics of new airplane designs. Wind tunnels, flight simulators and central computer facilities (360 7600) together with applications of advanced control theory will be employed as required. Specific systems for which support is planned during FY 1979 include: Type B VTOL AV-8 XFW-12A F-18 B-52 Advanced Fighter Technology Integration Program (AFTI), Submersible Bodies, Submarine Sail Development, A-10 Boeing 7N7 Aircraft Program, SRAM-L X-WING and Advanced Missiles.

W79-70098

505-11-42

Lewis Research Center Cleveland, Ohio

INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING

D N Bowditch 216-433-4000

The objective is to support requests from the Department of Defense, Department of Transportation and other federal agencies outside of NASA for aerodynamic testing in the facilities of the Lewis Research Center. Facilities typically used under this RTOP include 10x10 SWT, 8x6 SWT, 9x15 WT, icing tunnel and PSL.

W79-70099

505-11-43

Langley Research Center Hampton Va

INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING

W P Henderson and R E Bower 804-827-2676

The broad objective is to provide technical assistance and consultative services to outside agencies and the aircraft industry programs which involve specific requests for NASA support. The principal assistance is to the Department of Defense for aircraft and missile development programs. Current activity is focused in the areas of stall/spin aerodynamic characteristics at subsonic, transonic, and supersonic speeds; flutter and aeroelasticity; structures, landing loads and simulation. The approach will involve tests in applicable Langley facilities consistent with the availability of test time and the utilization need for the particular facilities requested. Analysis of test results will be performed and selected results will be documented. Consultation will include participation in pretest conferences, technical evaluation boards, and technical coordination committees.

W79-70100

505-11-44

Hugh L Dryden Flight Research Center Edwards Calif

INTERAGENCY ASSISTANCE AND TESTING

G P Layton 805-258-3311

The objective is to provide technical assistance, consultative services and support through use of NASA facilities to outside agencies. The principal assistance is to the Department of Defense for aircraft related research and development programs through their requests to NASA. Joint activities with other agencies are also conducted when requested. DFRC will fly the Mini-Sniffer vehicle in support of the Army and assist them in defining vehicle requirements for possible Army Mini-RPV missions. The LaRC developed aileron-rudder-interconnect for the F-14 aircraft will be flight tested by DFRC jointly with the Navy and LaRC. DFRC will provide technical assistance to the Navy in performance and flying qualities evaluations of the F-18 aircraft. DFRC will operate an F-111 aircraft in support of the USAF AFTI-111 program as well as participate in USAF AFTI design reviews, data system development and definition of flight test plans.

W79-70101

505-11-54

Hugh L Dryden Flight Research Center, Edwards Calif

REMOTELY PILOTED RESEARCH AIRCRAFT TECHNOLOGY

System Studies (Aeronautics)

W H Andrews 805-258-3311
(505-02-24 723-01-04)

This RTOP covers effort in two areas the AD-1 Oblique Wing Research Vehicle and the RPRV/RAV Facility Development program The AD-1 manned low-speed jet Oblique Wing research airplane is under construction The subsequent flight-test objectives have been selected to provide a data base and level of flight experience for planning a more comprehensive transonic evaluation of the configuration concept The RPRV Facility Development effort covers the continuing remotely piloted vehicle facility development to improve the capability of flight testing supersonic and highly maneuverable vehicles of the future This facility will be used to test vehicles such as HiMAT the Spin research vehicle the modified Firebee II designated as Drones for Aerodynamic and Structural Testing (DAST I and II), etc The Remotely Augmented Vehicle (RAV) facility development will continue to cover conceptual investigations of several candidate interfaces simplex ground computers and multi-channel airborne Fly-by-Wire control systems This effort will include pilot-in-the-loop control and failure modes and error analysis for those systems

W79-70102

505-11-84

Hugh L Dryden Flight Research Center Edwards Calif
AIRCRAFT OPERATIONAL SUPPORT
R S Waite 805-258-3311

Equipment, maintenance and operation are provided for (1) support aircraft including F-104N, F-104G T38, Aero Commander C-47 and Bell Helicopter and (2) service aircraft including B-52 PA-30, and JetStar Major effort and coordination of activities are provided by in-house resources with augmentation by supporting contractors (engine maintenance AGE maintenance inventory management) and reimbursable military elements (fuel, parts special functions) This effort supports research flight programs providing adequate proficiency of pilots, chase aircraft R/D support in terms of research investigations, and general operational support

W79-70103

505-15-31

Ames Research Center, Moffett Field Calif
MATHEMATICAL AND NUMERICAL ANALYSIS
H Lomax 415-965-5124
(505-06-11)

The objective is to develop new mathematical methods and models for computer simulation of fluid flows Various numerical techniques for the solution of the complete governing partial differential equations of fluid dynamics with attendant boundary and initial conditions will be analyzed, tested, and evaluated for reliability, accuracy, and efficiency Splitting of the finite-difference operators, implicit algorithms and direct elliptic solvers are some of the approaches to be studied Numerical analysis will be emphasized rather than the physical phenomenon The ultimate objective is the efficient use of the ILLIAC IV, CDC 7600, and other large computers in the simulation and understanding of fluid dynamics phenomena

W79-70104

505-15-33

Langley Research Center, Hampton, Va
APPLIED MATHEMATICS
W D Erickson and J E Duberg 804-827-2471
(505-15-32 505-15-37)

This RTOP provides for the conduct of basic research in applied mathematics and computer science The research is carried out by a combination of in-house efforts university research grants, and the continuing operation of the Institute for Computer Applications in Science and Engineering (ICASE) located at the Langley Research Center The in-house and grant efforts include research dealing with numerical solutions of differential and algebraic systems data analysis computer graphics, symbolic and algebraic manipulation, data base management programming languages microprocessor software and software engineering The broad research areas pursued in ICASE include the efficient use of vector and parallel computers, numerical analysis, computational research in selected areas of science and engineering of interest to NASA, and computer systems and software

W79-70105

791-40-11

Ames Research Center Moffett Field Calif
SHORT HAUL AIR TRANSPORT CONCEPTUAL DESIGN STUDIES
Wallace H Deckert 415-965-5886
(516-50-01)

Technology is currently being developed through analytical and experimental programs in all the traditional aeronautical disciplines The objective of this RTOP is to investigate the integration of these technologies into total aircraft systems and to identify the potential payoff when applied to short-haul transport aircraft This work will define the need for additional technology development through wind tunnel experiments, ground based simulation and flight research This RTOP covers short-haul air transport studies in two separate areas, first although work is proceeding on all classes of short-haul transport aircraft, there is increased emphasis on technology that can be applied to small transport aircraft for commuter and local service airline usage A project entitled Small Transport Aircraft Technology (STAT) has been formulated in FY 1978 and will be continued at least through FY 1984 The emphasis is on the near term application of technology that is now being developed in related military and NASA programs The STAT related studies conducted under this RTOP are companion to the ongoing systems technology work in RTOP 516-50-01 Second an additional effort under this RTOP will be an aircraft design study to assess the cost and benefits of propulsive-lift technology applied to medium-large size short-haul transport aircraft to enhance their capability for quiet high-performance terminal-area operations The propulsive-lift study is a companion to the ongoing systems technology work in RTOP 516-58-01

W79-70106

791-40-12

Lewis Research Center Cleveland, Ohio
PROPULSION SYSTEMS FOR SMALL TRANSPORTS
R J Weber 216-433-4000

Studies will be performed of advanced propulsion systems suitable for use on future small transport aircraft, such as those used by commuter airlines The work is planned to complement and support the Small Transport Advanced Technology (STAT) activities being conducted by Ames Research Center The studies will be accomplished through contracts with several engine companies

W79-70107

791-40-13

Langley Research Center Hampton, Va
LONG-HAUL AIR TRANSPORTATION SYSTEM AND CONCEPT STUDIES
D W Conner and R E Bower 804-827-3838
(516-50-23)

The objective is to develop through studies and analyses an overview of the technical economic and benefit aspects of existing and potential long-haul air transportation systems and systems elements The approach will be to identify the technology needs for advancing these systems, to analyze all-new transportation concepts and systems, to evaluate advanced aircraft concepts, to evaluate new technology incorporated into existing and derivative aircraft, and to evaluate design and operational issues related to common civil/military transport aircraft Both in-house and contractual efforts will be utilized

W79-70108

791-40-21

Ames Research Center, Moffett Field, Calif
VTOL SYSTEMS STUDIES
W H Deckert 415-965-5888
(505-10-31 505-10-36)

The main objective of this RTOP is to enhance in-house capability to evaluate military VTOL aircraft systems and technology Specific efforts will consist of conceptual design studies, technology assessments system studies and planning analyses as required in the course of in-house planning analyses

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W79-70109

791-40-23

Langley Research Center Hampton Va
FUTURE MILITARY AVIATION SYSTEM STUDIES
W C Sawyer and R E Bower 804-827-3181

The technical objective of this work is to identify aerodynamic propulsion and structural technology areas significant to the development of future generations of military systems including missiles and aircraft. In close coordination with DOD one or more technology studies will be conducted to evaluate alternative vehicle and system concepts and build an information base for research program planning in support of future military aviation systems.

W79-70110

791-40-31

Ames Research Center Moffett Field, Calif
ROTORCRAFT SYSTEM STUDIES
J V Christensen and John Zuk 415-965-6569
(514-50-01)

The objective of this RTOP is to assess the civil mission requirements growth patterns markets, foreign competition and other national needs/benefits of importance in the definition and advocacy of an integrated agency program in rotorcraft and related technology. Specifically the following areas will be assessed with emphasis on the identification of NASA research options: (a) rotorcraft markets and technology (b) large rotorcraft (cargo/transport) concepts, (c) public service/rescue needs requirements and technology research (d) civil markets and operational aspects of very heavy lift buoyant quad-rotor concepts and (e) helicopter accident analysis and prevention technology needs.

W79-70111

791-40-38

Wallops Station, Wallops Island Va
AIRBORNE EXPERIMENT PLATFORMS
H C Needleman 804-824-3411

This study effort is directed toward establishing the utility and technology requirements of two classes of unmanned air-borne experiment platforms - high altitude powered platforms, including heavier-than-air and lighter-than-air vehicles and unpowered platforms, including tethered and mid-air-deployed balloon borne platforms - for use by the scientific and applications experimenter community as tools to complement existing research techniques. User applications mission concepts and systems concepts will be investigated with emphasis on high altitude and deployment operations compatibility with science user requirements and system integration.

W79-70112

791-40-43

Langley Research Center Hampton Va
AERONAUTICAL TECHNOLOGY IMPACTS AND BENEFITS
D W Conner and R E Bower 804-827-3838
(791-40-13)

The objective of this line of effort is to define and clarify economic and government policy issues affecting aviation and transportation, to assess technology impacts and benefits, and to develop methods and an information base for use in OAST R&T program planning. The approach will be to search out and develop an understanding of the important factors influencing the growth and use of aviation for transportation of passengers and cargo, to identify through analysis of present situations, opportunities for technology advancements which can significantly reduce operational costs or improve operations of civil systems, and to develop and exercise methodology for assessing the potential market demands, economics, and cost/benefits for air transportation as affected by the introduction of improved technology in future aircraft and their operations. The FY 1979 activity will emphasize demand analysis methodology and the economics of advanced technology implementation.

W79-70113

791-40-47

Lyndon B Johnson Space Center Houston, Tex
INTEGRATED ELECTRICAL/ELECTRONIC CONTROL SYSTEMS STUDY
R C Kennedy 713-483-4281
(910-44-36, 505-07-25)

It is the objective of this RTOP to determine the applicability of new electrical, mechanical, and electronic technologies exposed

in the course of the space shuttle development to aeronautics with initial emphasis on civil air transport. Determinations will be made as to what steps are necessary to effect the technology transfer or alternately what additional technology is needed before the transfer can be realized. Digital atmospheric flight control, multiplexed data transmission for command and control and software monitoring and management of vehicle systems have been flight demonstrated during the orbiter approach and landing tests. Also the Johnson Space Center has completed the technology development of an electromechanical flight control actuator which uses a high voltage dc source and is sized to orbiter requirements. These technologies as applied to various classes of commercial transports will be analyzed and traded to determine if their use offers a potential for reducing aircraft acquisition and operational costs and/or increases overall aircraft productivity. Both new and derivative aircraft will be studied.

W79-70114

791-40-53

Langley Research Center Hampton Va
GENERAL AVIATION SYSTEM STUDIES
A W Hall 804-827-3274

The objective of this work is to undertake studies to evaluate missions and aircraft design concepts in order to identify the technology requirements for increased performance productivity and safety of general aviation aircraft. These studies will identify the technology requirements and attendant costs and benefits, for existing as well as for future general aviation aircraft missions.

Aeronautics Systems Technology Programs

W79-70115

510-53-02

Lewis Research Center Cleveland Ohio
MATERIALS FOR ADVANCED TURBINE ENGINES (MATE)
C P Blankenship 216-433-4000
(505-01-12)

The purpose of this program is to accelerate the application of advanced materials technologies to aircraft turbine engines in order to achieve improved engine performance benefits. The program involves the application of previously laboratory-verified advanced materials technologies for engines planned in the 1980-85 timeframe. It covers the advanced development rig testing and engine testing necessary to demonstrate the potential of the new materials for use in future engines. The program is conducted through contracts with domestic engine manufacturers and their vendors. New materials that have shown laboratory feasibility in exploratory development programs are selected for further development and evaluation under this program. Cost/benefit and risk analyses are conducted to help guide the selection of the best candidate materials. The selected materials are then scaled-up manufactured into appropriate engine hardware extensively evaluated to provide preliminary design data and tested in both engine-simulation rigs and experimental engines to demonstrate their potential for future engine use.

W79-70116

510-55-02

Lewis Research Center, Cleveland, Ohio
AEROELASTICITY OF TURBINE ENGINES
M J Hartmann 216-433-4000
(505-04-22)

The aeroelastic program is directed toward improving flutter boundary design criteria so that the occurrence of flutter in fans and compressors for advanced propulsion systems is essentially avoided. If flutter is encountered these criteria may also be used to expeditiously clear flutter from the operating region. The program will also provide through analytical and experimental research, a more fundamental basis for reliable analysis prediction and thus the avoidance of instability regions. Analytical methods and computer codes will be developed to predict the unsteady aerodynamic forces under various flutter conditions, and to calculate the structural modes of blades, shrouds and disks as utilized in fans and compressors for advanced engines. The unsteady aerodynamic analysis will be verified in cascades in

which the blades are driven as if they are in flutter. The structural analysis will be verified in a vacuum spin rig and in vibration rigs. The coupling of the aerodynamic forces and structure will be verified in suitable instrumented experimental fans. The prediction methods will be further verified by application to realistic data such as that obtained in full scale engine research programs. This aeroelastic program is the NASA portion of an interdependent and coordinated program involving LeRC and AFAPL. The effort involves inhouse projects as well as contract research with aerospace companies and grants to various universities.

W79-70117**510-56-01**

Ames Research Center Moffett Field Calif
FIREMEN - FIRE RESISTANT MATERIALS
 D A Kourides 415-965-5226
 (505-01-31 505-08-21)

Fire-resistant materials technology will be utilized for possible application in the design of fire safe airframe structures and aircraft interiors such as ceiling and sidewall panels and aircraft seats. This materials technology will be developed in conjunction with the airframe manufacturers to make aircraft components as fire-resistant as feasible in order to provide an increased probability of passenger and crew survivability in aircraft interior and crash fires. The flammability and other properties of the state-of-the-art and improved materials for aircraft interiors will be assessed. Various films, inks and adhesives will be evaluated for aircraft interior applications which will result in significant reduction of flame propagation and associated hazards. Fire-resistant materials including foams and fabrics will be evaluated as components of aircraft seats. This program will be conducted primarily with the major airframe manufacturers. The large scale testing of these components, especially seat components, will be coordinated with the Johnson Space Center.

W79-70118**510-56-05**

Jet Propulsion Lab Calif Inst of Tech, Pasadena
FIREMEN - FIRE MODELING AND SCALING METHODS
 P F Massier 213-354-3549

The objectives of this program are to provide an aircraft fire testing methodology and a set of fire scaling criteria to facilitate the integration and quantification of fire test results and their application to improved aircraft fire safety. The JPL Program will be coordinated with programs at JSC, the FAA and the major aircraft companies in extending and applying the enclosure fire analysis model developed by JPL. The 'Relative Energy Release Criteria' concept will be applied to the aircraft fire situation, in order to define consistent test objectives, test configurations, test conditions, and test instrumentation. The methodology developed will provide valid analytical scaling relationships for interpolating and extrapolating experimental aircraft fire test results to a variety of probable fire accident scenarios.

W79-70119**510-56-07**

Lyndon B Johnson Space Center, Houston Tex
FIRE SYSTEMS AND FULL SCALE TEST (FIREMEN)
 R W Bricker 713-483-3166
 (505-08-27)

This RTOP consists of work originally started in FY-76 and continued through FY-78. The RTOP provides for development and flammability testing of lightweight cargo bay liners, development of molding processes and techniques, procurement of floor panels for the cargo bay tests, in-house component test support, toxicity testing techniques, fullscale CY80 test preliminary procedures including site preparation, refurbishments of the 737 fuselage full scale test instrumentation and procurement of new non-metallic materials.

W79-70120**511-53-02**

Lewis Research Center, Cleveland, Ohio
QUIET, CLEAN, GENERAL AVIATION TURBOFAN (QCGAT)
 G K Sievers 216-433-4000
 (505-03-12)

An experimental program is being conducted to provide the technology for quiet, clean and economical general aviation

turbofan engines. The program utilizes existing general aviation turbine-driven gas generator cores in experimental, quiet high bypass turbofan engines. The experimental engines incorporate the latest quiet engine technology derived from the Quiet Engine Program, the Quiet Clean Short-Haul Experimental Engine Program and other related component technology programs. The approaches selected for noise reduction are those considered appropriate for one or more specific engine applications. They include both source noise reduction and noise suppression techniques. Three study contracts awarded to three engine manufacturers to provide NASA with information required to start an experimental engine program (QCGAT) have been completed. Two contractors for the current phase have been selected and both are under contract. Each will design, fabricate, assemble, ground test and deliver an experimental turbofan engine.

W79-70121**511-54-02**

Lewis Research Center, Cleveland, Ohio
ENGINE COMPONENT IMPROVEMENT TECHNOLOGY
 Joseph A Ziemianski 216-433-4000

The objectives of the Engine Component Improvement Program are to develop components with improved performance which would reduce fuel consumption of current engines and be ready for introduction into new production and where applicable the retrofit of these engines in the 1979 to 1982 time period and provide additional technology which can be used to minimize the performance degradation of current and future engines. The program has been divided into two parts: performance improvement and engine diagnostics. The performance improvement part is aimed at developing fuel saving components for new production of the JT8D, JT9D and CF6 engines and for upgrading of existing JT8D, JT9D and CF6 engines. The primary elements of this part of the program are feasibility analysis, component rig/model tests and full-scale engine tests. Components being evaluated include seals, clearance controls, fans, compressors and turbines. The engine diagnostics part of the program will consist of analysis and test of the JT9D and CF6 engines to identify and quantify the sources and causes of engine performance deterioration with time. This information will be used to improve current engines and aid in the design of future engines.

W79-70122**511-55-02**

Lewis Research Center, Cleveland, Ohio
STRATOSPHERIC CRUISE EMISSION REDUCTION
 D A Petrash and L A Diehl 216-433-6860
 (505-03-22)

The objective is to establish and demonstrate the technology necessary to reduce exhaust emissions from modern gas turbine aircraft engines to environmentally acceptable levels over the entire subsonic flight envelope with minimum adverse effects on performance, weight and complexity. Special emphasis will be placed on achieving extremely low (< 3g NO₂/kg fuel burned) oxides of nitrogen (NO_x) emissions at stratospheric cruise conditions. NO_x emissions will be reduced by operating the combustion system at extremely lean fuel-air mixtures. Initially, fundamental in-house, grant and contract studies will examine practical problems associated with this technique. Studies will be conducted to examine NO_x production in lean combustion systems, flashback and autoignition limits, fuel preparation and stability augmentation techniques, and combustor constraints imposed by the engine. With the design information from the initial studies, combustor concepts will be integrated into engine system designs and assessed. Concepts which show potential for achieving program goals will be tested and screened. The most promising designs will be developed through component tests leading to an engine verification. If resultant optimized concepts cannot be incorporated into an existing engine, a preliminary engine design compatible with the combustor will be developed.

W79-70123**511-56-02**

Lewis Research Center, Cleveland, Ohio
VARIABLE CYCLE ENGINE COMPONENTS
 Albert G Powers 216-433-4000
 (517-53-32 517-53-62)

Advanced supersonic transport aircraft are required to operate

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over a wide variety of flight conditions. This creates conflicting requirements on the propulsion system which, in many cases, can be most effectively met by a Variable Cycle Engine (VCE). A VCE typically has two or more distinct operating modes, each tailored to provide optimum efficiency at one of the major flight conditions, e.g. takeoff, subsonic cruise and supersonic cruise. SCAR engine studies conducted under RTOP 743-03-41 have identified two VCE candidates of primary interest. These are the Variable Stream Control Engine (VSCE) and the Double Bypass Engine (DBE). Both engines offer significant potential improvements over conventional engines in terms of both performance and environmental impact. Each depends, however, on the efficient functioning of novel and unique components including their compatibility with each other and with other engine subsystems when integrated into the selected engine configuration. It is the objective of this RTOP to generate the advanced component technology and component/engine integration data required in the most critical areas of candidate variable-cycle engines (VCE) in order to demonstrate the feasibility of readiness of these component technologies required for supersonic cruise engines having high propulsive efficiency together with reduced noise and emissions.

W79-70124

511-57-01

Ames Research Center, Moffett Field, Calif.

ADVANCED TURBOPROP - INSTALLATION AERODYNAMICS

D. P. Bencze 415-965-5879

The objective of this research is to support the development of the technology required to demonstrate the feasibility of advanced turboprop transport aircraft capable of cruise speeds and altitudes up to 8 Mach number and 35,000 ft. System studies will be conducted to analyze specific aircraft design tradeoffs. These studies will serve to determine the aircraft installation trades in terms of cruise speed, engine location, and propeller characteristics and thereby identify the most promising directions for future research. An advanced computational method using finite difference techniques will be developed to identify the near- and far-field flow fields which can be used in the analysis of the acoustic and aerodynamic characteristics of the propeller. Through a combination of theoretical and experimental studies the aerodynamic technology required to integrated advanced turboprop propulsion systems with transport aircraft using super-critical wing technology will be developed. Detailed flow interactions among the propeller slipstream, nacelle, and wing surface will be examined and methods identified to optimize the installation. Theoretical analyses will include existing linear methods and the development of an advanced method capable of handling the transonic slipstream-nacelle-wing interaction. Experimentally the flow interactions will be investigated using a slipstream simulator to define the characteristics of the slipstream-super-critical wing interaction and a powered semispan model to provide an accurate simulation of the actual flow conditions.

W79-70125

511-57-02

Lewis Research Center, Cleveland, Ohio

ADVANCED TURBOPROP TECHNOLOGY

James F. Dugan 216-433-4000

(511-50-01, 716-01-01, 505-04-72)

The objective of the Advanced Turboprop Program is to demonstrate technology readiness for efficient, reliable, and acceptable operation at cruise conditions comparable to current turbofan-powered aircraft. The Advanced Turboprop Program will be implemented in three phases. This RTOP covers Phase I of the program. In Phase I, wind tunnel tests will be performed to determine the aerodynamic and acoustic performance of two-foot-diameter models. The sound pressure level of an advanced two-foot-diameter propeller model will be determined in flight tests or in wind tunnel tests at Mach 0.8. Propeller noise prediction programs will be developed to include thin swept propeller blades experiencing airflow greater than Mach 1.0. Propeller blade materials and structural concepts will be screened for feasibility and aeroelastic behavior. Preliminary designs for advanced large-scale propeller blades will be evaluated. Through analysis and wind tunnel model tests, the interactions of the propeller, nacelle and wing will be evaluated. Propeller noise

attenuation will be investigated by conducting fuselage wall acoustic attenuation studies by performing model tests, and by investigating the feasibility of scaling fuselage acoustics. Design concepts for advanced gearboxes and pitch change mechanisms will be evaluated. Existing gas turbine shaft engines and cores will be screened for use as a propeller drive for Phases II and III.

W79-70126

511-57-03

Langley Research Center, Hampton, Va.

ADVANCED TURBOPROP-INTERIOR NOISE

D. G. Stephens and R. R. Heldenfels 804-827-3561

The objective of this program is to demonstrate technology readiness in the area of acoustics and noise reduction for advanced turboprop aircraft development. Configurations of interest are aircraft powered by highly loaded, multibladed turboprops for efficient high-speed operation. Program emphasis will be on propeller noise and fuselage attenuation technology. The approach consists of the development of improved analytical and experimental methods for predicting propfan noise both in the near field and the far field and for predicting the transmission of noise through the cabin sidewall. These prediction methods will be developed and validated by means of model tests during the Enabling Technology phase (I) of the program. The improved prediction methods will then be used to guide the design of low-weight high-attenuation sidewalls for passenger acceptance and the design of propfans for acceptable fuselage as well as community noise exposure. The sidewall and propeller configurations resulting from acoustic considerations will be demonstrated by large-scale testing in the Advanced Component Technology phase (II) of the program.

W79-70127

511-57-04

Hugh L. Dryden Flight Research Center, Edwards, Calif.

ADVANCED TURBOPROP - FLIGHT RESEARCH

J. A. Albers and R. S. Baron 805-258-3311

(511-57-02)

The objective is to develop and demonstrate by flight research the technology for advanced turboprop propulsion systems having high propulsion efficiencies at cruise speeds and altitudes up to Mach 0.8 and 35,000 feet. This technology could provide fuel savings of 20% to 25% relative to current high-bypass turbofan engines while meeting reliability requirements and environments noise constraints. A two-foot diameter scale model of an advanced high tip speed propeller will be installed on a subsonic aircraft capable of flying Mach 8 at 30,000 feet altitude. Microphones will be placed on wing and fuselage and acoustic flight research will be performed to obtain near field noise data. A feasibility study by one or more aircraft manufacturers will be performed to investigate the various approaches to evaluate advanced full-scale turboprop engines either as a testbed engine or as a replacement of existing aircraft engines.

W79-70128

511-58-02

Lewis Research Center, Cleveland, Ohio

HELICOPTER TRANSMISSION SYSTEMS TECHNOLOGY

W. J. Anderson and E. V. Zaretsky 216-433-4000

(505-04-42, 506-16-22, 511-54-02)

The objectives of this work are to develop the technology required for the design of advanced transmission systems for helicopter applications, to extend bearing, gearing, lubrication and traction concepts to achieve lightweight, compact low-noise, long-life, low cost mechanical power transmission systems for advanced commercial helicopters, and to evaluate these concepts in component and transmission tests. A helicopter hybrid traction drive which has the potential of being more compact and more reliable while being less costly and quieter than conventional transmissions will be designed and tested. Advanced NASA bearing, gearing, seals and lubrication technology will be demonstrated on standard type transmission systems to evaluate improvements in life, load carrying capacity and survivability.

W79-70129

511-59-02

Lewis Research Center, Cleveland, Ohio

BROAD SPECIFICATION FUELS TECHNOLOGY

J. Grobman and R. Niedzwiecki 216-433-6229

(505-03-22, 511-55-02)

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

The objective of this effort is to demonstrate the technology required to utilize broad specification fuels in current and next generation commercial jet aircraft. The intention of the new start is to extend the current R&T base Fuels Research Program to an integrated component investigation in an engine verification test. The engine to be selected will be a suitable and available advanced high-bypassratio turbofan engine and will preferably incorporate the latest E to the 3rd power and clean combustor technology. The effort will be conducted through multiphase contracts using two parallel contractors throughout the length of the project. The technical conduct of this project effort will be similar to the approach used in the NASA Experimental Clean Combustor Program. The multiphase contract effort will consist of three consecutive phases which will systematically screen out the more promising combustor and fuel system concepts for using the defined broad specification fuel (Phase I), evolve these concepts into component hardware which is compatible with an existing engine (Phase II), and actual verification tests to document engine performance and durability (Phase III).

W79-70130 **512-51-04**
Hugh L. Dryden Flight Research Center, Edwards, Calif
DIGITAL FLY-BY-WIRE FLIGHT EXPERIMENT
C R Jarvis 805-258-3311
(505-07-34)

The overall objective of this effort is to provide the technology necessary for the implementation of advanced reliable digital fly-by-wire systems in future aircraft. The program is being carried out in accordance with the schedules and resources identified in the Digital Fly-by-Wire Experiment Project Plan Document. Currently the second phase of a two-phase program is underway in which a two-fail operational digital fly-by-wire primary flight control system is being flight tested in an F-8 research aircraft. Over fifty successful flights have been accomplished to date. Current activity is being directed toward evaluation of adaptive control laws and analytical redundancy management algorithms developed jointly with the LaRC Lightning susceptibility testing is also planned for FY-79 to determine optimum lightning hardening techniques for DFBW systems. Future tasks include flight evaluations of concepts (being developed in the R&T Base) addressing the use of resident backup software to compensate for generic software faults in multichannel control systems and the implementation of a dual-fail-operate flight control concept.

W79-70131 **512-52-01**
Ames Research Center, Moffett Field, Calif
GENERAL AVIATION ADVANCED AVIONICS SYSTEMS
B Y Creer 415-965-5435
(512-52-02 513-50-11)

The objective of this program is the design and demonstration of a totally integrated advanced low-cost avionics system to enhance the safety, reliability and utility of future general aviation aircraft. The approach is to synthesize various subsystem concepts and conduct supporting studies of the projected microelectronic and fluidic technology aircraft design and air traffic control environment of the 1980's, to formulate a system definition which can be scrutinized against requirements and cost-benefit criteria to formulate final specifications and designs. The system design will be verified in simulations and flight tests with active participation of the FAA and the aviation industry. This is a joint program between ARC and LaRC. The lead center is ARC who, in addition to subsystems development, is responsible for the overall final system design, fabrication, simulations and flight tests. LaRC is responsible for the development of fluidic and other avionics subsystems with emphasis directed towards the light aircraft end of the general aviation spectrum.

W79-70132 **512-52-03**
Langley Research Center, Hampton, Va
GENERAL AVIATION ADVANCED AVIONICS
H J E Reid Jr and J E Stitt 804-827-3551
(505-07-13, 505-07-33)

The objective of the work under this RTOP is the development of subsystem concepts, using fluidic and electronics technology which will enhance the safety and utility of general aviation light aircraft. The approach is to develop and test in simulation

and flight, navigation, control and display components instrumentation and subsystems. Potential reliability and low cost are stressed in this work. Control concepts for autopilot application, which are independent of aircraft primary control and with a reduced authority are examples. A fundamental thrust of this work is to develop autopilot concepts which eliminate expensive high-maintenance components such as gyroscopes. This is a joint program between ARC and LaRC. The lead center is ARC who, in addition to subsystems development, is responsible for the overall final system design, fabrication, simulations and flight tests. LaRC is responsible for the development of fluidic and other avionics subsystems with emphasis directed towards the light aircraft end of the general aviation spectrum.

W79-70133 **513-50-11**
Ames Research Center, Moffett Field, Calif
SYSTEM TECHNOLOGY STUDIES, SIMULATION METHODS FOR THE VALIDATION OF DIGITAL FLIGHT CONTROL SYSTEMS
H C Lessing and C N Burrows 415-965-5428

This RTOP consists of two elements: a joint NASA/FAA program entitled Simulation Methods for the Validation and Failure Effects Analysis of Digital Flight Control and Avionics Systems and a program for Feasibility and Validation of Low Cost MLS Avionics. The overall objective of the joint NASA/FAA program is to identify, evaluate, and improve simulation methods for validating digital avionics and flight control systems. Specific objectives are to evaluate, develop, and increase the confidence in reliability and failure effects prediction techniques; improve the government's understanding of the validation process and the effectiveness of various methods; and reduce the amount of flight time and cost required to certify digital avionics systems. The approach is to identify digital avionics validation problems and requirements, select, improve and evaluate reliability/failure effects prediction programs, review and assess methods of flight software validation and conduct simulations with redundant digital avionics systems to evaluate and improve validation methods. The objectives and approach of the second element, the program for Feasibility and Validation of Low Cost MLS Avionics, are to identify technology system requirements, and critical cost-benefit parameters associated with microwave landing system (MLS) avionics, demonstrate the feasibility of low cost MLS avionics by designing, fabricating and testing a MLS airborne receiver for general aviation and small community operations, and assess suitable cost/performance/technology tradeoffs.

W79-70134 **513-50-13**
Langley Research Center, Hampton, Va
CTOL SYSTEMS TECH STUDIES
Billy L. Dove and James E. Stitt 804-827-3681

Fault-tolerant integrated digital avionics systems will have need for more thorough laboratory analyses than previous generations of avionics to generate the understanding of a new technology, provide insight into complex redundancy management schemes, and create an experience data base upon which all future aircraft system designs may be based. A special analysis tool—the diagnostic emulator—is required for this analysis task but does not exist presently with the needed capabilities, such as the rapid redefinition of designs for making modifications and the controlled insertion of faults. A diagnostic emulator will be built for determining the performance, reliability and safety of fault tolerant systems. This effort is identified in the FAA-AIFS (Advance Integrated Flight System) Committee program plan and is partially funded by FAA.

W79-70135 **513-52-13**
Langley Research Center, Hampton, Va
TERMINAL CONFIGURED VEHICLE PROGRAM
J E Stitt and J P Reeder 804-827-3745
(505-07-31)

The Terminal Configured Vehicle (TCV) program is an advanced technology activity focused on Conventional-Takeoff-and-Landing (CTOL) transport aircraft that will be operating in reduced weather minima in the future high-density terminal areas equipped with new landing systems, navigational aids, and increased surveillance and automation under development by DOT/FAA. The broad

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objectives of the program are to provide improvements in the airborne systems (avionics and air vehicle) and operational flight procedures for reducing approach and landing accidents reducing weather minima increasing air traffic controller productivity and airport and airway capacity saving fuel by more efficient terminal area operations, and reducing community noise by operational procedures. This involves research analyses simulations and flight studies. A modified Boeing 737 airplane (Research Support Flight System RSFS) equipped with highly flexible display and control equipment made available by DOT/FAA will be used to study operations in simulated future terminal area environments.

W79-70136

513-54-11

Ames Research Center Moffett Field Calif

HELICOPTER AND ADVANCED ROTORCRAFT OPERATING SYSTEMS EXPERIMENTS

B Y Creer and G Xenakis 415-965-5430

(513-53-11 505-07-11 517-54-01)

The objective is to develop a data base for use in establishing navigation guidance and automatic control system concepts design criteria and operational procedures for helicopters and advanced rotorcraft. This technology base will aid the development of efficient and economical all-weather helicopter and advanced rotorcraft operations that will be compatible with future ATC concepts. The objective also includes a research and technology program to support military requirements for assuring helicopter and advanced rotorcraft operational capability into a wide variety of landing sites under reduced visibility conditions. The approach will utilize analytical studies piloted closed-loop simulations and flight experiments. Analytical studies will be carried out in-house and under contract. Piloted simulation studies and development and validation of the airborne computer software will be accomplished at Ames in the S-19 dual-purpose (UH-1H and XV-15) fixed-base simulator and in the CH-53/SH-3 fixed-base simulator. Flight tests will be conducted with the UH-1H SH-3 CH-53 and the XV-15 Tilt-Rotor research aircraft. The flight research systems include V/STOLAND in the UH-1H and XV-15 an airborne radar/data acquisition system in the SH-3 a digital research/data acquisition system in the CH-53 and the ring laser gyro tetrad system in the UH-1H. The flight research systems will be used to investigate alternate system configurations time constrained flight paths steep and helical approaches airborne radar approaches and advanced navigation guidance, display and automatic control system concepts.

W79-70137

513-54-13

Langley Research Center Hampton Va

ROTARY WING VTOL OPERATING SYSTEMS EXPERIMENTS

J F Garren, Jr and J E Stitt 804-827-3621

The program will encompass the investigation of operating systems and piloting techniques for operations from downtown vertiports under all-weather conditions. Terminal air traffic procedures airspace requirements, and avionics system requirements will be defined. The scope of the objective includes technical integration of advanced control and display concepts with advanced navigation and guidance systems coupled with development of suitable terminal-area operating procedures, to permit the routine utilization of trajectories optimized from the standpoint of noise airspace fuel and overall efficiency considerations. Flight vehicles and simulation facilities equipped with electronic display systems and advanced control concepts will be used to define the degree of automation required in the aircraft control system and in the guidance display and communication systems onboard the aircraft for VTOL terminal-area operations.

W79-70138

514-50-01

Ames Research Center, Moffett Field Calif

ADVANCED ROTORCRAFT CONCEPTUAL AND TECHNOLOGY ASSESSMENT STUDIES

J V Christensen and W J Snyder 415-965-6569

(791-40-31)

The objective of this effort is to investigate concepts in rotorcraft technology which offer unique performance and operational advantages for civil and military applications. Advanced

technology concepts for solution of rotorcraft problem areas (such as vibration noise safety, and gust response etc) will be evaluated in terms of vehicle configurations. The near-term activities will focus on technology assessments of promising concepts for improving existing and future classes of rotorcraft. The longer term investigations will emphasize the assessment of advanced concepts systems technology etc offering potential for new markets new classes of rotorcraft etc such as large multiple rotor systems and higher performance vehicles (heavy lift large transports quad rotor systems stored rotor x-rotor systems etc). These technology assessments will obtain assessment data to provide the basis of determining research directions and emphasis.

W79-70139

514-52-03

Langley Research Center Hampton Va

WAKE VORTEX ALLEVIATION ANALYSIS

A W Hall and R E Bower 804-827-3274

The objective of this effort is to reduce the hazard potential of wake vortices shed by transport aircraft through aerodynamic means without significant detrimental effects on aircraft performance. This objective will be met by developing experimental techniques and theoretical numerical methods to enhance the understanding of the fundamental flow mechanisms associated with the generation of multiple vortex wakes their interaction and turbulent decay. A detailed understanding of the relationship of aircraft span-load distribution and turbulence effects will be obtained.

W79-70140

514-52-04

Hugh L Dryden Flight Research Center Edwards Calif

WAKE VORTEX MINIMIZATION FLIGHT EXPERIMENTS

M R Barber 805-258-3311

This RTOP covers continuing DFRC activities related to full-scale flight-test evaluations of various aerodynamic wake vortex alleviation devices. These devices have been and/or are being developed in ground facility tests at ARC and LaRC. The approach taken is that of flying the devices on actual transport aircraft (eg 747 s, DC-10 s, L-1011 s etc). Comparisons of the vortex characteristics with and without the devices are made by probing the aircraft's wake with specially instrumented probe aircraft (eg DFRC's T-37 and the FAA's DC-9). To facilitate wake probing specialized vortex visualization systems are being used and developed.

W79-70141

514-55-03

Langley Research Center Hampton, Va

LAMINAR FLOW CONTROL TECHNOLOGY

R J Muraca and H T Wright 804-827-2045

The broad objective of this laminar flow control (LFC) element of the NASA aircraft energy efficiency (ACEE) program is to demonstrate that predicted reductions in fuel consumption are attainable for new-design commercial transports through the application of laminar flow control and to validate acceptable economics in the manufacture and safe commercial operation of LFC airplanes. The technology developed will be applicable to although insufficient for military transports. The LFC element of ACEE consists of three phases: (1) precursor activities and systems definition; (2) systems developed; and (3) flight validation. The Phase II activities which will be accomplished in fiscal years 1979 through 1982 are covered by this RTOP.

W79-70142

514-55-04

Hugh L Dryden Flight Research Center Edwards Calif

LAMINAR FLOW CONTROL FLIGHT RESEARCH

T G Ayers 805-258-3311

The overall objective of this RTOP is to improve the aerodynamic efficiency of cruise aircraft through viscous drag reduction by maintaining laminar flow over significant portions of an aircraft's lifting surfaces. The LFC research will determine the practical incremental reduction in drag achievable with distributed boundary layer suction. These drag reductions and subsequent energy efficiency will be evaluated in relation to the weight, complexity and power requirements of the suction system and the impact on aircraft design.

W79-70143**515-51-11**

Ames Research Center Moffett Field Calif
HUMAN FACTORS IN AVIATION SAFETY
 H P Klein C E Billings and J K Lauber 415-965-5094
 (505-09-31 505-08-21)

This research is designed to identify factors which contribute to or cause human error in the aviation system, and to explore methods to prevent human error accidents by eliminating human error or by minimizing the adverse impact of such errors when they occur. Descriptive and analytic studies of occurrences, incidents and accidents are used to determine system factors associated with human error. Full-mission simulation studies are performed to evaluate the effects of these factors on human performance. Laboratory studies are used whenever necessary to supplement the simulation experiments especially in those areas which involve human behavior in complex man-machine systems. Candidate solutions to problems identified are examined in full-mission simulations or in flight. The entire program is carried out in close collaboration with other government and industry groups.

W79-70144**515-50-01**

Ames Research Center Moffett Field Calif
SHORT-MEDIUM RANGE ADVANCED TRANSPORT AIRCRAFT TECHNOLOGY
 W H Deckert and L J Williams 415-965-5903
 (791-40-11)

The objective of this work is to help develop a sound technological base for future decisions relating to the design and development of short/mid-range commercial air transports. This objective will be achieved through selected experimental activities that will help to identify the critical relationships between aircraft technology, aircraft economics and environmental constraints. These activities include wind tunnel tests, ground based simulation and flight research. For FY-79 emphasis is being placed on technology that can be applied to small transport aircraft for commuter and local service airline usage. A project entitled Small Transport Aircraft Technology (STAT) has been formulated in FY-78 and it is planned to continue at least through FY-84. The project involves several divisions in the Aeronautics and Flight Systems Directorate in both experimental programs and analytical studies. Overall emphasis is on the near term application of technology that is now being developed in military programs (e.g., fly-by-wire materials and structural design) and related NASA programs such as the natural laminar flow and high speed turboprop programs. In FY-79 the program includes airfoil design and test, wing high lift device design and test, and engine-propeller/airframe integration.

W79-70145**515-50-23**

Langley Research Center Hampton Va
ADVANCED TRANSPORT AIRCRAFT TECHNOLOGY
 D W Conner and R E Bower 804-827-3838
 (791-40-13)

The objective will be to provide technology for advanced transport aircraft through (1) studies of all-new total aircraft configuration concepts, (2) studies of incorporating promising new subsystem concepts in advanced aircraft configurations, and (3) precursor studies to generate the technology identified as critical to advanced subsystems where such technology needs are not otherwise being addressed. These studies covering future needs for both passenger and cargo transports are aimed at improving aircraft economics, fuel use, noise, emissions and airport congestion. Subsystem areas involve advanced structures, advanced aerodynamics and advanced propulsion systems including use of alternate fuels. The approach will be to utilize both in-house and contractual efforts.

W79-70146**515-53-01**

Ames Research Center Moffett Field Calif
AIRCRAFT ENERGY EFFICIENT PROJECT (ACEE) ASSISTANCE AND TESTING
 Richard H Petersen and J W Davis 415-965-5851

Technical assistance, consultative services and support through the use of NASA-Ames facilities will be provided to NASA Langley for the aircraft energy efficient project (ACEE). Support tests

will be primarily conducted in the Ames 11- by 11-foot transonic and 12-foot pressure wind tunnels. Specific ACEE programs for which support is planned during FY-1979 are energy efficient transport (EET) and laminar flow control (LFC).

W79-70147**515-53-03**

Langley Research Center Hampton Va
ENERGY EFFICIENT TRANSPORT
 W J Alford and H T Wright 804-827-2396

The objective of this RTOP is to expedite industry acceptance and application of advanced aerodynamics and active controls technology in an integrated manner to achieve significant energy, economic, and aircraft sales benefits. In-house and industry experimental and analytical efforts will be continued in the areas of supercritical aerodynamics, high-lift systems, propulsion/airframe integration and wing/empennage/flight control systems. The industry activities are oriented both at near-term derivative aircraft product improvements and farther-term new aircraft development. The in-house activities are generally focused on the longer-term new generation aircraft technologies that have higher potential benefits with commensurately higher risks. Emphasis will be placed on technologies having the greatest benefits to long-haul subsonic derivatives and new transport aircraft.

W79-70148**515-53-04**

Hugh L Dryden Flight Research Center Edwards Calif
ENERGY EFFICIENT TRANSPORT FLIGHT RESEARCH
 M R Barber 805-258-3311
 (515-53-03, 505-02-24)

This RTOP covers three separate elements as follows: (1) flight tests of Whitcomb Winglets on a KC-135 aircraft, (2) development of system integration technique resulting in the design of an active control system that will provide gust alleviation, maneuver load control and flutter suppression for the Aeroelastic Research Wing Vehicle (ARW-2) and (3) determination of the extent of natural laminar flow that can be achieved in a flight environment over the upper surface of a subsonic cruise airfoil.

W79-70149**515-58-01**

Ames Research Center Moffett Field, Calif
QUIET PROPULSIVE-LIFT TECHNOLOGY EXPERIMENTS
 L Roberts, W H Deckert, and C T Snyder 415-965-5486
 (515-58-02, 515-58-03, 515-58-04, 769-02-01)

This program will furnish the U.S. Government and aircraft industry with flight data to develop certification criteria and design methods for propulsive-lift short-haul transports. It will take maximum advantage of civil-military STOL/RTOL transport commonality. The program will develop advanced technology for propulsive-lift short-haul transport applications which will benefit civil derivatives of the AMST, future-generation military STOL transports, and future civil propulsive-lift R/STOL transports. Broad flight experiment areas involve (1) correlation of methods for predicting vehicle characteristics with flight-measured characteristics, (2) studies of certification criteria for quiet propulsive-lift transports and (3) studies of flight control systems, cockpit displays and navigation system requirements for STOL/RTOL terminal area flight operations. These experiments will be conducted through a complementary flight test program using the QSRA, Augmentor Wing Jet NASA's Quiet Short-Haul Research Aircraft (QSRA) and Augmentor Wing Jet STOL Research Aircraft and the AMST aircraft. A small part of the QPLT effort includes ground-based technological efforts to support and/or complement flight activities. Most of the flight experiments will be conducted on the QSRA, with the approach being to utilize the QSRA as a national propulsive-lift flight facility.

W79-70150**515-58-02**

Lewis Research Center Cleveland, Ohio
QPLT EXPERIMENTS
 M F Valerino 216-433-4000

This RTOP provides for Lewis Research Center participation in the NASA quiet propulsive-lift technology (QPLT) experiments program which includes flight research experiments in the areas of propulsion system performance and noise to be conducted using the NASA Quiet Short-haul Research Aircraft (QSRA).

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Emphasis will be on propulsion acoustics including measurements of effects of forward velocity and of the QSRA OTW engine configuration of the farfield noise characteristics. The flight measurements will be made through a cooperative effort with AMES Research Center

W79-70151

517-53-11

Ames Research Center Moffett Field Calif

FUEL TANK SEALANTS

R W Rosser 415-965-5244

Fuel tank sealants will be developed which offer improved service life under conditions encountered in advanced supersonic aircraft when compared to state-of-the-art materials. The specific objective is to obtain pilot plant quantities of characterized and useful sealant materials for flight test evaluation. The goal will be accomplished through a series of steps as follows: produce a fluoroether dinitrile prepolymer in 10-20 lb range; chain extend the prepolymer into a heterocyclic-fluoroether gum stock and develop a process for its manufacture; select a suitable and adequate crosslinking system for the gum stock; compound the gum stock into a useful material which will afford mechanical properties suited to a fillet seal application; and apply the fluoroether sealant material to flight simulation studies and develop a performance specification from actual flight tests.

W79-70152

517-53-13

Langley Research Center Hampton, Va

SCR MATERIALS AND STRUCTURES

E E Mathauser 804-827-2036

The objective of this program is to establish a supersonic materials and structures technology base by developing capability in structural concepts and design loads and aeroelasticity and materials fatigue and manufacturing methods. The development of capability for computer-aided analysis and synthesis will be undertaken, and validation of the computer design tools and methodology by applications to supersonic cruise configurations will be made. Advanced transonic/supersonic aeroelastic load prediction methods will be developed. Development and experimental validation of active load control landing gear design methodology will be made and a description of high altitude atmospheric turbulence environment obtained. Included also is work on strength, fatigue and fracture to establish structural integrity of materials and representative components, application of advanced resins and adhesives and performance of time-temperature-stress studies of composites, and development of fabrication methods for composites and titanium with emphasis on superplastic forming. The technology from this program will permit major reductions in structural weight, improved structural integrity, and lower cost for supersonic cruise aircraft.

W79-70153

517-53-14

Hugh L. Dryden Flight Research Center Edwards Calif

SCR MATERIALS AND STRUCTURES FLIGHT RESEARCH

B M Kock 805-258-3311

The objective of this activity is to advance the technology related to structural materials suitable for high-speed cruise and/or high-temperature applications. Airframe component parts will be manufactured, laboratory tested and installed on airplanes for flight validation. Components will be manufactured of both metallic and composite materials.

W79-70154

517-53-43

Langley Research Center Hampton, Va

SCR - AERODYNAMIC PERFORMANCE TECHNOLOGY

C Driver and R E Bower 804-827-4576

The objectives of this program are to advance the state of the art in supersonic aerodynamics through the generation of comprehensive data bases on promising advanced supersonic configuration concepts, through the development of better tools for aerodynamic design and analysis and through continued research on important sonic boom phenomena. Aerodynamic advances resulting from this program will be studied in concert with technology advances in the related disciplinary areas of propulsion, structures and materials, and controls through detailed technology integration studies of representative supersonic cruise aircraft concepts. Throughout the studies, major consideration

will be given to the factors which influence and improve the noise pollution, energy efficiency and overall performance of potential future supersonic cruise aircraft. Objectives of the program will be accomplished through construction and tests of models of industry and NASA supersonic cruise concepts through support of in-house industry and university approaches to the development of critical design and analysis methods and through in-house and university studies of sonic boom. In-house NASA and industry technology integration teams will assess the applicability and potential payoff of advanced supersonic technology to an adequate depth to provide reliable direction to the future research effort. Where possible the basic researcher and industry teams will work closely together on the difficult technical problems of supersonic flight.

W79-70155

517-53-62

Lewis Research Center, Cleveland Ohio

PROPULSION SYSTEM/AIRFRAME INTEGRATION TECHNOLOGY

D N Bowditch 216-433-4000

Inlet-engine airframe integration design methods will be generated which will allow the optimization of the SCR inlet/VCE engine propulsion systems and their mutual interactions with the SCR airframes. Inlet-type-variable engine cycle matching and optimization studies will be conducted both in-house and on contract to the SCR & VCE contractors. Subscale experimental inlet data will be obtained for candidate inlet types over the full aircraft speed range from brake release to supersonic cruise. Inlet/wing integration data will also be obtained with these models. The results of the studies and subscale tests will be used to guide the design of a full-scale inlet to match the testbed VCE. The full-scale inlet/engine system (including stability and control systems) will be tested over the full speed range.

W79-70156

517-53-63

Langley Research Center, Hampton, Va

SCR PROPULSION SYSTEM/AIRFRAME INTERACTIONS

C Driver and R E Bower 804-827-4576

Model variable cycle engines have been defined in previous SCR supported studies for possible application to commercial supersonic transport aircraft. The extended flow variability made possible by such engines requires greater versatility of the inlet and exhaust nozzle than for conventional engines. The range of flexibility of all propulsion system components needs to be defined such as to maximize internal thrust and minimize nacelle and interference drag throughout the flight regime. As part of the SCR program a study of the integration problem of the propulsion system will be made to identify technology requirements and advance the various component disciplines to the point where intelligent choices can be made. The effort involves in-house and contracted research on isolated inlets and nozzles as well as the mutual installation effects on complete airplane configurations. This effort will be a cooperative and coordinated endeavor of both Langley and Lewis Research Centers.

W79-70157

518-51-01

Ames Research Center Moffett Field Calif

ROTOR SYSTEM TECHNOLOGY INTEGRATION VALIDATION

Samuel White, Jr 415-965-6566

(505-10-21, 514-50-01, 744-01-01)

The objective of this systems technology program is to provide and validate integrated rotor system technology required to substantially improve the performance utility, efficiency, dynamics, noise, maintainability and ownership cost of civil and military rotorcraft through system design studies, focused small- and large-scale tests in ground-based facilities and selected flight tests of current state-of-the-art rotors and advanced concept rotor systems. The goals of this program are to advance the aerodynamics and structural dynamics technology of rotor blades to increase performance and efficiency, and to reduce noise, vibration, weight/cost, and control system requirements. Utilize active rotor control technology to improve rotorcraft gust response and flight control/stability characteristics, expand the ground-based facility data base on rotors, the flight data base on existing production rotor blades and the technology for composite rotor

hub and control systems This RTOP also covers the remainder of the tasks involved in the transfer of helicopter research from Langley to Ames This includes the transfer from Langley to Ames early in FY 1979 of the second Rotor Systems Research Aircraft (RSRA) and the CH-47 with the equipment as specified in the transfer plan completion by FY 1982 of a coordinated series of systems design studies, wind-tunnel and simulation tests to define the first advanced concepts to be acquired for flight validation on RSRA and XV-15, and completion in FY 1983 of comprehensive flight investigations of the RSRA with the delivered S-61 rotors

Aeronautics Experimental Programs

W79-70158

Lewis Research Center, Cleveland Ohio
ENERGY EFFICIENT ENGINE TECHNOLOGY
 Neal T Saunders 216-433-4000
 (511-54-01, 510-53-01 505-04-02)

The objective of this project is to develop and demonstrate technology for a next generation turbofan engine having 10-15% lower specific fuel consumption at least 5% reduction in direct operating cost and reduced emissions and noise levels as compared to current high-bypass turbofan aircraft engines Initial program efforts included preliminary engine design and integration studies through contracts with two aircraft engine manufacturers On the basis of these studies and associated airframe and airline evaluations engine cycles and configurations that best meet project goals were identified The major part of the project was then initiated with award of parallel component development and integration contracts to the same two engine companies These latter contracts emphasize the advancements in component and systems technologies required for possible future commercial development of more energy-efficient engines Advanced engine components are being designed and developed and performance will be verified by rig tests The high-spool core system will be designed, fabricated, and tested to evaluate its performance characteristics and to further refine the design of the components The low-spool assembly will be integrated with the core to evaluate two-spool integrated performance and mechanical systems performance

W79-70159

Langley Research Center Hampton Va
HIGHLY MANEUVERING AIRCRAFT TECHNOLOGY
 W P Henderson and R E Bower 804-827-2676

The objective of this research is to promote and stimulate the application of new and innovative technologies in a multidisciplinary manner so as to exploit to the highest practical degree, the synergistic potential of the new technologies for the design of future fighter aircraft A vital part of this research will be to support the ongoing NASA HiMAT programs The study of the highly integrated canard-wing concept will be pursued with the objectives of defining the stability and control characteristics at high angles of attack Promising ideas for obtaining high aerodynamic performance for maneuvering fighter aircraft will be examined analytically and experimentally with primary emphasis on investigating their aerodynamic performance, propulsion stability and control characteristics Representative promising concepts which may be incorporated into the basic canard-wing concept include a high aspect ratio, two-dimensional, vectored nozzles and anti-spin devices The experimental studies will be conducted in the Langley 16-foot full scale and spin tunnels, and simulator studies in the Differential Maneuvering Simulator (DMS)

W79-70160

Hugh L Dryden Flight Research Center Edwards Calif
HIGHLY MANEUVERABLE AIRCRAFT TECHNOLOGY FLIGHT RESEARCH
 P C Loschke 805-258-3311

This RTOP covers the flight-test phase of a program to provide improved technology for the design of highly maneuverable

716-01-02

aircraft Present design restraints will be relaxed to permit complete freedom in the application of state-of-the-art systems such as integrated, computerized controls composite structures propulsion augmentation of lift and control, and the like in order to achieve maximum benefits from synergistic effects The complex and innovative configurations such as the HiMAT design can only be validated and the high risk technology matured for manned vehicle application through extensive testing of the complete configuration in the real and dynamic environment of flight The high level of technical risk inherent in the HiMAT designs precludes their application to manned prototype vehicles because of pilot safety concerns and the enormous cost of these aircraft This program will use large scale free-flying models controlled by remote piloting techniques to acquire actual flight-test data at a minimum cost The facility for these tests exists at DFRC and is currently being extended to handle supersonic vehicles

W79-70161

Langley Research Center, Hampton, Va
COMPOSITE COMPONENTS TECHNOLOGY
 L F Vosteen and H T Wright 804-827-3081
 (505-01-33, 734-01-03 734-01-23)

The objective of the composite components program is to accelerate the introduction of composite structures in commercial transport aircraft This will be accomplished through the progressive introduction of selected components in current aircraft production Design technology for typical secondary structure components and medium sized primary structures will be developed Manufacturing processes suitable for production will be developed and verified through comprehensive ground testing

W79-70162

Langley Research Center, Hampton, Va
BEHAVIOR OF ADVANCED COMPOSITES IN AIRCRAFT ACCIDENTS
 R J Huston and R R Heldenfels 804-827-2851
 (505-01-33, 505-02-13, 734-01-03)

The objective of this program is to determine the risks associated with the accidental release and dissemination into the atmosphere of carbon/graphite fibers from composite materials upon the crash and burning of civilian aircraft The amount of single fibers released from various types of aircraft parts will be determined in order to guide the design of future airframe components Studies of fire plumes will be conducted so that an algorithm will be available to model the wide range of possible aircraft fire situations The lifetime and degradation of deposited graphite fibers will be studied to establish the likelihood and extent of redissemination of fibers from various natural environments Experimental studies of various fiber transfer factors such as fiber systems building containment and equipment packaging will be studied experimentally to establish the effectiveness of such methods in limiting fiber access to sensitive equipment components The damage susceptibility of many types of electrical/electronic equipment to graphite fiber exposure will be studied experimentally and analytically An advanced risk assessment methodology will be developed and tested using the constituent source dissemination transfer, and vulnerability factors Outdoor testing involving the actual exposure of a number of types of susceptible equipment to graphite fibers released from a simulated aircraft fire will then be conducted to verify the analytical risk assessment

W79-70163

Lewis Research Center Cleveland, Ohio
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE
 Carl C Czepluch 216-433-4000
 (505-05-32)

The objective of this program is to design build and test experimental engines to consolidate and demonstrate the technology needed for very quiet, clean and efficient propulsion systems for economically viable and environmentally acceptable powered-lift short-haul aircraft Two experimental propulsion systems, engines and nacelles, one for under-the-wing and one for over-the-wing installations will be designed, built, tested and delivered to the Lewis Research Center Acoustic and aerodynamic performance testing in wing-flap system installations will be

734-01-13

734-01-23

738-01-02

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conducted to verify system characteristics and achievement of program goals

W79-70164

744-01-01

Ames Research Center, Moffett Field, Calif

TILT ROTOR RESEARCH AIRCRAFT

W H Deckert and James H. Brown 415-965-5442

The objective is to design, develop and conduct flight research in two XV-15 Tilt Rotor Research Aircraft to prove the tilt rotor concept for potential military and civil missions. The following proof-of-concept tasks utilizing the two XV-15 aircraft will be performed: (1) investigate through flight research the viability of the tilt rotor concept, particularly by verifying rotor/pylon/wing dynamic stability and aircraft performance over the entire operational envelope; (2) experimentally establish a safe operating envelope and initially assess the handling qualities of the XV-15 Tilt Rotor Research Aircraft for use in follow-on advanced flight research; (3) investigate tilt rotor aircraft gust sensitivity; (4) investigate the effect of tilt rotor disc loading and tip speed on downwash and noise; and (5) initiate effort to support civil and military mission suitability testing.

W79-70165

744-01-04

Hugh L. Dryden Flight Research Center, Edwards, Calif

FLIGHT TEST OF THE TILT ROTOR RESEARCH AIRCRAFT

R E Klein 805-258-3311

The DFRC's support to the Ames Research Center for the flight test of the Tilt Rotor Research Aircraft program is outlined. DFRC would support a joint flight-test team with Flight Operations, Aeronautics and Data Systems Directorates expertise as needed to successfully complete the flight-test program.

W79-70166

769-02-01

Ames Research Center, Moffett Field, Calif

QUIET SHORT-HAUL RESEARCH AIRCRAFT (QSRA)

Wallace H. Deckert, and John A. Cochrane 415-965-5662 (516-58-01)

This RTOP covers the design, fabrication and test of a quiet propulsive-lift research aircraft which will permit flight research beyond the flight regime of the AMST and the Augmented Jet Flap STOL Research Aircraft. The project will include low cost modification of an existing C-8A aircraft into an advanced hybrid/upper surface blowing propulsive-lift configuration with updated Lycoming YF-102 engines and A-9A accessories. Key design simplification guidelines are use of fixed landing gear, 160 knot maximum speed, +2g, -0.5g limit load, and design life of 500 flight hours. The flight research will advance technology for future development of reliable quiet and economical propulsive lift transports. The test program will provide information on flight characteristics and powered lift performance and information on design noise, operational features and propulsive-lift system economics as needed by designers, regulatory agencies and operators. The research aircraft design goals include capability of usable approach lift coefficients greater than 4.6, 90 EPNdB noise footprint smaller than one square mile, and roll control power greater than 0.8 rad/sq sec. The flight research program covered under this RTOP consists of a brief contractor conducted flight test program to assure airworthiness and a NASA flight test program that includes definition of the research capability of the aircraft and interagency pilot evaluation. A related RTOP includes a follow-on flight experiments program to obtain data for establishing design and certification criteria for quiet propulsive-lift aircraft.

W79-70167

769-02-02

Lewis Research Center, Cleveland, Ohio

QUIET PROPULSIVE-LIFT TECHNOLOGY: QSRA PROPULSION SUPPORT

M F Valerino 216-433-4000

LeRC is supporting ARC relative to the propulsion systems of the QSRA aircraft. This support has included the study of engines potentially suitable for the research aircraft in achieving its powered lift, noise, and near terminal performance goals. Based upon the results of the engine and the aircraft studies, the hybrid upper surface blowing system was selected for

incorporation into the Buffalo aircraft and the Lycoming YF-102 series turbofan engine was selected as most suited for the application. The propulsion support has included the determination of the updating required to government-owned YF-102 engines to meet the needs of the research aircraft, the use of one YF-102 engine for supporting ground-test studies by LeRC, the provision of a nonoperational mockup engine to the airframe contractor, and the provision of five updated/refurbished/acceptance-tested engines for the flight aircraft, including one spare flight engine. The continuing support effort will include: (1) provision of engine parts for the QSRA Flight Test Program; (2) review of propulsion system performance and acoustic results obtained during the flight acceptance tests; and (3) participation as required in all other propulsion aspects of the aircraft program.

Space Research and Technology Base

W79-70168

506-15-21

Ames Research Center, Moffett Field, Calif

ADVANCED ELECTRONICS AND MATERIALS RESEARCH

E E Whiting 415-965-5690

The objective is to investigate the atomistic structure and physical properties of epitaxially absorbed layers of metallic and semiconducting materials on well defined single crystal substrates, and to study the change of adsorption properties when co-adsorbing active gases. The critical material parameters that control the achievement of very low work function surfaces by adsorption will be defined. Performance testing and initial application studies of the Mark II Auger-microprobe (300 angstroms spot size) will be continued. Another objective is to develop reliable methods for computing rates of chemical reactions with and without the presence of intense laser fields, and to continually advance the state of the art of computing wave functions for small molecules and atomic clusters. The results of the reaction rate calculations will be of great utility in developing a basic understanding of how laser beams can drastically affect the rates and the outcome of chemical reactions. The advanced wave function calculations will continue to be of great utility in the areas of entry physics, stratospheric pollution studies, catalysis, and materials science.

W79-70169

506-15-23

Langley Research Center, Hampton, Va

ADVANCED ELECTRONICS AND MATERIAL SCIENCE

E J Conway 804-827-3781

This basic research program is composed of two major thrusts: (1) R&D on III-V semiconducting compounds such as GaAs and (2) computational chemistry of solids surfaces, and gaseous reactions. The technology for high efficiency (18 to 20% in space) GaAs/GaAlAs solar cells with high temperature (200-300 C) operating capability and long life in a radiation environment is being developed for potential space applications such as solar electric propulsion, a space-power station, or near-sun missions. Currently this program emphasizes radiation effects on materials and cells, and also high temperature long-term effects on contacts, materials and cell parameters. A new effort seeks to develop high-speed materials devices, and circuit technology for spacecraft advanced data processing systems having greatly increased data processing rate and fewer circuit elements. Quantum theoretical techniques are developed and used to study covalently bonded solids (e.g. diamond) and a variety of gaseous molecules. By developing a method for computing the energy and structure of solids and surfaces, general chemical trends are obtained. Computational chemistry on atmospheric gases investigates rapid molecular reactions of trace reactive species, such as NO₃. This approach avoids the experimental difficulties associated with low concentrations and side reactions of short lived intermediate species by fundamental computations of reactions and chemical and spectroscopic properties.

W79-70170

506-15-25

Jet Propulsion Lab., Calif Inst. of Tech., Pasadena

PROPERTIES OF MATERIALS FOR ELECTRONIC APPLICATIONS

G W Lewicki 213-354-4530

This program pursues basic investigations into new technologies needed to meet NASA's requirements for electronics. Investigations are directed at thin metal-oxide-silicon (MOS) structures, advanced GaAs solar cells, advanced cryogenic infrared detectors, superconducting digital microcircuits, and high temperature superconductivity. Thin MOS (metal-oxide-silicon) structures with oxide thicknesses of 100 Å or less are being investigated in order to (1) solve basic problems at the Si/SiO₂ interface which are crucial to the emerging VLSI (very-large-scale integration) technology and (2) enable the successful development of detectors for 2000 GHz applications. The GaAs Solar Cell Task is aimed at new methods of achieving low-cost, high-efficiency, radiation-resistant gallium arsenide solar cells. Variations of Schottky barrier and homojunction structures are to be developed using chemical vapor deposition growth techniques which can give more flexibility than liquid phase growth and which allows for large area devices and eventual high-volume production. Studies are being directed at developing improved very-far IR and mm-wave detectors based on superconducting and semiconducting phenomena effective at temperatures below 4 K. Feasibility studies of arrays of these detectors for imaging purposes are also being undertaken. Superconducting microcircuits suitable for detector output processing, high-speed computers, and ultra-sensitive gravitational wave detectors are also being developed. The feasibility of synthesizing a superconductor with a high transition temperature, e.g., T_{sub c} approximately 100 K or higher, is being investigated. This effort will facilitate future developments in space and energy technologies where superconductivity plays a fundamental role. The approach involves the study of quasi-one-dimensional metals (which represent the most promising system for achieving high transition temperature).

W79-70171

506-15-33

Langley Research Center, Hampton, Va.
ELECTRONIC CRYSTALS, GROWTH AND PERFECTION
 R K Crouch and J E Stitt 804-827-3661

The objective is to develop techniques to grow bulk compound semiconductor single crystals that are required for future infrared detector and electronic device development. Analytical studies and laboratory investigations will be conducted to better define the causes of crystalline defects such as voids, dislocations, grain boundaries, and inhomogeneities, in these materials. To eliminate the effects of thermal convection which is often thought to be the cause of many crystalline defects, emphasis will be placed on growth techniques in the space environment.

W79-70172

506-16-11

Ames Research Center, Moffett Field, Calif.
SURFACE PHYSICS AND COMPUTATIONAL CHEMISTRY
 E E Whiting 415-965-5690

The purpose of this research is to expand the understanding of metal interface properties by probing their structure on an atomistic scale and to improve the knowledge of surface/environment interactions (corrosion) by studying gaseous surface reactions and their relationship to microscopic material properties. Well defined metal clusters will be used to simulate preferential surface interactions which also can be correlated with basic catalytic processes. New experimental studies are initiated which are designed to test the feasibility of mapping hydrogen concentrations on metal surfaces. Another objective is to use efficient computer codes previously developed at Ames under this RTOP to calculate wave functions and thereby many basic properties of small atomic clusters. The existing codes will continually be upgraded for use on the CDC 7600 and other super computers to enable more precise results and the consideration of larger systems. Emphasis will be placed on studies of chemisorption, catalytic particles, and modeling of hydrogen embrittlement. In the latter two cases the material properties will be predicted by extrapolating the results obtained from the wave function calculations on smaller clusters.

W79-70173

506-16-12

Lewis Research Center, Cleveland, Ohio
PHYSICS AND CHEMISTRY OF SOLIDS

R A Lad 216-433-4000

The objective of the basic research herein is to increase the base of understanding of the relationships between the electronic, atomic, molecular and microscopic structures of solids and their mechanical structural and chemical properties. The focus is mainly on problems associated with the strength and impact behavior of metal matrix composites, the high temperature corrosion processes in gas turbine engines and battery materials problems in the Ag-Zn battery. The emphasis in composites is (1) on factors that limit the strength of fibers and on methods for increasing strengths and impact resistance, (2) on determining the fundamental mechanisms that are operating in the composite during impact failure and (3) on the properties of the fiber-matrix interface that play a role in limiting strength and fatigue resistance. The high-temperature corrosion studies center on (1) measurement and identification of the role of the chemical species involved in corrosive combustion systems, (2) the establishment of the thermodynamics that pertain, (3) characterization of the roles of elements present in the superalloys and corrosive gases and (4) measurement of parameters required to support a Na₂SO₄ deposition theory. The battery materials research is designed to (1) ascertain the relative importance of convection and diffusion in the cell, (2) determine the conditions under which pulse charging is beneficial, and (3) develop new polymers for separator application.

W79-70174

506-16-22

Lewis Research Center, Cleveland, Ohio
ADVANCED MATERIALS, MANUFACTURING, AND LUBRICATION PROCESSES
 W D Klopp and W J Anderson 216-433-4000
 (511-54-01, 511-58-01 506-23-40)

The objectives of this program are to characterize the suitability of present materials, develop improved materials and manufacturing processes, develop improved heat pipes and better understand the friction, wear, and adhesion behavior of materials for advanced space systems, such as power generation, propulsion, and communications systems. Materials and manufacturing studies include space environment effects on mechanical properties of superalloys and improvement of alumina/aluminum and boron/aluminum composites. Heat pipe studies include identification of improved heat pipe materials, working fluids, designs, and processing methods for efficient, durable, and economical heat pipes over a wide temperature range. Lubrication studies are directed toward advancement of technology of aerospace devices by application of improved materials and designs, utilization of advances in aerospace materials, lubricants and lubrication methods for the general benefit of mankind, and pursuit of solutions for anticipated materials and lubrication problems in aerospace vehicle mechanical components.

W79-70175

506-16-23

Langley Research Center, Hampton, Va.
MATERIALS FOR ADVANCED SPACE SYSTEMS
 R T Swann and R R Heldenfels 804-827-2042
 (524-71-03 517-53-13)

The objectives of this research are to determine the durability of resin matrix composites in the space environment and to develop advanced materials such as metal matrix composites for future transportation systems and space structures. To assess the space durability of composites, detailed effects on materials of various types and levels of radiation will be determined and suitable methods for simulating the space environment will be developed. Theoretical models which predict the effects of space environmental exposure on structural composites will be developed and verified by comparison with experimental data. Materials which have good long-term resistance to the space environment will be identified. For higher temperature applications, metal matrix composites such as silicon carbide/Ti, B/Al and silicon carbide/aluminum, as well as other advanced structural materials, will be developed and subjected to thermal, environmental and mechanical cycles. Residual mechanical properties will be evaluated, and degradation of these properties will be correlated with microstructural and physical changes. Analyses of diffusion, phase change, and chemical reactions will be developed, and these analyses will be applied to predict microstructural changes.

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Atomic models will be developed of point and extended defects and their interactions

W79-70176

506-16-27

Lyndon B Johnson Space Center, Houston Tex
REFINING OF NONTERRESTRIAL MATERIALS
R J Williams 713-483-5280

The primary objective of this RTOP is to study and quantify processes by which metals, oxygen and other useful products might be obtained from nonterrestrial oxides and silicates by studying theoretically and experimentally the physical chemistry of such processes. The work will use theoretical and experimental techniques to obtain details and to quantify refining processes. The emphasis will be on processes using electrical, thermal, or physical means for refining rather than chemical techniques. The work will involve in-house research studies emphasizing the electrolysis of refining gases using solid ceramic electrolytes and contracted research and study on electrical, thermal, or physical refining techniques.

W79-70177

506-16-41

Ames Research Center, Moffett Field, Calif
TPS MATERIALS AND SYSTEMS EVALUATION
H K Larson 415-965-5369
(506-26-21)

The objective is to provide thermal protection systems concepts and materials for heat shields to protect earth and planetary entry vehicles and planetary probes during atmospheric entry. The specific objectives are to (1) develop improved minimum weight TPS to enhance the space shuttle and enable fully reusable advanced space transportation systems development (2) develop planetary probe heat shield materials and determine methods to minimize heat shield weights, (3) develop concepts and heat shield materials for safe earth entry of radioactive power sources and to support DOD requirements. The system requirements for each end use are defined. Thermal protection materials parameters are determined that meet these requirements. Materials are either selected from the extensive technology in existence or new materials with optimized properties are developed. Candidate thermal protection concepts and materials are subjected to systematic analysis and testing to qualify them for the defined end use. Extensive unique Ames arc plasma test facilities, developed for space shuttle and planetary entry probes, are used in the experimental evaluations. Analytical studies are performed utilizing unique environmental computer codes developed by ARC that include detailed models of both the aerothermal environment and material response to obtain in-depth understanding of the material characteristics. Detailed temperature dependent radiation properties are computed for gaseous species required for thermal response analysis. Materials are often developed as a result of these studies to meet the ever more stringent requirements for atmospheric entry thermal protection.

W79-70178

506-16-43

Langley Research Center, Hampton Va
TPS MATERIALS FOR SPACE TRANSPORTATION SYSTEMS
R T Swann and R R Heldenfels 804-827-2969

The objectives of this RTOP are to provide heat shield testing to support the space shuttle program and to develop improved thermal protection materials and systems for advanced space transportation systems. Available ARC-tunnel and other facilities will be used as required to validate the space shuttle TPS. If problems are discovered in the course of this testing, in-house programs will be undertaken to find solutions. Environmental exposure testing of RSI will continue. For advanced vehicles, new materials and materials configurations will be developed with emphasis on metallic materials. High temperature creep will be studied, data will be generated on various alloys and a design methodology will be developed. Thermomechanical processing techniques which improve creep resistance and other properties of materials will be evaluated. The possibility of developing a high performance carbon-carbon heat shield material will be explored.

W79-70179

506-17-13

Langley Research Center Hampton Va
ADVANCED SPACE STRUCTURES
A Guastaferrro and H T Wright 804-827-3265
(524-70-03, 524-72-03)

Research and technology will be conducted on structural concepts and closely related areas that have been identified as key technology drivers in the design and development of future large area space systems. Because these systems will be carried into orbit on shuttle flights the concepts developed under this effort will consider materials erection or deployment schemes and packaging techniques that are compatible with the shuttle. New concepts along with the most promising existing concepts, which are in varying stages of development will be identified, developed, and verified through small scale ground tests. Erectable and deployable techniques for constructing platforms, reflectors, and long booms in space will be developed. Research will be conducted in many subsystem areas such as lightweight structural elements and joints, assembly procedures, active shape control techniques, surface accuracy measurement systems and dynamics of large structures. Graphite thermoset/thermoplastic composite materials will be examined and utilized where possible to achieve the stiffness, thermal control and minimum weight characteristics required for the structures. Laboratory tests will be conducted on these materials to evaluate adverse effects of environmental conditions, such as radiation exposure and lifetime prediction techniques will be developed.

W79-70180

506-17-23

Langley Research Center Hampton, Va
SPACE STRUCTURAL DESIGN METHODS
Harvey G McComb Jr and R R Heldenfels 804-827-3121
(505-02-33, 517-53-13)

Advanced structural analysis and design methods will be provided to predict accurately and economically the performance and durability of future space systems. Theoretical analysis and design efforts include research on new equations to represent structural behavior and rapid, effective solution techniques to make complex analysis and design calculations feasible. The effort includes selected computer code development to provide practical tools and selected structural experiments to evaluate the accuracy of advanced methods. Current emphases are on efficient analysis and design procedures for structures exposed to significant thermal as well as mechanical loads. Basic advancements in nonlinear structural analysis procedures and methods to predict fatigue life of composite structures. Methods for including effects of damage on strength of composite structures and design techniques to increase residual strength of damaged composite structures will also be studied.

W79-70181

506-17-33

Langley Research Center, Hampton, Va
SPACE VEHICLE DYNAMICS
M F Card and R R Heldenfels 804-827-3054
(506-17-13, 524-72-03)

The objective of this effort is to develop and validate advanced analysis and test methods for the prediction of dynamic and acoustic response of space transportation systems and payloads. A major part of the effort is to establish new analysis and test techniques for dynamic response which will permit rapid, accurate prediction of the response of new candidate payloads from knowledge obtained on early launch vehicle flights. In current studies, refined methods of vehicle-payload coupling will be investigated, as well as advanced methods of measuring and reducing in-flight dynamic data on a candidate shuttle payload. Research will also be conducted on the dynamic response of very large, flexible structures with distributed control force loadings and deployment motions. The effort also includes studies of the control and relief of dynamic loads associated with space vehicle performance and the thermal acoustic response of launch vehicle thermal protection systems.

W79-70182

506-17-35

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
SPACE VEHICLE DYNAMICS METHODOLOGY
J A Garba 213-354-6796

The principal objective of this five-year effort is to perform research and advanced development in dynamics criteria design, analysis, and testing to develop and update analysis and test methods. Basic research will be performed in structural dynamics related to future problems such as large complex nonlinear space structures. These methods will be used for the prediction and verification of structural response and stability in support of advanced design optimization and qualification of space transportation systems and payloads. The activities will be coordinated with NASA headquarters, other NASA centers, and the Dynamic, Acoustic and Thermal Environment (DATE) Working Group chaired by GSFC. The task will utilize existing data from flight programs (Viking, Voyager, and others) until the shuttle orbiter bay flight data are available.

W79-70183**506-17-36**

Goddard Space Flight Center Greenbelt Md
PAYLOAD ENVIRONMENTS AND DYNAMICS
 J P Young 301-982-4284
 (750-04-09)

Specific objectives are to develop and validate an improved method for predicting the random vibration environment of STS payloads to enhance and validate a method for predicting STS payload bay acoustic environment, and to obtain STS payload bay flight data that is specifically suited for providing verification of payload design loads, vibration, acoustic and thermal environment prediction methods. The approach is to develop an empirically based vibroacoustic transfer function method that incorporates a computerized data bank to serve as the principal investigator for the LDEF acoustic environment measurement experiment to correlate measured flight acoustic data with math model predictions and, via the DATE Working Group activity plan and manage the acquisition and processing of OFT payload flight data obtained from the DFI system and operational flight data to be obtained from the TFI system.

W79-70184**506-17-39**

Marshall Space Flight Center Huntsville, Ala
SPACE VEHICLE ACOUSTICS AND DYNAMICS
 R S Ryan 205-982-2481

The objective is to develop and validate dynamic, acoustic response and stability prediction capability to provide for improved structural design and optimization of space transportation systems and payloads. The thrust of this technology enhancement shall be to improve the accuracy and efficiency of analytical predictions through improvements in structural/environmental modeling, numerical methods, and computer applications, response computations, structural dynamic testing and analysis/test correlations. Also, a study of the interaction of control and structural dynamics as the control requirements drive the structural dynamic modeling and test requirements will be made. In addition, it is the objective to develop Spacelab experiment structural design packaging criteria for loading and off-loading mission requirements. The approach will be to conduct basic literature and experiment searches, develop concepts and approaches formulate analytical and/or test procedures equations etc., evaluate and compare alternatives and verify by analysis and test. The following major task areas are being undertaken to accomplish the objective: component design and test criteria (high frequency), improved structural design and fluid dynamics analysis capability (includes nonlinear-viscoelasticity) accuracy requirements of input environments and payload loads (loading and off-loading).

W79-70185**506-17-43**

Langley Research Center, Hampton, Va
HIGH TEMPERATURE SPACE STRUCTURES
 S C Dixon and R R Heldenfels 804-827-3423
 (517-53-13, 505-02-43, 524-71-03)

The objective is to develop structural and TPS concepts required for improved efficiency, life and cost of airframes for space transportation systems. Define the aerothermal loads and flow/structure interaction parameters required for design of such structure. Evaluate structural concepts via radiant heating and mechanical loading tests, and define aerothermal loads and evaluate TPS concepts via tests in the 8-foot high temperature

structures tunnel and the thermal protection system test facility. Focus current effort on hot metallic structures and metallic TPS concepts for earth-to-orbit vehicles.

W79-70186**506-18-11**

Ames Research Center Moffett Field Calif
ULTRASENSITIVE DETECTORS FAR IR SENSORS
 C R McCreight and H Lum 415-965-6525
 (188-41-55, 506-25-21, 506-18-21, 358-41-06)

The objective of this RTOP is to develop advanced infrared detection systems for astronomical research. This program will provide the technology for new and more efficient data acquisition capability throughout the infrared (IR) spectrum (2-120 microns) for the low background astronomical application. It will benefit the entire NASA IR astronomy program including future programs such as the Shuttle Infrared Telescope Facility and the space telescope, and the on-going ground-based, airborne, and balloon-borne programs. Activities will include development of hybrid and monolithic arrays of high sensitivity extrinsic silicon and germanium detectors. The IR array expertise developed by the Department of Defense (DoD) and NASA will be used for wavelengths below 25 microns. New IR arrays will be developed for wavelengths beyond 25 microns. Activities will also include development of real time data preprocessing/data compression electronics for use with the arrays in the astronomical application. The IR detector expertise in industry will be used for design fabrication and preliminary testing of the arrays. Detailed evaluation of the arrays and electronics will be carried out at Ames and also at university facilities by interested IR astronomers. Realistic observational testing will be conducted using existing ground-based and airborne facilities. All work performed under this RTOP will be closely coordinated with related DoD and NASA activities.

W79-70187**506-18-13**

Langley Research Center, Hampton, Va
ULTRASENSITIVE DETECTORS, IR SENSORS
 H D Hendricks and J E Stritt 804-827-3418
 (506-20-33)

The objective of this research is to develop and evaluate infrared ultrasensitive detectors that will provide tenfold increase in usable data acquisition through improvements in sensitivity resolution and spectral range for application in aerospace missions such as earth resources, atmospheric, ocean pollution and environmental monitoring. The main thrusts are: (1) to develop monolithic indium antimonide detector arrays (1-5 micrometers) with on chip signal processing and readout of infrared sensors utilizing charge coupled (CCD) technology; (2) to develop mercury cadmium telluride monolithic infrared arrays (8-14 micrometers) utilizing CCD technology; (3) to develop improved pyroelectric detector-CCD arrays that will operate near room temperature; (4) to develop high quantum efficiency - two Giga-Hertz bandwidth photomixers for laser heterodyne spectrometry; and (5) to develop calibration compensated detector arrays for multi-spectral scanners. Materials processing, device technology and fabrication technology will be developed to give the improved signal to noise ratios, increased resolution and broader spectral sensitivity. Techniques for calibrating and compensating detector arrays will be perfected.

W79-70188**506-18-15**

Jet Propulsion Lab Calif Inst of Tech, Pasadena
INFRARED DETECTOR ARRAY DEVELOPMENT
 J B Wellman 213-354-3712

The objective of this program is to develop infrared detector arrays to be used as building blocks in the development of remote sensing instruments for future NASA missions. The development of IR arrays which utilize charge coupled device multiplexers to realize the advantages offered by large numbers of detectors is being actively pursued by a number of semiconductor manufacturers funded primarily by the military. While this technology offers the potential for several orders of magnitude increase in information return from future NASA missions it will require substantial development in order to satisfy the unique requirements of NASA missions. Primary among these is the need to acquire data with radiometric precision in an environment

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with low thermal background. Additional requirements include the need to produce images and moderate resolution spectra high detectivity performance at intermediate temperatures of 50 to 100 K achievable with radiative coolers long operating life, and survival in a radiation environment. The approach to the development of detector arrays consist of three interrelated activities--user oriented mission and instrument definition, detector technology development and the implementation of a state-of-the-art infrared detector test capability. The mission and instrument definition activity will be the source of requirements for the detector development and will provide fundamental engineering trades to support proposal readiness. Technology development consists of selecting from the several technologies those which are appropriate to our needs and designing and manufacturing the detector arrays under contract to JPL. The development of a strong test capability is a key part of this program. Because of the unique requirements mentioned earlier much of the test capability possessed by industry fails to properly address the device parameters of concern to our missions. The results of our evaluation of detector performance will be factored into the development program at the contractor, and used in the development of instrument concepts.

W79-70189

506-18-23

Langley Research Center Hampton, Va
HIGH RESOLUTION LASERS: ELECTRO-OPTICAL SENSOR TECHNOLOGY

S L Ocheltree and J E Stitt 804-827-2791
(750-03-03)

The objective of this research is to investigate advanced laser and electro-optic sensor concepts, develop related systems technology and perform proof-of-concept field demonstrations for remote and in situ sensing of oceanographic and atmospheric properties. Sensor concepts to be investigated are laser backscatter and fluorescence techniques for marine and estuarine water parameter measurement and continuously tunable visible and infrared laser techniques for high resolution absorption and emission spectroscopy and measurement of low concentration atmospheric constituents.

W79-70190

506-18-26

Goddard Space Flight Center, Greenbelt Md
HIGH RESOLUTION LASERS LASER RANGING
M W Fitzmaurice 301-982-4948
(681-21-02)

The purpose of this RTOP is to develop the high performance laser components and subsystems needed for on-going NASA programs in geodynamics, with particular emphasis on the Earth and Ocean Dynamics Application Program (EODAP). The principal focus is on instrumentation systems which can provide global coverage from an orbiting platform such as the space shuttle. Specific objectives are as follows: (1) develop the components and engineering model for a high accuracy (1-2 cm) spaceborne laser ranging system; (2) carry out analytical and experimental investigations of the effects of the earth's atmosphere on ground-based and space-based laser ranging systems; and (3) develop and evaluate tracking and control system techniques for very accurate (1 arc-second typ) pointing of ground-based and shuttle-based laser systems. The technical approach in each of these respective areas is: (1) develop subnanosecond, flight qualified Nd:YAG lasers and very wideband (typ 35 GHz) optical receivers; (2) improve existing models using sample meteorological data and ray trace calculations, and carry out multiwavelength propagation experiments to test the models; and (3) using the computer controlled 1.2 meter telescope facility at GSFC, evaluate new angle tracking devices and software techniques.

W79-70191

506-18-33

Langley Research Center, Hampton, Va
MULTIFUNCTION MICROWAVE: BROADBAND RADIOMETERS

R F Harrington and J E Stitt 804-827-3631

The objective of this program is to develop the technology of and demonstrate the feasibility of an array of broadband microwave precision radiometers for simultaneous imaging of earth surface parameters on an all-weather basis. The technical

approach will be to improve the basic radiometers by improving the performance resolution bandwidth stability and reliability of these devices through the development of low loss front end components broadband devices with flat frequency response microwave integrated circuit devices broadband antenna feeds, etc. Broadband laboratory breadboard sets of improved microwave radiometer arrays with simultaneous imaging will be constructed calibrated and evaluated.

W79-70192

506-18-35

Jet Propulsion Lab., Calif Inst of Tech., Pasadena
MULTIFUNCTION MICROWAVES: DEVELOPMENT OF SUBMILLIMETER WAVELENGTH COMPONENTS

J W Waters 213-354-3025
(506-18-35, 198-10-06, 638-20-05, 750-01-25)

This RTOP is for a program to develop low-noise coherent, submillimeter wavelength receivers for multifunctional uses. The goal of the program is to provide the technological developments necessary for constructing low-noise receivers operating up to 2000 GHz frequency (0.15 mm wavelength). These receivers will be of importance to the following areas of the space program in the time period beyond 1980: (1) terrestrial atmospheric observations from aircraft, balloon and earth orbit; (2) astronomical observations from aircraft and from earth orbit; (3) missions to planets and comets; and (4) supporting laboratory spectroscopy. Measurement needs of upper atmospheric research require that these receivers be developed as soon as possible. At present no technique exists for global monitoring during both day and nighttime conditions of the chemically active species atomic O, OH, ClO, HCl and others. Measurement of these species in the upper atmosphere is of recognized importance for assessing the extent to which man's technological activities may be affecting earth's protective ozone layer. Calculations have shown, however, that these species can be measured by observations of their emission spectra with submillimeter receivers. In fact, for some of the species, submillimeter receivers may be the only means for their measurement. A satellite dedicated to upper atmospheric research is being considered for launch in approximately 1985. Development of the submillimeter technology to meet measurement needs for the scientific objectives of this and following satellites is one goal of this RTOP. Four major component areas must be addressed: (1) development of efficient quasi-optical techniques for submillimeter receiver front ends; (2) development of techniques for efficient coupling of submillimeter radiation to nonlinear devices; (3) development of appropriate nonlinear devices capable of efficient operation at submillimeter wavelengths; and (4) development of local oscillator sources.

W79-70193

506-18-36

Goddard Space Flight Center, Greenbelt Md
MULTIFUNCTION MICROWAVES
J L King 301-982-4949

The objective of this RTOP is to develop advanced technology and system concepts for passive microwave and millimeter wave sensing of the earth's environment. These sensors operate in selected bands over a frequency range from 6 to 225 GHz to measure parameters such as atmospheric water vapor, temperature, precipitation, sea surface temperature and wind speed, soil moisture, and snow water content, etc. These multifrequency and multifunction systems require advanced receiver technology and high tolerance reflector development above 100 GHz. In the lower microwave region large aperture scanning beam and multibeam pushbroom antennas must be developed to provide enough resolution and swath coverage for meaningful space applications. Wideband (20 GHz) low noise mixers (8 dB noise figure) and solid state oscillator development will continue in the 180-225 GHz range for the water vapor sounding radiometer. The 1.4 GHz electrically scanned soil moisture radiometer array task will continue with the development of a ten meter long three to four element breadboard model microstrip array for pattern range testing. This year's thirteen channel (1-100 GHz) advanced scanning microwave radiometer concept study (three meter/mechanical scan) will be followed up with a detailed design study of the scan mechanism, multichannel feed, and diplexer network.

W79-70194 **506-18-45**
 Jet Propulsion Lab Calif Inst of Tech, Pasadena
HIGHLY RELIABLE SENSOR TECHNOLOGY PREDICTABLE
LONG-LIFE LSI MICROCIRCUITS
 J Maserjian 213-354-3801
 (186-68-83)

The objective of this RTOP is to provide a means of acquiring advanced LSI (large-scale-integration) components with predictable reliability. The effort focuses on MOS technologies including CMOS, CMOS-SOS, NMOS and CCD which are likely to remain the dominant LSI technologies for years to come. These LSI technologies are key to future missions requiring large information return (earth observation, planetary, and shuttle). However, flight qualification of advanced LSI components represents a major problem. NASA can no longer depend entirely on standard parts lists and screening methods, since LSI components are really subsystems which undergo ever-changing designs--many of which must be custom--and the components are too complex for thorough testing. The approach is based on the concept of developing test-chip and test-wafer procedures for use on LSI lines. These procedures provide the data needed for reliability prediction that cannot be obtained from the LSI components themselves. The data can also be the basis for screening out unreliable LSI processes, lines or wafer lots and thus avert serious problems downstream. The test procedures being developed are of a fundamental nature and are thus applicable to a rapidly moving LSI technology. The key information needed has been established through device physics and in-depth studies of failure mechanisms. Electrical and chemical diagnostic techniques have been developed to assist these studies, and to provide test procedures for acquiring the key physical parameters. Device models are developed to allow prediction of device performance in terms of these basic parameters. Thus, by determining the stress-time dependence of the few key parameters, it is possible, using conventional computer simulation techniques, to predict reliability of complex LSI components. These basic developments are being done in-house. Verification is achieved through interactions with industry, other government agencies and NASA quality assurance teams.

W79-70195 **506-19-13**
 Langley Research Center Hampton, Va
PRECISION POINTING AND CONTROL ADVANCED
SPACECRAFT/EXPERIMENT SYSTEMS
 W W Anderson and J E Stitt 804-827-3049
 (750-03-15)

The objective of this RTOP is to develop techniques, hardware, and software to further the long range spacecraft guidance and control, and information systems goals of 10 times greater accuracy in experiment pointing systems, the development of long life navigation, guidance and control system concepts, and the development of large structures control and pointing technology. To achieve these goals, new devices, concepts and analyses are being pursued. These include (1) spacecraft attitude control momentum devices, such as the magnetically suspended Annular Momentum Control Device (AMCD), (2) new techniques for experiment vernier pointing, such as the Annular Suspension and Pointing System (ASPS), (3) analytical studies of optimum spacecraft maneuvering, (4) analytical studies of the stabilization and control of large space structures, and (5) analytical studies of automation technique applied to the construction and assembly of large space structures. Through these efforts, technology is being developed to permit the design and implementation of cost effective spacecraft and experiment control systems. System and component requirements as well as conceptual designs are being defined through the use of simulation. Effective system configurations, low cost system integration, multipurpose operation, and component standardization will be used to reduce system and component costs while achieving required performance. Development of control software and hardware will be undertaken and critical hardware elements will be carried through laboratory evaluation to establish feasibility. This effort is being directly coordinated with GSFC, JSC, MSF and JPL.

W79-70196 **506-19-15**
 Jet Propulsion Lab Calif Inst of Tech, Pasadena
PRECISION POINTING AND CONTROL TECHNOLOGY
(PPACT) DEVELOPMENT
 S Z Szirmay 213-354-4431

The long-range objective of this RTOP is to develop and demonstrate precision pointing and control conceptual designs, analysis tools, and implementation approaches applicable to a wide range of NASA programs including technologies required for large structure control and pointing, experiment pointing and spacecraft control. Future missions demand systems and components with longer life, lower weight and less power. The use of high-accuracy pointing systems will facilitate the attainment of the long-range goals of a tenfold increase in the acquisition of new and usable data and 50% decrease in cost. Principal program targets are: (1) develop for planetary application a breadboard model of a precision pointing and tracking system to provide 10 arcsecond accuracy and 0.2 arcsecond stability while tracking at rates up to 400 arcseconds per second, and with a slewing capability of 2 degrees per second by FY-81; (2) provide definition of advanced shape control techniques for control of large flexible spacecraft and complete initial comparison studies by FY-80; and (3) identify advanced technologies required for control of large space structures and a plan of development implementation by early FY-80.

W79-70197 **506-19-23**
 Langley Research Center Hampton Va
ONBOARD NAVIGATION LANDMARK TRACKERS
 W E Howell and J E Stitt 804-827-3551
 (750-03-14)

These proposed landmark tracking studies and experiments are designed to support the development of landmark tracking techniques for evaluation aboard early shuttle flights. The method is based on pointing or tracking via contrast properties of the landmark, providing pointing and tracking error signals not dependent on knowing spacecraft ephemeris and attitude to great precision, as required in present methods. This effort will allow an early assessment of instrument characteristics, software requirements, and proper flight experiment objectives. These objectives will be evaluated in simulated orbital passes over representative targets obtained by using equipment developed under earlier contracts. Separate studies will be made to evaluate the potential use of real-time optical correlation systems in landmark tracking applications.

W79-70198 **506-19-25**
 Jet Propulsion Lab Calif Inst of Tech, Pasadena
AUTONOMOUS NAVIGATION FOR UNMANNED SPACE-
CRAFT
 E Heer 213-354-3060
 (506-19-14, 506-20-11, 310-10-60)

The objective is the orderly and timely development of navigation technology and navigation systems needed for the efficient conduct of future space missions. Long range goals are a ten-fold increase in system accuracy and scientific data acquisition capability while reducing total costs. Technology developments are aimed at reducing the navigation costs of future Galileo-type missions by over \$0.5 million per mission and future Voyager-type missions by over \$0.25 million per mission. Included are Automated Optical Navigation (AON) for application on earth, and Optical Measurement Technology (OMT) development. A prototype version will have been tested in FY-78 using recorded Viking mission data from the Martian encounters of 1975, and will be flight-demonstrated in FY-79 using Voyager Jupiter encounter data. Advanced versions will be demonstrated on the MODCOMP minicomputer at Voyager Saturn encounter, and the system will be operational during the Galileo mission orbital phase. This ground-based system will provide a technology base for post Galileo fully automated onboard navigation. The OMT project will contribute to the navigation capabilities of CCD cameras and provide navigation sensor technology for post-Galileo dual-purpose sensors, a science-navigation sensor and a tracker-navigation sensor. OMT development will enable acquisition and processing of navigation data increased many-fold in volume, at a net reduction in navigation cost, and provide onboard

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data acquisition and processing capabilities which can enhance reliability and enable automated onboard navigation after the galileo mission. The technical plan presented is consistent with the 17 Feb 1978 joint OAST/OSS Memorandum of Understanding Development of Approach Optical Navigation-Automated Data Processing on the JPL Realtime Mini Computer System. FY-78 marked the completion of the development of breadboard maneuver strategy software for satellite gravity assist orbit control and the completion of development of advanced algorithms. FY-79 will mark the completion of the validation of dynamic models for outer planet satellite motions.

W79-70199

506-19-26

Goddard Space Flight Center, Greenbelt Md

ON-BOARD NAVIGATION NEAR-EARTH SATELLITES

A J Fuchs 301-982-6846

The long-term objectives of this RTOP are to develop the means for performing on-board satellite navigation and to demonstrate the feasibility of the techniques by means of an experiment on-board a satellite in the 1981-1982 timeframe. Satellite navigation is defined to include the determination and control of spacecraft orbit and attitude and applications thereof. During the initial phase of this RTOP, the techniques and procedures for on-board orbit and attitude processing and instrument control for earth-pointing imaging spacecraft such as the LANDSAT-D or in the shuttle bay will be developed, whereby all of the components (hardware, software, and sensors) for on-board image registration are defined. The system components for orbit and attitude determination being studied during this phase of the RTOP are the Global Positioning System and the MMS attitude control system respectively. Subsequently, the techniques and procedures for providing on-board orbit, attitude and timing data for other classes of missions will be specified and developed. Alternative approaches for on-board orbit determination such as the utilization of TDRSS data or a follow-on synchronous satellite system will be investigated.

W79-70200

506-19-29

Marshall Space Flight Center Huntsville Ala

ON-BOARD NAVIGATION - LASER GYRO SYSTEM

L J Cook and D Stone 205-453-0785

An objective of this RTOP is to complete the evaluation of the integrated laser gyro dodecahedron IMU/navigation system with the level of technology development completed in FY-78. An evaluation will be made of advanced laser gyro concepts. Selection will be made of technology developments to be considered for inclusion in an advanced redundant IMU/navigation system for aerospace applications.

W79-70201

506-19-30

National Aeronautics and Space Administration, Washington D C

ROBOTICS/MACHINE INTELLIGENCE ARTIFICIAL INTELLIGENCE CONCEPTS

W Gevarter 202-755-3227

(506-19-35)

The objective of this RTOP is to improve NASA's ability to automate spacecraft functions and operations, to manage large amounts of data to effectively utilize sensed information, and to provide more efficient methods for processing information. Near-term targets include development of automated problem-solving systems and techniques for machine perception and analysis of scenes. The technical approach is to develop computer models which simulate intelligent system operations -- such as perception, problem-solving, question-answering and learning -- and to test these models with various real or approximately real functional problems. The results will provide guidelines for the development and exercise of autonomous or robotic systems such as automated manipulation and assembly, mission operations, autonomous spacecraft automated checkout and test, etc. The work will be performed through a series of research grants and contracts with academic and industrial laboratories recognized for their competency in automated systems R&D.

W79-70202

506-19-35

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

ROBOTICS/MACHINE INTELLIGENCE AUTOMATED SYSTEMS

E Heer 213-354-3060

(506-19-21 199-51-04, 506-20-11, 506-19-14)

This plan covers a robotics and machine intelligence applications program to meet NASA's needs. The objectives are to develop and flight qualify specific technology. Specific objectives are (1) automated vision and recognition systems (2) automated mission operations and on-board command generation (3) automated techniques for handling assembly and construction in space and (4) concepts and requirements for highly automated spacecraft/ground systems in the late 1980's. The objectives will be accomplished by (1) developing real-time scene analysis capability, an artificial retina, and automatic image classification and retrieval algorithms (2) modify and improve the automatic problem-solving system and apply learning and error-correction techniques to the man-machine interface (3) implement assembly coordinator facilitating effective interaction among subprocessors develop advanced arm control techniques, develop techniques for dynamic manipulator guidance and perform preliminary assembly experiments and (4) conduct a systems study to define detailed technology requirements and implementation strategies for highly automated spacecraft/ground systems.

W79-70203

506-20-13

Langley Research Center, Hampton, Va

ADAPTIVE DATA HANDLING SOFTWARE SUPPORT SYSTEM TOOLS AND TECHNOLOGY

E C Foudriat and J E Stitt 804-827-2077

The objective of this RTOP is to define and develop software support tools and technology which will provide for the effective utilization of digital electronics in avionic and space flight systems. To be effective, the user (e.g., research, flight test engineer) must be involved in all stages of program development and checkout so he maintains visibility and continuity with his flight test objectives. The tool system concept must also keep pace with the rapidly advancing and changing computer hardware developments. The approach is to develop flexible software language systems, validation, and test procedures whereby the particular hardware system characteristics can be made semi-transparent yet efficient to the user. These software techniques will be developed and tested by application to NASA flight test programs and will be available to NASA, other government agencies, universities and industry.

W79-70204

506-20-15

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

ADAPTIVE DATA HANDLING DIGITAL DATA SYSTEM

M Ebersole 213-354-4595

(186-68-89 506-19-32, 506-19-21, 506-23-55)

The Digital Data Systems task has been identified as an area of critical technology requiring development for the NASA End-to-End Data System (NEEDS) in the shuttle era. The specific objective of the task is to develop a modular distributed processor digital data system utilizing microprocessor and other LSI technologies as basic building-block elements to demonstrate multi-mission adaptive systems which support the NASA goal to decrease science data and life-cycle costs by more than 10X. This work is based on the Unified Data System (UDS) activity conducted through FY-77 which was a proof-of-concept effort culminating in the completion of a distributed processor digital data system breadboard. Effort in FY-78 has included the preliminary design of the application of the distributed processor data system concept to the Galileo flight project and the design and checkout of a microprocessor based module, the Remote Terminal Unit (RTU), which is an essential building block of a flight quality version of the distributed processor data system. The key FY-78 activity was the design of a second-generation UDS breadboard which incorporates more advanced microprocessor technology, fault tolerance and flight quality design requirements. The design is specifically tailored towards being the baseline for a Shuttle Data System demonstration in FY-81. Emphasis in FY-79 will be on fabrication test, and evaluation of the LSI breadboard system and development of the necessary operating system software and software support aids to allow the system user to develop low cost application unique software.

The LSI data system will serve as the forerunner for earth orbital missions such as SEASAT Planetary missions to the outer and inner planets and specifically the Shuttle Demonstration Data System. This RTOP also provide supporting technology which is beneficial to the Robotics RTOP (506-19-32) the Guidance and Navigation RTOP (506-19-21), the Automated Power Management System (APSM) RTOP (506-23-55) and the DSS RTOP (186-68-89)

W79-70205**506-20-18**

Goddard Space Flight Center Greenbelt, Md
ADAPTIVE DATA HANDLING RESOURCE EFFECTIVE DATA SYSTEM (REDS) DEFINITION
J Y Sos 301-982-2213

The REDS Definition is one of five elements within the NEEDS Phase I program. This RTOP describes the REDS study effort. The objectives of this study are to determine and quantify the data/information system drivers based on an in-depth analysis of probable future missions and their requirements on the system, to establish systems concepts of NEEDS which will satisfy in a near optimum manner the NASA data/information management requirements of the post-1980 time frame and to understand and quantify the systems performance of the present and conceptual systems from an analysis and modeling perspective. The most important aspect of the study is the analysis of the manner in which data are collected, processed, handled, managed and distributed by NASA's ensemble of data/information systems for the 1980's. This evaluation will provide management with alternatives in the selection of system configurations. These choices of system configurations will imply certain options in the areas of technology, management and cost and will thus identify the thrusts which must be undertaken to implement the selected NEEDS design. It is expected that the study will obtain an analytical systems solution for effectiveness and efficiency of event detection, data transfer, and information extraction which will satisfy the user requirements.

W79-70206**506-20-23**

Langley Research Center, Hampton, Va
ON-BOARD DATA PROCESSING: MULTISPECTRAL DATA PROCESSOR
Charles Husson and J E Stitt 804-827-3535
(506-20-33)

The objective of this work is to develop on-board data processing technologies to enhance the performance of operational and analytical spacecraft systems. The specific objective is to develop stand-alone, lightweight, real-time programmable processors for data manipulation and computational applications suitable for analysis of LANDSAT multispectral data. This work is intended to economically and expeditiously reduce data obtained from remote sensing vehicles. The long-range goal is to achieve a 1000-fold increase in the capability of earth-based stations to process multispectral data. Current research efforts include the development and evaluation of a multifunction CCD processor integrated circuit, a universal linear predictor matrix operator, and the peripheral support electronic technology. This work also will evaluate these projected devices in breadboard architectural hierarchies based on multivariant interactive digital analog systems processors.

W79-70207**506-20-25**

Jet Propulsion Lab., Calif Inst of Tech., Pasadena
ON-BOARD DATA PROCESSING: SYNTHETIC APERTURE RADAR (SAR) IMAGE PROCESSOR
R Piereson 213-354-3322
(656-44-04)

This RTOP is part of the NASA NEEDS Program. The general objective of this RTOP is to develop real-time electronic synthetic aperture radar (SAR) processor technology to meet the requirements of future space missions. The specific objective is to design and build a developmental SAR processor (DSP) and use it in 1980 to demonstrate processing of a 20 km swath of Seasat-A data at the real-time rate. Although the DSP will be used in a laboratory environment, the basic design will be amenable to implementation for on-board processing applications. A major element of this task will be to develop a custom LSI circuit

using digital charged-coupled-device technology to perform the azimuth correlation function.

W79-70208**506-20-26**

Goddard Space Flight Center Greenbelt Md
ON-BOARD DATA PROCESSORS. PARALLEL PROCESSING TECHNOLOGY

David H Schaefer 301-982-5184

The objective of this RTOP is to develop hardware especially suited for very high-speed analysis of data. Such hardware is especially needed for analysis of images sensed by earth observation and planetary spacecraft. The approach is to develop massively parallel processing systems. Such computational systems contain thousands of processors functioning simultaneously.

W79-70209**506-20-33**

Langley Research Center, Hampton Va
SOLID STATE DEVICE TECHNOLOGY: ADVANCED COMPONENTS

R A Breckenridge and J E Stitt 804-827-3535
(506-20-23, 506-18-13)

The objective is to develop advanced electronic devices and components for increased capability and cost efficiency of information handling in future aerospace missions. Theoretical and experimental investigations in selected areas of electronic materials, device concepts and processes will be conducted in-house. Research contracts and grants will be used to develop new and improved solid-state devices and components. Those material and process technologies which have potential for yielding improved and reliable performance in cost effective electronic devices and components will be emphasized. Current efforts include the investigation of new materials, device concepts and processing techniques for the development of data processing devices, data storage devices and data transfer devices.

W79-70210**506-20-42**

Lewis Research Center, Cleveland, Ohio
MICROWAVE AMPLIFIER TECHNOLOGY
R E Alexovich 216-433-4000

The objective is to advance the state of the art of microwave power amplification for space and terrestrial applications above one GHz. To achieve this objective, research and technology development programs will be undertaken on microwave amplifiers, high current density electron emitters and high power microwave passive components. Studies and investigations of space-earth propagation and interference will be undertaken to guide high power communication component and subsystem investigation. Specific techniques such as multistage depressed beam collection and beam refocusing for linear amplifiers are among promising techniques being investigated in addition to RF circuit and electron gun optimization studies.

W79-70211**506-20-45**

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
HIGH SPEED DATA TRANSFER: X/S BAND COMPONENTS
J F Boreham 213-354-4107
(650-10-15)

The objective of this RTOP is to provide microwave subsystems, techniques and feasibility studies to enable high rate data transfer from spacecraft to earth as needed by earth applications and deep space missions in the 80's. The approach incorporates the following key items: (1) development of an X-band transponder including increased ranging channel bandwidth and stability, and compatibility with one-way differenced ranging navigation, (2) develop a 22 watt X-band solid state, power amplifier with greater than 20% dc to RF efficiency as a replacement for expensive, unreliable TWTAs, (3) development of near-field measurement techniques and efficient analytical methods necessary for cost-effective testing and design of large, high frequency (X-band and above) and/or complex antennas required for high speed data transfer, (4) development of system concepts and techniques necessary to carry a low-cost information distribution system to a demonstrated pre-operational status. The X-band transponder, in conjunction with OTDA RTOP

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

310-20-64 X-Band Uplink Development, will provide NASA the economy of a single frequency unified X-band system and a 10 to 1000 fold increase in navigation, radio science telemetry, and command performance while reducing uplink interference with earth orbiting satellites. It may also offer the possibility, for the first time, of detecting gravity waves. The XSSPA will use a modular concept which will retain functional compatibility with an array feed power amplifier approach being demonstrated by the end of FY-78.

W79-70212

506-20-46

Goddard Space Flight Center, Greenbelt Md

HIGH SPEED DATA TRANSFER, S/K-BAND COMPONENTS AND TECHNIQUES

D Santarpia 301-982-6375
(310-20-46)

The objective of the work to be accomplished under this RTOP is the advancement of spacecraft RF technology in tracking and data transfer to satisfy the demanding communications requirements of future space flight projects. The flight programs of the 1980's are characterized by high data rates (up to 600 Mb/s), simultaneous multiline and reliable long-life operation. The accommodation of such requirements shall be achieved through technological advances in spacecraft RF techniques and hardware.

W79-70213

506-20-55

Jet Propulsion Lab Calif Inst of Tech Pasadena

HIGH CAPACITY DATA STORAGE AND DISPLAY. FIBER OPTICS DATA LINKS

A R Johnston 213-354-4054
(506-18-21, 180-24-51)

The goal of the proposed effort is to apply the emerging technology of fiber optic data links to NASA needs, and to contribute to the advancement of the technology in selected areas. Development of fiber optic data transmission will support OAST goals both in terms of a great increase in mission capability and a decrease in mission costs. The principal benefits to be expected from the use of fiber optics are the EMI immunity of the transmission line, its small size and weight, wide bandwidth, and ultimately lower cost than copper equivalents. Two long-term objectives will focus the work: (1) development of a space data bus capability, and (2) development of a high capacity data distribution capability. During FY-79 a breadboard of a spacecraft data bus will be evaluated. A high data rate application related to requirements of future NASA data distribution will be identified, and a link conceptual design developed. Technology limitations and needed single-mode component development consistent with a 1 G bit/sec data rate will be identified. Applications will be sought for quantitative evaluation and to help identify limiting technology. New effort is needed in the area of wave guiding components, including bus couplers, directional couplers, and sources and detectors. An appropriate mix of evaluation of available devices with development of selected concepts is planned.

W79-70214

506-20-59

Marshall Space Flight Center, Huntsville, Ala

HIGH CAPACITY DATA STORAGE AND DISPLAY - ARCHIVAL DATA STORAGE TECHNOLOGY

G A Bailey 205-453-1595

The long range objective of this RTOP is to provide the technology and techniques necessary to construct a high density (10 to the 7th power bits/sq cm), high capacity (10 to the 15th power bits), fast (10-20 Mb/sec read-write rates), inexpensive (10 to the 8th power cents per stored bit) optical storage and retrieval system. The primary application of this effort is the Archival Storage System to be used in the NASA End-to-End Data System (NEEDS) Program. This memory is intended to replace the use of magnetic tapes used in archival storage facilities of large data base centers. A breadboard system has been completed and demonstrates the feasibility of the archival memory needed by the NEEDS program. The fundamental technology required to implement the archival memory is available such that technology breakthrough need not be scheduled. However, fundamental experimentation and

characterization of the storage media itself must be performed to determine impacts, limitations and problem areas. Emphasis will be placed on photographic film and metal-on-polyester. These materials will be investigated to determine probability and sources of errors as a function of spot size, center spacing and contrast ratio. These experiments will also be applied to replicated (second-generation) data. Replicating materials and techniques will be directed toward providing a conceptual design of a low-cost, self-contained reader that can directly use fiche copies from the archival data base. While it is believed that the archival memory developed for the NEEDS program will establish new standards for storing large quantities of data, the full benefits of such a system will only come to fruition when an inexpensive reader places the data base in the hands of many users.

W79-70215

506-20-60

National Aeronautics and Space Administration Washington, D C

HIGH DENSITY CIRCUIT TECHNOLOGY. ELECTRONIC DEVICES

C E Catoe 202-755-3266

The objective of this program is to provide effective coordination of NASA sponsored research and development efforts on electronic devices and systems with similar work supported by DOD and other government agencies. Through associate membership on the Advisory Group on Electron Devices and its constituent working groups, NASA program managers receive expert advice on the feasibility, currency and soundness of planned R&D procurement activities, long ranging R&D requirements, complementary work in other government agencies and forecasts of new technical developments.

W79-70216

506-20-69

Marshall Space Flight Center, Huntsville, Ala

HIGH-DENSITY CIRCUIT TECHNOLOGY - COMPUTER AIDED DESIGN AND TESTING

J M Gould and L C Hamiter 205-453-3772

The underlying goal is the reduction of the cost of electronic subsystems through enhancement of high density circuit technology. The principal subsystem cost factors are packaging, parts fabrication and the screening and reliability testing of parts. To have a significant effect upon packaging costs, it is essential to dramatically reduce parts count by increasing the degree of integration of monolithic arrays while maintaining low parts fabrication and screening costs. Such high density arrays must consist both of off-the-shelf parts such as microprocessors and memories and of custom designed arrays for collecting random interface and control logic. This effort will provide the technology techniques, equipments, and sources to insure that high density arrays can be produced with assured reliability in an economical and consistent manner. This will be accomplished through the development of automated design, process and test hardware and software, high density large scale integrated circuit technologies, and improved methods and techniques to assess and assure reliability.

W79-70217

506-21-12

Lewis Research Center, Cleveland Ohio

ADVANCED CHEMICAL PROPULSION TECHNOLOGY

John W Gregory 216-433-4000
(910-03-02, 790-40-12)

The objectives are to provide the technology for improvements in performance and reusability of liquid rocket components and subsystems and to provide improved understanding of basic chemical and physical processes in advanced chemical propulsion. The general advanced research and technology program will include analytical and experimental programs to improve the understanding of combustion phenomena and to evaluate thrust chamber life, advanced cooling techniques, and improved fabrication techniques for more reliable long life chambers. In the advanced hydrogen-oxygen engine area, a staged combustion cycle powerhead system will be assembled and utilized as a test bed to evaluate engine systems technology and to verify and update engine system computer models. Basic combustion and heat transfer work will be pursued with high density (hydrocarbon) fuels-oxygen at operating conditions representative

of main combustion chambers and preburners for high pressure, staged combustion cycle engines. In low thrust hydrogen-oxygen propulsion system area work will be initiated on engine system design and parametric data for use in low thrust orbit transfer vehicle (OTV) tradeoff studies. Component technology development will continue for components applicable to both auxiliary propulsion systems and main propulsion systems for low thrust OTVs. Low gravity fluid system studies will investigate critical characteristics of and develop design criteria for, in-orbit fluid storage acquisition and transfer systems.

W79-70218**506-21-17**

Lyndon B Johnson Space Center Houston Tex

ADVANCED SPACECRAFT PROPULSION TECHNOLOGY

Robert W Polifka 713-483-5495

The objectives of this effort are to identify evaluate and characterize promising low cost propellants (LOX/Hydrocarbon type) for potential future space transportation system applications. The emphasis of this effort will be directed towards low earth orbit manned maneuvering systems. Basic engine and propellant characterization data will be generated to confidently support future vehicle trade studies, as well as propellant and engine cycle selections for minimum cost and risk development programs. Contracted technology efforts shall be conducted to analytically and experimentally characterize the critical engine performance, combustion cooling, and overall system related properties of promising low cost LOX/Hydrocarbon type propellants. The initial combustion characterization and screening tests will be conducted at the basic single injector-element level. The cooling characterization tests shall be conducted with resistance heated tubes and/or channels. The final characterization testing of the most promising propellants will be conducted at a thrust level (approximately 10,000 lbf) such that the results can be confidently applied to the actual engine application. The testing will be conducted over a wide operating range so as to adequately support vehicle trade studies.

W79-70219**506-21-25**

Jet Propulsion Lab, Calif Inst of Tech Pasadena

LONG LIFE ADVANCED PROPULSION SYSTEMS FOR PLANETARY SPACECRAFT

D L Young 213-354-3217

(525-71-05)

The first objective is to provide the research and technology base for the rocket engine assembly and for key liquid feed assembly components for advanced liquid propulsion systems for use on planetary missions. This effort involves the support of an on-going effort to develop a fluorine-hydrazine engine. The feed assembly components effort will be the continuation of the on-going component work, specifically long-term materials testing evaluation of preprototype component tests, and procurement and testing of the prototype components. This work will directly support the system's effort initiated during FY-77 under RTOP 525-71-05. The second objective is to provide the research and technology base for an earth-storable bipropellant pump-fed spacecraft propulsion system needed to replace less efficient pressure-fed systems for the planetary missions requiring larger propellant quantities planned for the late 80's and beyond. The initial study will focus on propellant combinations and potential of an integrated attitude control system. Following the demonstration of an earth-storable system work will be extended to space storable propellants. The third objective is to assess the storage lifetime of squibs by modern physiochemical means and identify design improvements. The fourth objective is to prepare and evaluate new thermally stable storable propellant formulations based on standard hydrocarbon prepolymers and on dianhydride chain-extended and cross-linked binders and to develop a heat sterilizable solid propellant motor which will satisfy the requirements of future planetary lander missions. A 280 kg 84% solid grain, composite (Kevlar) chamber and the necessary insulation systems will be fabricated and tested through the required sterilization cycles. Two flightweight solid motors using the technology established will be loaded, sterilized and tested.

W79-70220**506-21-45**

Jet Propulsion Lab Calif Inst of Tech Pasadena

PLANETARY PROPULSION RESEARCH AND ADVANCED CONCEPTS

W Gin 213-354-3790

(506-21-25)

The overall objective is to create and explore new concepts as well as provide supporting research which is needed to increase performance decrease costs remove or reduce risk and improve reliability and flexibility of chemical propulsion systems which are utilized in every NASA mission. Selected tasks contribute directly or indirectly to technology which enables future high-energy long duration missions to and exploration at outer planets and terrestrial bodies. Approaches will be both experimental and analytical. The specific tasks are (1) Planetary Atmospheric Propulsion study of advanced concepts to enable exploration at or sample return missions from the planets (2) Microbial Production of Ammonium Perchlorate feasibility demonstration of synthesis of perchlorate by low-cost biochemical methods (3) Advanced Propellant Concepts formulation of new cost-effective propellants using mixtures of ammonium perchlorate with other oxidizers and formulation of new propellants with very high solids loading by use of new binders with chemically-built in bonding agents and (4) Combustion Studies fundamental combustion studies with the porous plate burner will be continued as well as the application of a coat to the oxidizer for instability control. New experimental studies will be initiated to measure the intrinsic ignition temperature of solid propellant and to compare cold flow nozzle admittances with theoretical values (5) Viscoelastic Mechanical Behavior formulation of techniques to control propellant mechanical properties processing and environmental stability, and derive information for the design of motors and prediction of useful life-times under expected environmental duty cycles (6) Nozzle Exhaust Plume Models use of new mathematical techniques in rocket exhaust plume models to predict forces torques heating rates and loss of thrust due to plume impingement (7) Materials Compatibility with Liquid Propellants determination of compatibility of MMH, H2H4 and N2O4 with various materials of construction (8) Liquid Rocket Engine Physiochemical Processes study of rocket engine combustion processes to obtain improved design methods and procedures.

W79-70221**506-21-49**

Marshall Space Flight Center Huntsville Ala

PLUME CHARACTERIZATION AND LASER-HEATED PROPULSION

R J Richmond 205-453-0974

The research and technology effort which is described is directed at developing a chapter for the JANNAF Plume Technology Handbook deals with developing vehicles base flow and base heating developing a low altitude rocket plume flow field prediction computer program, and providing a technology base for laser heated propulsion. Existing computer programs and experimental data dealing with all areas of plume technology are being reviewed and documented in a JANNAF Plume Technology Handbook. The present year's effort is directed at preparing the chapter on vehicle base flow and base heating. A streamlined, low altitude rocket plume flow field computer program, or set of programs, will be developed by combining the best features of the existing programs into one new program. Laser radiation absorption experiments using pure hydrogen, seeded hydrogen and other propellant gases will be conducted. Experimental results will be compared with analytical predictions and a generalized thruster design model developed. Parametric analyses of thrusters using various propellants will be conducted. The more promising configurations will be selected for further analyses and finally one configuration will be selected for fabrication and test.

W79-70222**506-22-12**

Lewis Research Center, Cleveland, Ohio

AUXILIARY ION THRUSTER SYSTEM TECHNOLOGY

R C Finke 216-433-4000

(506-22-22 506-22-32 750-06-01)

The objective is to define and develop the technology for auxiliary electric propulsion systems, including thrusters and associated power processing, for application to geosynchronous spacecraft and future large space structures. Auxiliary propul-

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sion systems, possibly with propellants other than mercury suitable for application to large space structures will first be defined by study and then developed. The integration with geosynchronous spacecraft and cost drivers of mercury bombardment thrust systems operated between half and two millipound of thrust will be evaluated by study. The design of the 8-cm mercury bombardment thrust subsystem will be verified by extended testing of critical subsystem elements and a complete subsystem life test. The work will be performed both by in-house and contracted efforts.

W79-70223

506-22-16

Goddard Space Flight Center, Greenbelt, Md
AUXILIARY ELECTRIC PROPULSION SYSTEMS
Robert A. Callens 301-982-4205

Ion engine technology has reached sufficient maturity that further study needs to be conducted to determine the feasible applications of electric propulsion to LEO/GEO spacecraft in the shuttle era. This will be accomplished by first generating a reliable cost basis for electric propulsion modules and then by investigating the viability of applying ion propulsion for a spacecraft application that requires high power for instrument operations. Lewis Research Center is cooperating in implementing this RTOP.

W79-70224

506-22-22

Lewis Research Center, Cleveland, Ohio
ION THRUST SUBSYSTEM TECHNOLOGY FOR SOLAR ELECTRIC PROPULSION (SEP)
R. R. Lovell 216-433-4000

The overall program objective is to develop electric propulsion thrust subsystem technology. A baseline program is directed toward demonstrating the technology readiness of a baseline system by the end of FY 1980. An extended performance program is directed toward improving the performance of the 30cm mercury thruster baseline system in order to enhance planetary mission capability. An advanced technology program is directed at defining and developing electric propulsion technology for enhanced performance and reduced cost. The approach in the baseline program is to develop engineering model thrusters to develop functional model power processors and to integrate the resulting thrusters and power processors into a thrust subsystem module for test and evaluation. The program also includes endurance testing engineering model thrusters and performing test evaluation in the long term multiple (3) thruster mission profile life test and in system interaction tests using multiple thrusters and power processors. The approach to the extended performance and advanced technology programs includes a planned progression of developing components, combining components into thrusters and power processors and testing the resulting high performance systems.

W79-70225

506-22-32

Lewis Research Center, Cleveland, Ohio
ION THRUSTER RESEARCH AND ION BEAM APPLICATIONS
R. C. Finke 216-433-4000

The objectives are to (1) obtain the understanding of the basic physical processes of electric propulsion and develop models in order to establish design guidelines, understand controlling processes, and define interface criteria, (2) investigate alternative electric propulsion concepts and predict performance, life, and interface criteria. Examples of systems in an early development stage requiring further investigation are the inert gas bombardment ion thruster system and the synchronous linear accelerator (mass driver), and (3) identify, evaluate, develop and transfer to the user community nonpropulsive applications of ion thruster technology. The development of new or improved materials, processes, and products for nonpropulsive applications that are enabled by ion thruster technology will be explored.

W79-70226

506-22-35

Jet Propulsion Lab, Calif. Inst. of Tech., Pasadena
MPD THRUSTER SYSTEM TECHNOLOGY
E. V. Pawlik 213-354-3455
(506-23-55, 506-24-25, 506-22-29, 506-23-35)

This RTOP supports the PASO specific objective of pursuing

research into the controlling physical processes involved in electric propulsion, evaluate advanced concepts such as the MPD accelerator and to investigate the nonpropulsive applications of electric propulsion technology. Specifically, this effort will establish the fundamental viability of the magnetoplasmadynamic (MPD) thruster by demonstrating that the problems limiting performance and lifetime can be resolved. The MPD thruster offers promise as a simple, high efficiency, low cost thruster. It requires high power and thus is particularly suitable to the high power levels expected to be available in the shuttle era as large power modules are developed. The high thrust densities attainable with this thruster make it suitable for use in near-earth payload transportation or for the exploration of the outer planets. Virtually every aspect of the MPD thruster system requires study in order to evaluate the potential benefit of this system. The approach will be to (1) evaluate the technology associated with operating quasi-steady state MPD thrusters with inductive storage energy transfer, (2) define the potential performance, efficiency and lifetime of the MPD thruster, (3) conduct a preliminary conceptual study of how an MPD thruster might be incorporated into either a solar electric propulsion or a nuclear electric propulsion vehicle, and (4) provide basic understanding of the physical processes involved in electric thrusters and the application of this technology. A target for this effort is to complete the preliminary technology development and evaluation of the MPD accelerator by the end of FY 1981. With successful demonstration of this technology, efforts can then proceed with thruster development.

W79-70227

506-23-12

Lewis Research Center, Cleveland, Ohio
SOLAR CELL TECHNOLOGY
D. T. Bernatowicz 216-433-4000

The objective of this RTOP is to develop the technology for low-cost solar cells and blankets with high end-of-life efficiency. Research and technology programs will be continued in the following areas: (1) radiation damage mechanisms in silicon solar cells, (2) high efficiency cells including low resistivity N on P cells and thin N-I-P cells, (3) very thin cells with coplanar back contacts, (4) 14 percent with wraparound contacts, (5) processes for fabricating cells at low cost, (6) very thin covers and encapsulants, (7) evaluation of suitability of terrestrial cells for space use, and (8) an effort will be initiated in gallium arsenide solar cell technology.

W79-70228

506-23-15

Jet Propulsion Lab, Calif. Inst. of Tech., Pasadena
PLANETARY SOLAR ARRAY RESEARCH & TECHNOLOGY
J. A. Scott-Monck 213-354-6132

The research and technology objectives and plans for photovoltaic energy conversion are to improve conversion efficiency, reduce mass, reduce cost and increase the operating lifetime of photovoltaic converters and arrays. The following tasks are in support of the above objectives and targets of the FY-79 PASO: (1) demonstrate pilot production of thin (approximately 50 micrometer), large area (greater than or = 25 sq cm) silicon solar cells at efficiencies greater than 13 percent by FY-80, (2) to test and evaluate solar cells to develop an improved understanding of cell performance in space including characterizing cell types being considered for near term (0-7 years) mission use, with respect to temperature, intensity and space radiation effects, (3) to demonstrate blanket technology, compatible with the concept of automated fabrication for incorporation into greater than 120 W/kg planar solar arrays by FY-80, and to (4) demonstrate blanket technology and establish design criteria for concentrator-enhanced solar arrays in FY-82.

W79-70229

506-23-16

Goddard Space Flight Center, Greenbelt, Md
ATS-6 SOLAR CELL RADIATION DAMAGE EXPERIMENT AND A COMPILATION OF SOLAR ARRAY TESTING AND FLIGHT PERFORMANCE RESULTS
L. W. Slifer 301-982-4841

The objective of this RTOP is to extend the collection, analysis and reporting of data from the ATS-6 Solar Cell Radiation Damage Experiment and to compile, correlate and analyze results of solar array testing and results of flight performance. The final product

will be yearly reports of the ATS-6 results plus a document in which information pertaining to GSFC in-house solar array design components materials etc and their environmental performance in test and in flight is consolidated

W79-70230**506-23-22**

Lewis Research Center Cleveland Ohio

ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE

Stuart J Fordyce 216-433-4000

The objective of this program is to attain long life high energy densities high reliability and lower cost of electrochemical energy storage and conversion devices. The emphasis is on alkaline batteries separators operating techniques for improving life, H₂-O₂ fuel cells (alkaline) to operate at higher efficiency and endurance new membranes for solid polymer (SPE) with electrolyzers and exploratory studies on higher energy density systems. During FY-1979, the data base on the 12 AH long-life secondary silver-zinc will be completed and a new predictive model developed. Work on the silver hydrogen cell will be completed with demonstration of 40-watt hr/lb greater than 900 cycles in a 50 AH cell on synchronous orbit regime. The lightweight (25-watt hr/lb) nickel-cadmium program will be supported with lightweight electrodes and new separators on test, in sealed cells and discharge reconditioning methods and cell modifications defined. Battery separator technology will make a transition as the alkaline inorganic/organic technology is completed and new crosslinked solid solution polymer types continue to evolve. Multi-kilowatt hour storage technology will continue. The feasibility of the 100 AH toroidal Ni/Cd cell will be explored further and work begun on a new membrane for the SPE electrolyzer for use with a fuel cell in a storage system. Alkaline H₂-O₂ fuel cell technology will aim for 40 000-hour life, maintainable for energy storage application as well as orbital transfer vehicle applications. The exploration of less than 150 C sodium-intercalated cathode cell concept for 150-watt hr/lb continues.

W79-70231**506-23-25**

Jet Propulsion Lab Calif Inst of Tech Pasadena

ADVANCED NICKEL-CADMIUM AND PROBE BATTERIES

A A Uchiyama 213-354-4039

(506-23-22)

The objective of this RTOP is to provide the technology base for space battery power systems needed for use in near-earth space and in the exploration of the solar system. The specific objectives are to develop advanced nickel-cadmium and advanced orbiter and probe batteries with improved energy density longer life, and extended operational capability. The effort involves two major tasks with the following objectives: (1) to experimentally verify accelerated nickel-cadmium test methodology by the end of FY-79 and double the life and/or useable energy of nickel-cadmium batteries by the end of FY-81 and (2) to demonstrate a 330 W-hr/kg probe and lander lithium battery with storage life greater than 5 years by the end of FY-82, and establish feasibility of 5-year life geosynchronous application greater than 220 W-hr/kg secondary battery by the end of FY-82. The approach is to (1) achieve increased life and energy density of the nickel-cadmium system by developing and testing new technology components and integrating them into an optimized design, and by developing improved operational flight techniques and accelerated/predictive test methods and to (2) achieve high energy density primary and secondary batteries by development, test, and qualification of lithium batteries based on candidate couples such as LiSOCl₂ and Li-VCrS₂.

W79-70232**506-23-27**

Lyndon B Johnson Space Center, Houston Tex

ORBITAL ENERGY STORAGE AND POWER SYSTEM

Hoyt McBryar 713-525-6491

The objective of this program is to advance electrochemical cell technology to maximum efficiencies and life when used in a regenerative fuel cell configuration for application to large orbital energy conversion and storage requirements. This energy concept is based upon photovoltaic conversion of solar radiation, electrochemical conversion of appropriate materials through

electrolysis cells with intermediate fluid storage, and electrochemical recombination of the electrolyzed materials through fuel cells for darkside electrical power with reformation of starting materials. Through a series of contracted efforts and supported by mission and system analyses conducted by this agency, an energy conversion and storage concept using a breadboarded unit will be tested to begin developing a data base of systems interaction. A system design concept will evolve and ultimately culminate in fabrication of a representative sized engineering model for field demonstration to establish readiness of this technology for development toward orbital operations.

W79-70233**506-23-35**

Jet Propulsion Lab Calif Inst of Tech Pasadena

THERMOELECTRIC THERMIONIC ENERGY CONVERSION TECHNOLOGY

J F Mondt 213-354-6847

An electric propulsion stage with a 400 kWe power subsystem having a specific weight of approximately 20 kg/kWe can be used for exploration and intensive study of the solar system and its surroundings. The overall objectives of this RTOP are to demonstrate technology feasibility of a power S/S for electric propulsion and to improve energy conversion devices for RTG power S/S. The following three tasks (-01, -02, and -03) are contained within this RTOP in response to the Level IV elements of the OAST PASO document. The first task will (1) define and continually update the power subsystem design which is compatible with the mission requirements (2) delineate the critical technology that needs to be demonstrated and (3) experimentally demonstrate feasibility of the critical technologies. This will be accomplished by design analysis and integration of the power S/S with the NEP spacecraft by determining the operation parameters and material properties required of the technology, and by testing prototype sections of the power conversion system including heat source heat pipes insulators, power conversion modules and heat rejection system components. The second task will demonstrate the technology feasibility of thermionic and thermoelectric conversion at the temperature (1600 to 1800 K) power density and efficiency required for the power subsystem as defined in Task-01. Fabrication test and evaluation of new thermoelectric conversion materials and devices and of new thermionic converters will be used to accomplish this task. The third task will develop the technology for high efficiency thermoelectric and thermionic devices for use with the radioisotope or solar heat sources at temperatures around 1300 K. Analytical and experimental investigations of new devices concepts and materials with potentially high efficiencies will be conducted.

W79-70234**506-23-42**

Lewis Research Center Cleveland Ohio

SPACECRAFT CHARGING AND HIGH VOLTAGE-PLASMA EFFECTS

R C Finke 216-433-4000

The objective of this program is to investigate the interaction of space plasma environment with high voltage systems and spacecraft surfaces. As an output of this program, design guidelines for controlling the interactions will be issued. The environmental interactions considered in this program involve all interactions between spacecraft and the charged particle environments of space that can impact the operation or life of spacecraft systems. Specifically, investigations will be conducted to evaluate interactions between the geomagnetic substorm environment and spacecraft surfaces (spacecraft charging), interactions between high voltage spacecraft systems and the charged particle environment, and interactions between large space structures and the environment at various altitudes. The approach used to attain the program objectives is to conduct a comprehensive analytical and experimental technology program to identify the environmental fluxes and the interactions of concern, to evaluate these interactions to develop the design guidelines and to transfer this technology to designers of operational systems. The spacecraft charging portion of this program is being phased down (completion by end of FY-81, while the other aspects of the interactions are being emphasized).

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W79-70235

506-23-47

Lyndon B Johnson Space Center, Houston Tex
PLASMA AND RADIATION ENVIRONMENTAL INTERACTIONS EXPERIMENTS FOR APPLICATION TO LARGE SPACE POWER SYSTEMS
J E McCoy 713-483-6487

Two separate tasks are proposed Task 1 The Large Chamber Experimental Program is intended to provide a direct link between smaller scale experimental data, analytical models, and space flight systems, thereby reducing the risk and expense for flight experiments The objective is to conduct a combined experimental and analytical program to study the interaction of 1-10 meter size high voltage surfaces with space plasmas The program will (1) allow verification and scaling of (power leakage) data obtained in smaller scale experiments, (2) provide baseline data and verification of computer models to develop design criteria for large space power systems and (3) provide for preflight test and calibration of related flight test systems The program will employ the unique 20 meter dia Plasma Lab facility at JSC to provide simulated space plasma conditions for testing large models with adequate room available for free space development of the high voltage plasma sheaths without the usual limitations inherent to lab testing due to wall effects and scaling errors The work will be conducted in close coordination with existing lab and flight projects at LeRC and would be one part of the proposed joint AF/NASA Environmental Interaction Technology Investigation Task 2 Electron Precipitation Demonstration Based on feasibility studies by the Stanford Radioscience Lab in FY-78 and FY-79 definition study is proposed to complete the paper design of a shuttle experiment to demonstration capability to reduce the radiation belt intensity/hazard by VLF precipitation of electrons It is expected that this study would be followed in FY-80 by a hardware development proposal leading to flight readiness in 1981

W79-70236

506-23-52

Lewis Research Center, Cleveland Ohio
POWER MANAGEMENT AND LOW COST POWER SYSTEMS
Fred Teren 216-433-4000

The objective is to provide the technology base for low cost multi-KW Space Power Systems and Subsystems including Solar Photovoltaics, Energy Storage Electrical Components, Circuit Concepts Power Processing Transmission and Distribution needed for semi permanent low earth and geosynchronous power systems in the mid 1980s The proposed work will define and develop the technology necessary to both extend shuttle tended capabilities and establish semi-permanent central utility power capabilities essential to the habitation and development of near earth space In-house and contractor studies will be conducted to determine performance requirements, identify system constraints, estimate cost weight and size of potential space power systems, identify technology needs, and determine benefit/cost ratio of proposed technology programs Contractor/in-house analysis and experimentation will be used to define, develop and test components, circuit concepts subsystems and systems needed for low cost semi permanent earth orbital electrical power systems A strong activity will be maintained to coordinate with and support work at other NASA centers

W79-70237

506-23-55

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
PLANETARY POWER SYSTEMS R & T
D L Ross 213-354-4049
(506-22-25)

The objective is to provide the systems research base necessary for the very high-performance power systems required for long-life untended operation in hostile environments, as well as for electric propulsion, and to develop critical system components which permit the simultaneous achievement of low-cost and high-power space energy systems Two separate tasks (-01, -02) are contained within this RTOP The first task is to develop the capability of a spacecraft power system to automatically perform monitoring computational, command, and control functions without the need for ground intervention Future planetary exploration missions will result in long round-trip signal

time and large variations in power system operating parameters preventing the proper management of these power systems through conventional earth-based monitoring and command functions An existing spacecraft power system will be modified to incorporate a selected number of command control computational and monitoring functions Improvements in power system operation efficiency lifetime and reliability as a result of incorporating these functions will be demonstrated Technology readiness will be achieved at the end of FY-80 for an initial APSM The second task is to develop a lightweight power source capable of surviving the intense Mercury thermal environment Various solar thermoelectric generators (STG) configurations will be evaluated and demonstrated in a 10-16 sun simulation to ascertain feasibility and technology readiness by the end of FY-82 Conventional silicon solar cell array technology is inadequate to produce power in the existing thermal environment The STG development represents an enabling technology for the Mercury orbiter and other near sun missions

W79-70238

506-23-59

Marshall Space Flight Center Huntsville, Ala
MULTI-KW LOW COST EARTH ORBITAL SYSTEMS
J R Graves 205-453-2514

The objectives of this RTOP are to provide the technology and capability within NASA to process distribute, and control electrical power in 100 kW type systems and to reduce space energy costs through improved efficiency, life, reliability, and maintenance These objectives will be accomplished via a combination of in-house and contracted efforts and will consist of the following tasks (1) establish component and subsystem requirements sizes voltages and sensitivities and rank critical technologies consistent with overall system development, (2) design and develop the necessary power processing/conditioning circuitry for high voltage multi-kW power systems (3) develop utility-type power management and control techniques for space power systems, and (4) construct a system breadboard for evaluation and demonstration of new technologies and power management and control techniques

W79-70239

506-25-21

Ames Research Center Moffett Field Calif
CRYOGENIC TECHNOLOGY FOR COOLING DETECTORS BELOW 10 KELVIN

J W Vorreiter and H Lum 415-965-6525
(790-40-19, 188-78-51, 188-41-55 188-41-54, 506-18-11)

The objective of this effort is to provide space compatible technology for detectors requiring operating temperatures between 10 and 0.02 Kelvin Efforts will be directed in five general areas (1) maintain cognizance and coordination with all related cryogenic activities within NASA DoD NBS and ERDA to minimize possible duplication of effort, make maximum use of already existing technical talent and knowledge, and identify future NASA technology needs as well as recognize and evaluate possible new applications in this area, (2) develop space compatible cooling technology related components for photon detectors, gravity wave detectors and a large variety of superconducting devices (3) develop methods to protect cold optics from contamination (4) develop technology for three-year lifetime near earth helium space cryostats, and (5) investigate the application of high speed superconducting on-chip signal processors for on-board data compression from large infrared detector arrays

W79-70240

506-25-25

Jet Propulsion Lab, Calif Inst of Tech Pasadena
APPLIED MATHEMATICS AND ADVANCED CRYOGENIC TECHNOLOGY FOR SPACEFLIGHT
F B Estabrook 213-354-3247

The objectives are (1) to develop new methods of applied mathematics especially for nonlinear systems, and to apply these methods to problems where solitons and nonlinear or nonconservative wave processes are expected to be important, (2) provide technology for spaceborne cryogenic systems that cool from 10 K to 0.001, and (3) provide flight tested hardware for (1) low temperature cryogenic systems for 3-9-year missions, (2) spaceborne dilution refrigerators and (3) a multipurpose low temperature cryogenic system for shuttle flight A novel geometric

approach has been developed utilizing Cartan's calculus of exterior differential forms. The approach has led to our discovery of 'prolongation structures' or generalized potentials. The relation between prolongation structures, Backlund transformations, and variational principles is being investigated to obtain new analytic and computational techniques. As an example of other techniques and areas of investigation, the method of functional integration is being applied to soliton charge carriers in quasi-one-dimensional conductors and an extension of kinematic wave theory is under development for application to nonconservative wave motion in nonuniform shear flows. In FY-79 development will be initiated of technologies identified in FY-78 for low temperature systems for long duration missions. Studies will determine critical components for these systems and the fabricated components tested using breadboard subsystems. Conceptual design of a spaceborne adiabatic demagnetization refrigerator will identify critical components and subsystems that must be developed and tested. Continuing will be the investigation of the non-gravitational separation of experimental He-3 rich and He-4 rich phases of the He-3 He-4 dilution refrigerator working fluid. A breadboard refrigerator system incorporating a He-3 absorption cooler that utilizes special valves will be used to test refrigerator components. Modifications of these valves suitable for use in direct He transfer will be tested. Study of direct He transfer, both in the laboratory and in the KC135 aircraft facility, will continue using a unique apparatus designed for this purpose in FY-78.

W79-70241**506-25-26**

Goddard Space Flight Center, Greenbelt, Md
CRYOGENICS FOR SPACE FLIGHT
 Allan Sherman 301-982-5405

The overall objective of the cryogenics program is to provide low temperature technology which will be applicable to the large number of future missions that will require instrument cryogenic cooling. The program to accomplish these objectives includes technology development in the areas of mechanical coolers and solid cryogen coolers. The specific objectives of the mechanical cooler R&T program are (1) to develop the technology for a 3-5 year lifetime mechanical cooler with operating parameters (e.g. cold-end temperature, power requirement, etc.) that match NASA needs and (2) develop the technology that is required for a one year lifetime mechanical cooler that could be utilized prior to the development of the 3-5 year machine. The specific objectives of the solid cryogen program are (1) lifetime/capacity enhancement for a given size (2) temperature range extension down to 8 K, and (3) wider range of application for a given cooler system design.

W79-70242**506-25-27**

Lyndon B Johnson Space Center, Houston, Tex
ADSORPTION PUMPING CRYOGENIC REFRIGERATION
 R R Richard 713-483-2497

The objective of this RTOP is to develop an operational closed cycle Molecular Adsorption Refrigerator System (MARS). This refrigerator will be used for cooling infrared detectors used in remote sensor systems for scanning or for radiometric measurements. The final product will be a refrigerator producing three to five watts of cooling at liquid nitrogen temperatures in a form compatible with aircraft environments. The approach will be to optimize the adsorption pumping refrigerator concept perfected in previous efforts by the University of Texas. The adsorption pumping concept utilized zeolite crystals (also called molecular sieves) for gas storage and subsequent pressurization through the application of heat for the compression portion of the refrigeration cycle. After expansion and partial liquefaction through a Joule-Thompson valve, the unliquefied gas is adsorbed in a second zeolite storage container. Through appropriate reversal of functions and cycling gas is continuously liquefied. Since nitrogen is used as the prime refrigerant, precooling is required and this is accomplished with liquid nitrous oxide which is provided from an ancillary zeolite system.

W79-70243**506-25-29**

Marshall Space Flight Center, Huntsville, Ala
ADVANCED SUPERCONDUCTING INSTRUMENTATION

P N Peters 205-453-5134
 (188-41-54)

Existing facilities for thin film deposition and microfabrication are being utilized to investigate and develop advanced superconducting instrumentation compatible with flight experiments requiring cryogenically cooled surfaces. Superconducting thin film Josephson junctions individually and in arrays are being investigated and developed for magnetometry and radiation detector applications in space, and a design for a step-up dc superconducting transformer is being investigated as a possible coupling device. Investigations into solving coupling problems with the junction devices, the properties of superradiant array structures and detector response to photon energies greater than the superconducting energy gap are being pursued.

W79-70244**506-25-31**

Ames Research Center, Moffett Field, Calif
RADIANT ENERGY CONVERSION
 K W Billman 415-965-5233

The objective is to conduct basic research on the interactions of photons with matter for major advances in the generation, storage, transmission and utilization of energy. The focus will be basic research and in-depth analysis of selected concepts for radiant energy conversion in space. To this end the program will (1) expand the concept base in the area by continuing an examination of novel concepts for space energy conversion to define research needs and, (2) continue an in-depth examination of selected concepts. The first will be accomplished through continued solicitation of concepts, dialogue, literature search, seminars, and conferences. The second will involve sponsored and in-house analysis of promising areas such as the use of large-area lightweight space reflectors, novel radiator concepts, particle beams, and storage rings, direct photoemissive conversion, solar-thermionic conversion, solar-sustained plasmas, and the elements of any space laser power transmission system. Excitation means lasing scheme (e.g. direct solar excited free electron, etc.) and the laser energy converter.

W79-70245**506-25-33**

Langley Research Center, Hampton, Va
PHOTON-MATTER INTERACTIONS
 F Hohl and P F Holloway 804-827-3781

Research will be performed to characterize radiation induced plasmas and to obtain efficient high-power conversion of nuclear energy directly into electromagnetic radiation, laser power, or work. The interaction of fission fragments with uranium hexafluoride and with other gases will be determined. Radiation-induced plasma will be studied to determine possible population inversion, nonequilibrium emission and ionization and excitation cross sections. The potential of the recently achieved nuclear-pumped lasers for increased power output will be investigated. Also the possibility of new lasers in the ultraviolet and visible region with greatly increased power output will be studied. Studies for the selection of the most promising lasing medium and transitions will be performed using non-nuclear excitation. Actual tests will be performed using the U.S. Army Pulse Radiation Facility at Aberdeen, Maryland and other reactors. Intense broad-band UV and visible photon sources will be used to investigate broad-band pumped chemically reversible lasers and plasma heating. Efficient methods of converting broad-band and monochromatic photon energy directly to electricity and storable hydrogen and oxygen cells and protection of corrodible electrodes by inactive films or by passive electrolytes, will be investigated.

W79-70246**506-25-36**

Goddard Space Flight Center, Greenbelt, Md
SUBMILLIMETER-WAVE LASER RESEARCH
 N McAvoy 301-982-4943

The objective of this RTOP is to develop efficient, stable lasers emitting energy at the submillimeter wavelengths and to develop the measurement techniques associated with their application in receivers and radiometers. The approach is to use the common-resonator originated at GSFC to develop lasers suitable for space applications. The lasers developed under this program will then be employed as local oscillators in experimental test systems designed to measure atmospheric propagation at

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the submillimeter wavelengths detect molecules and radicals in the upper atmosphere perform spectroscopic studies of planetary and stellar gases, and conduct probing measurements of pressure, temperature, and wind velocity in the upper atmosphere

W79-70247

506-25-41

Ames Research Center, Moffett Field, Calif

LASER ENERGY CONVERSION AND APPLICATIONS

R L McKenzie 415-965-6158

The general objective is to incorporate modern laser technology and photophysics in a program to develop photodiagnostic techniques for the characterization of gaseous media in a dynamic state. In most cases, the gas will be flowing but it may also be dynamically unsteady and thermally or chemically out of equilibrium. In the near-term, primary emphasis has been placed on the measurement of turbulent fluctuations in the state variables of cold transonic and supersonic wind tunnel flows. For this fiscal year, the specific objectives are to investigate (1) new methods for the use of fluorescent and nonlinear optical phenomena to make nonintrusive measurements of density and temperature fluctuations at an arbitrary point in turbulent and separated flows, (2) new methods of three-dimensional flow visualization and streamline tracking using laser light scattering and interference techniques, and (3) generalized analytical methods for the design and analysis of polarizing optical networks leading to advanced optical instruments and laser elements useful in these photophysics applications

W79-70248

506-25-43

Langley Research Center, Hampton, Va

TUNABLE MOLECULAR LASERS

R V Hess and J E Stitt 804-827-2818

(506-18-12)

The broad objective of this program is to develop moderate to high power infrared, visible and ultraviolet lasers for remote sensing of the atmosphere of earth and other planets. The lasers will be developed for use on Shuttle, orbiters with higher available power and future planetary probes. Experiments and analysis will be performed to optimize lasers needed for such missions, i.e., repetitively pulsed, high frequency stability CO₂ lasers tunable in the 9-12 gamma m region at pressures from approximately 1/3 to 3 atm where continuous tuning with several CO₂ isotopes becomes possible. The high frequency stabilities are obtained using the novel approach of amplification by transient injection locking. A parametric study will be made for variations in the moderate/high power CO₂ laser medium pulse duration, and cavity, and in the very low power tunable lasers used for injection. Computer algorithms for CO₂ lasers will be extended to dye excimer, and Nd YAG lasers. Applications include remote sensing of trace constituents and Doppler wind velocities, photochemistry, and spinoffs to DOE and DOD.

W79-70249

506-26-11

Ames Research Center, Moffett Field, Calif

COMPUTATIONAL AND EXPERIMENTAL AEROTHERMODYNAMICS

J G Marvin 415-965-5390

The objective is to establish aerothermodynamic technology and configuration design concepts to improve vehicle safety, reliability, versatility, and aerodynamic efficiency with maximum payload for earth-orbital missions and planetary exploration. Advanced computational methods and computer codes will be developed for predicting vehicle flow fields and performance. Turbulence models (used in these computer codes) will be developed from building block numerical and physical experiments. New instrumentation techniques will be developed for the measurement of turbulence quantities in 3-dimensional flow fields.

W79-70250

506-26-13

Langley Research Center, Hampton, Va

SPACE VEHICLE AEROTHERMODYNAMICS AND CONFIGURATION TECHNOLOGY

B Z Henry and P F Holloway 804-827-3911

The objective is to develop configuration design concepts and the associated aerothermodynamic technology data base

which will allow the achievement of space transportation vehicles operational in the 1990s and beyond which offer significant improvement in operational efficiency, economy and safety. The intent is to study both analytically and experimentally, configuration concepts utilizing technologies advanced beyond the base being established by the space shuttle. Specific studies will be directed toward solution of the aerothermodynamic problems associated with these concepts in such areas as aerodynamic performance, viscous-interaction and real-gas effects, vortex interactions, heat transfer, basic configuration shaping and optimization. Computational flow-field methods will be developed with emphasis on realistic configurations and techniques for integrated configuration design analysis and optimization will be developed and continuously improved. Feasibility studies of the use of the Space Shuttle Orbiter to obtain fundamental aerothermodynamic data applicable to future vehicle design will be pursued. Various perfect gas and real-gas facilities will be utilized in experimental investigations to provide design data over a broad range of parameters.

W79-70251

506-26-21

Ames Research Center, Moffett Field, Calif

PLANETARY PROBE AEROTHERMODYNAMIC TECHNOLOGY

H K Larson 415-965-5269

(506-16-41)

This effort is directed at providing the aerothermodynamic technology base in high-speed aerothermodynamics required for the design, development, and verification of probes entering planetary atmospheres and to provide computational and experimental support in a timely manner, for the specific development of planned and approved missions in accord with the following targets: (1) to provide a complete understanding and prediction of the shock-layer and ablation product radiative gasdynamics for planetary entry vehicles, (2) to provide coupled flow field/ablation solutions for the outer planet probe, (3) to provide systematically coupled performance analysis, (4) to support the aerodynamic development of planetary probe configurations and to provide the flight mechanics data in support of atmospheric reconstruction experiments. The coupled nature of outer planet probe aerothermodynamics requires a highly integrated computational and experimental program. The theoretical and experimental efforts in the area of shock-layer radiation must be coupled with similar efforts in ablation product radiation and absorption. These efforts in turn must be coupled with research associated with shock layer flow which is highly blown by ablation products. In addition, the flight mechanics of the probe, both static and dynamic, are significantly affected by the ablation mass loss and shape change. Finally, all these theoretical efforts and experimental validations must be systematically coupled computationally to provide the required aerothermodynamic input to outer planet probe development.

W79-70252

506-26-23

Langley Research Center, Hampton, Va

PLANETARY MISSION SUPPORT

G D Walberg and P F Holloway 804-827-3031

The objectives are (1) to provide computational and experimental support as required for aerothermodynamic design, development and verification of planetary mission vehicle configurations with special emphasis on the Jupiter Orbiter/Probe mission, (2) to develop a technology base that can be used to minimize planetary mission costs, maximize science return, and insure a high probability of mission success, and (3) to support atmospheric reconstruction experiments through ground-based aerodynamic tests and analyses, and through development of trajectory reconstruction analyses that allow deduction of vehicle aerodynamic and planetary atmospheric characteristics from entry data. These objectives will be pursued using analytical and experimental methods and will be conducted primarily in-house with contract support as justified. This work will encompass the following topics: (1) refinement of benchmark flow field solution techniques for outer planet entries, (2) use of benchmark solutions to predict entry environments for Jupiter (Project Galileo) and Saturn probe missions, (3) development of "engineering" flow field solution techniques for Jovian entry, (4) experimental

measurement of radiative properties of ablation products. (5) determination of planetary probe aerodynamic characteristics from ground tests and analysis of flight data from Viking and Pioneer Venus. (6) development of wake flow and base heating solutions for Jovian entry and (7) studies of effects of mass loss, shape change and real gas aerodynamics on atmospheric reconstruction experiments

W79-70253**506-26-31**

Ames Research Center, Moffett Field Calif

SPACE SHUTTLE: CONFIGURATIONS AND AEROTHERMODYNAMICS

J G Marvin 415-965-5390

The objective is to provide the analytical and experimental support to the Shuttle Program Office as required for aerothermodynamic design, development, and verification of the shuttle orbiter, launch and ferry configurations and subsystems. The necessary expertise and facilities will be provided to support in-house and program-generated action items as required during the design development and verification of the space shuttle. A single flow field computer code will be developed to simulate the hypersonic nonequilibrium flow over the windward surfaces of the space shuttle orbiter.

W79-70254**506-26-33**

Langley Research Center, Hampton Va

SPACE SHUTTLE DEVELOPMENT SUPPORT

B Z Henry and P F Holloway 804-827-3911

This RTOP focuses Langley's expertise in configuration aerothermodynamics and operational flight mechanics on those concerns having greatest impact on successful development of the shuttle. The RTOP supports the shuttle program by (1) providing time in Langley ground-based facilities for direct OSF/contractor-requested support, (2) continuing independent in-house shuttle technology and development studies and (3) responding to specifically requested task-study areas from the Program Office at JSC. In addition, Langley will perform independent evaluations and assessments of the configurations and operational modes and requirements as necessary. This RTOP's program is coordinated with other NASA Centers and the Phase C/D contractor through appropriate Program Office Engineering Coordination Panels at JSC.

System Studies (Space)**W79-70255****790-40-11**

Ames Research Center, Moffett Field Calif

SPACE-BASED PLANETARY DETECTION SYSTEMS

D C Black 415-965-5527

(790-40-06)

The objective of this RTOP is to study space-based methods of detecting other planetary systems. The methods to be studied are infrared interferometry and apodization of optical telescopes. The approach is (1) to examine the feasibility of detecting planets by space-based instrumentation, (2) to delineate such instrumentation in sufficient detail to identify areas where advanced technology development is required, and (3) to undertake a preliminary cost analysis of space-based planetary detection systems.

W79-70256**790-40-12**

Lewis Research Center, Cleveland, Ohio

ELECTRIC PROPULSION FOR AUXILIARY CONTROL OF LARGE SPACE SYSTEMS

Fred Teren 216-433-4000

(790-40-22, 506-22-12, 506-22-22)

The objective is to identify technology needs and development options for potential future missions and to evaluate and rank candidate technical advancements for use in technical plan generation. Studies of advanced propulsion systems for future vehicles are being conducted. In-house and contract studies of electric propulsion for applications in near-earth space have been started and will continue in FY-79 with additional R&D sponsorship provided by RTOP 506-22-22. Studies of low-thrust chemical

propulsion systems currently on-going are transferred from this RTOP to 709-40-22. Dual-fuel OTV engine studies will be completed and the results transferred to user centers prior to the start of FY-79. In FY-79 a program will be initiated to study the application of electric propulsion for auxiliary control of large space systems. The objective of the program is to define areas where electric propulsion enables or significantly enhances the control of large space systems and to define the required electric propulsion technology for such applications. These study activities will be closely coordinated with evolving large space system technical activities.

W79-70257**790-40-13**

Langley Research Center, Hampton, Va

TECHNOLOGY REQUIREMENTS OF A GLOBAL INFORMATION SERVICE SYSTEM

W R Hook 804-827-3666

(790-40-23, 524-70-03)

An interCenter team is continuing the study of an advanced global information services system in order to provide timely information for planning the Agency's advanced research and technology programs. Based on current studies, an Advanced Data Acquisition Platform (DAP) and a Geosynchronous Information Service Platform (GISP) have been selected for detailed analyses. Current work has produced a baseline DAP systems description. Detailed parametric analysis will be performed for each subsystem/discipline area. Figures of merit for competing technologies will be established. A system concept for a GISP was proposed as a result of previous work. Current effort will produce a set of mission requirements for such a vehicle. A baseline design for a GISP will be produced under this effort. The overall objectives of this work are (1) to develop a new concept of global services to the public sector, (2) to assess the feasibility of developing, constructing, and flying the DAP & GISP, (3) to make enabling technology forecasts in the disciplines of propulsion, power, materials, structures, and electronics, and (4) to identify technology needs, development options, and necessary space flight experiments. The technology forecast will be based on independent studies and access to classified company proprietary and foreign technology programs. Resulting information will be important to both Center and Headquarters management to support research and technology development planning.

W79-70258**790-40-15**

Jet Propulsion Lab., Calif Inst of Tech., Pasadena

ADVANCED AUTOMATION NEEDS ANALYSIS

E Heer 213-354-3060

During FY-77 and FY-78, the NASA Study Group on Machine Intelligence and Robotics has examined the means by which advanced automation can contribute to the enhancement or enablement of future NASA missions and programs. The Study Group has prepared a final report on its findings and made recommendations to NASA management. The objectives of this RTOP are (1) to review and evaluate the Study Group's recommendation in the light of NASA needs and cost constraints, and (2) to develop a plan for incorporating the Study Group's representatives from NASA/HQ, JPL, LaRC, GSFC, KSC, MSFC, JSC and ARC. This group will hold two meetings at NASA/HQ and will make recommendations for incorporating the Study Group's recommendation into the New Initiative Plan.

W79-70259**790-40-22**

Lewis Research Center, Cleveland, Ohio

LOW-THRUST CHEMICAL PROPULSION SYSTEMS FOR EARTH ORBITING MISSIONS

Fred Teren 216-433-4000

The objective is to identify propulsion system and technology alternatives for near-term missions and to provide an evaluation of alternatives for use in agency planning. Low-thrust chemical propulsion systems for earth orbital missions will be studied. Candidates include systems using hydrogen-oxygen or storable propellant combinations. Focus of the studies will be on LEO-GEO orbit raising and both in-house and contracted studies will be conducted.

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W79-70260

790-40-31

Ames Research Center Moffett Field Calif

ADVANCED SPACE MISSION CONCEPTS-SYSTEM STUDIES

J P Murphy and H Lum 415-965-6520

(358-41-06 506-18-11, 506-19-15 506-25-21, 790-14-11)

The objective of this RTOP is to study advanced space system mission concepts. The studies to be conducted will provide a definition of baseline system concepts and subsystem and technology requirements. System performance will be predicted based on both existing and projected technology. Program implementation requirements will be determined based on an assessment of relevant technology. New technology initiatives required to enable or enhance the system concepts will be clearly identified. The approach is to conduct studies on two potential mission concepts: a Large Ambient Deployable Infrared (IR) Telescope and a shuttle Infrared (IR) Interferometer. Both of these concepts have been identified by OSS as possible missions for the late 1980's or early 1990's. An additional study will be conducted on Orbiting Reflectors for Augmented Terrestrial Insolation.

W79-70261

790-40-32

Lewis Research Center, Cleveland, Ohio

ADVANCED MISSION CONCEPTS SPACEBORNE MEGAWATT POWER SYSTEMS

Fred Teren 216-433-4000

(506-23-52)

The objectives of this RTOP are to forecast future systems and to develop projected technology needs in their support. In FY-79, technology needs for a megawatt power system for space applications will be studied. Future missions and mission requirements which require megawatt power systems for use in space, such as global services or space industrialization, will be identified. Technology needs will be identified in the areas of power generation, energy storage and power distribution and conversion. Contractor studies and in-house analysis support will be used to identify potential missions and define the systems and subsystems needed for earth orbital megawatt power. The similarity and differences between multi-kW and megawatt technologies will be identified to determine the drivers for technology choices. The studies will determine system constraints, performance requirements and evaluate the potential benefits of proposed technology efforts. This effort will be coordinated with work at other NASA Centers.

W79-70262

790-40-33

Langley Research Center Hampton, Va

TECHNOLOGY REQUIREMENTS OF INTEGRATED EARTH-TO-GEOSYNCHRONOUS SPACE TRANSPORTATION SYSTEMS

B Z Henry and P F Holloway 804-827-3911

The objective of this study is to identify and evaluate the technology required for the design and operation of advanced systems capable of meeting the goals of economical transportation within the earth-moon sphere of influence in the post-shuttle timeframe. The intent is to analyze potentially attractive concepts which build upon the technology base developed for the space shuttle program utilizing projected advances in the areas of materials, structural design, propulsion, aerothermodynamics, design interaction and others. Definition of approaches to advanced system design and a detailed examination of the relative impact of assumptions as to achievable levels of various technologies offer a suitable means of identifying those technologies which are crucial as well as those most cost effective; this identification will be a primary output of the effort. An inherent characteristic of any such advanced system is that it offers clear and significant cost/capability advantages relative to current systems. Programs to provide solutions to key technology issues will be designed based on the results of these studies. The activity will be pursued through a series of contractual system studies, technology planning, methodology development studies, and selected in-house analyses as required.

W79-70263

790-40-36

Goddard Space Flight Center, Greenbelt, Md

ADVANCE MISSION CONCEPTS

A F Durham 301-982-2889

The objective of this RTOP is to identify the system technology that constrains our ability to develop the space missions for the last decade of this century. Selected major systems will be defined and their technology constraints identified and assessed thus providing input data for planning the development of future technology. A Global Services System was selected in 1978, for the first application of this RTOP. Working with an inter-center team, led by Langley Research Center, GSFC is responsible for the communications and information management technologies, and for supporting LaRC in the overall system design.

W79-70264

790-40-37

Lyndon B Johnson Space Center, Houston, Tex

SPACE APPLICATIONS OF NON-TERRESTRIAL RESOURCES

E M Crum 713-483-3083

The primary purpose of this RTOP is to reduce the uncertainties and improve the design details in the comparison of the relative merits of constructing large space structures with materials from the moon and from the earth. It will continue the previous concept definition and comparison studies, amplifying and defining in greater detail selected concepts. More sophisticated sensitivity, decision, and cost analyses will be conducted. The uncertainty in defining the feasibility threshold for lunar material use will be narrowed and a preferred lunar utilization concept will be recommended.

W79-70265

790-40-39

Marshall Space Flight Center, Huntsville, Ala

NON-TERRESTRIAL PROCESSING AND MANUFACTURING OF LARGE SPACE SYSTEMS

Georg vonTiesenhausen 205-453-2789

A study will be performed on the utilization of nonterrestrial materials in the construction of large space systems. It will define the technical requirements and assess economic, resource, environmental and other consequences. The study product will be a comparison of large space systems construction from terrestrial and nonterrestrial materials and a definition of critical technology areas involved. The results of prior studies on large-scale processing and manufacturing will be consolidated and evaluated as related to this requirement.

Space Systems Technology Programs

W79-70266

520-73-06

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

NASA END-TO-END DATA SYSTEMS. MODULAR DATA SYSTEMS

M Ebersole 213-354-4595

(506-20-15)

The broad objectives of this task are to build on the technology developed in the NEEDS Phase I Program to develop a modular spacecraft-data-system concept which would satisfy the onboard spacecraft data handling and control requirements for multi-purpose earth-orbiting and planetary spacecraft. The modular data system would incorporate the systems technology, software and advanced microcomputer technology to provide spacecraft that (1) are adaptive, (2) provide simplified spacecraft/operator interaction, and (3) provide automated on-board fault recovery. The general approach to the development is to first formulate a baseline mission set and generate the functional requirements for the Modular Data System. The requirements then would serve as the basis for the development of the modular data system technology. The modular data system concept would be proven first by a breadboard demonstration, and would ultimately culminate in an integrated shuttle demonstration with the GSFC.

W79-70267

524-71-03

Langley Research Center, Hampton, Va

CASTS-COMPOSITES FOR ADVANCED SPACE TRANS-

PORTATION SYSTEMS

J G David, Jr and R R Heldenfels 804-827-2125
(505-01-33, 505-02-33, 517-53-13)

The broad objective is to increase the maximum operating temperature of resin-matrix composite materials for structural applications to 600 F to meet requirements for advanced space transportation systems and payloads. This objective will be achieved through a joint in-house and aerospace industry contract effort which will include (1) development and characterization of currently available polyimide resins and adhesives and new resin systems, (2) development of manufacturing and quality control procedures (3) development of thermal structural design methods (4) design fabrication and ground tests of small scale components and full scale space structure demonstration components

W79-70268

Langley Research Center, Hampton, Va
LARGE SPACE SYSTEMS TECHNOLOGY
H T Wright 804-827-4606
(524-70-03, 506-17-13)

524-72-03

Systems level activities will be conducted to clearly define the multidisciplinary technology requirements for large space systems. Preliminary technology concepts including analysis and design methods will be developed and evaluated for erectable, deployable, and space-fabricated structures. Composites, improved membrane material systems and other advanced materials will be developed and evaluated for application to large space structures. The needed technology to design and synthesize control systems, possibly using distributed control techniques, for large space systems will be developed, and the interaction between the control system and structure understood. Accurate surface measurement and control techniques will be developed. Electrical/electronic technology will be developed to provide data and power distribution systems for large space structures. Ground test philosophies and techniques as well as the identification of future flight experiments will be defined to evaluate key technology developments. The Langley Research Center has been designated as the lead center for the Large Space Systems Technology (LSST) Program. The LSST Program Office at Langley will plan and coordinate the development of technology for large space systems among the five participating NASA centers.

W79-70269

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
LONG LIFE SPACE STORABLE PROPULSION SYSTEMS TECHNOLOGY
D L Young 213-354-3217
(506-21-25)

525-71-05

The overall objective of this effort is to demonstrate technology readiness of a complete spacecraft-sized, flight-weight fluorine-hydrazine (F₂/N₂H₄) propulsion system by the end of FY 1982, using both past and on-going individual component and system-related developments. The demonstration will consist of a hot-fire test of the complete system to a preselected duty cycle that will simulate a typical application. The system level design effort initiated during FY-77 will continue through the critical design review to be held in mid FY 1980. The system configuration and structural layouts have been completed and the structural detail design will be completed in FY-79. System thermal studies have been completed which indicate system feasibility for long-term planetary missions. The system level thermal verification test plan will be completed in early FY 1980 and assembly and testing in the thermal vacuum simulator will be completed in early FY 1981. System procurements and assembly will be accomplished in FY 1981 culminating in the full system demonstration test in FY 1982. The feed assembly components and rocket engine assembly to be used in this demonstration system are being designed and fabricated under RTOP 506-21-25.

SHUTTLE PAYLOAD DEFINITION, SPACE FLIGHT TECHNOLOGY EXPERIMENTS

Fred Teren 216-433-4000
(750-03-21)

This effort is to conduct definition studies for potential shuttle/spacelab experiments which support, complement or proceed from OAST research and technology programs specifically to determine the technical and programmatic requirements for the experiment effort. A definition study will be carried out on a Spacelab Two Phase Fluid Mechanics and Heat Transfer Facility.

W79-70271

Lewis Research Center, Cleveland, Ohio
DEFINITION OF PHYSICS AND CHEMISTRY EXPERIMENTS IN SPACE (COMBUSTION AND FLUID MECHANICS)
Fred Teren 216-433-4000
(506-21-42, 506-21-12)

750-01-52

This effort is to conduct definition studies for potential Spacelab experiments which support, complement, or proceed from OAST research and technology programs specifically to determine the technical and programmatic requirements for the experiment effort. Definition studies will be carried out in fluid physics on mass transfer, bubble motion, fluid surface dynamics and capillarity, connection phenomena, and multiphase mixtures. In combustion, studies will be pursued in premixed gaseous combustion, gas jet combustion, droplet and particle combustion, large surface liquid and solid combustion, combustion of particle clouds, ignition and autoignition, extinguishment, and gravitational scaling. All efforts are to be consistent with the recommendations of the physics and chemistry experiments working group, including stipulations.

W79-70272

Marshall Space Flight Center, Huntsville, Ala
DEFINITION OF PHYSICS AND CHEMISTRY EXPERIMENTS (PACE) IN SPACE
George H Fichtl 205-453-0875
(750-03-26)

750-01-59

The objective of this RTOP is the conduct of scientific and feasibility studies of candidate experiments, in the area of the physics and chemistry of fluids, granular media, and relativity theory which require and utilize the unique environment of earth orbit. The candidate experiments (tasks listed below) are motivated by the need to resolve fundamental scientific problems and issues which are of significant importance in the areas of pure and applied physics and which relate to national needs. The approach for this effort will be based on the PACE Committee phasing of effort. The total effort involves six tasks, namely (1) - G-Jitter Effects in Fluid (2) - Basic Soil Behavior, (4) - Nematic Fluid Mechanics, (5) - Liquid/Gas Interfacial Contamination Effects, (6) - Stochastic Differential Equations for G-Jitter Effects, and (7) - Soil Dynamics.

W79-70273

Langley Research Center, Hampton, Va
LONG DURATION EXPOSURE FACILITY PROJECT
W H Kinard and H T Wright 804-827-3704

750-02-01

The broad LDEF Project objectives are the following to develop LDEF, a simple, low cost, free-flying facility for performing long duration technology and other experiments in the space environment using the STS. To develop a first set of experiments for the facility and, by the performance of these experiments, obtain valuable technological data and demonstrate the unique shuttle/LDEF capabilities and features. To broaden the STS user community by providing a simple low cost approach to integrate and operate a large number of OAST and other unmanned long duration experiments via the STS. The LDEF is a reusable, unmanned, low cost, free-flying structure on which many different experiments can be mounted. The facility will be delivered to earth orbit by the shuttle. After an extended period in orbit, the facility will be retrieved on a subsequent shuttle flight and returned to earth for experiment analysis. Many of the experiments being considered for the LDEF are completely passive with the active

Space Experimental Programs

W79-70270

Lewis Research Center, Cleveland, Ohio

750-01-22

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data measurements being made in the laboratory after the experiments are returned

W79-70274

750-03-01

Jet Propulsion Lab Calif Inst of Tech, Pasadena DEVELOPMENT OF A SHUTTLE FLIGHT EXPERIMENT DROP DYNAMICS MODULE

Dave H Swenson 213-354-5110

The principal objective of this RTOP is to design fabricate and test an acoustic positioning and manipulation module for Spacelab and to utilize it to perform an initial set of experiments as part of the NASA Physics and Chemistry in Space Program on an early shuttle/spacelab flight. The module is scheduled to be ready for the ESA-NASA joint Spacelab mission, and will be available for Spacelab flights thereafter. This acoustic positioning and manipulation module will allow us to utilize the unique zero-G environment provided by a shuttle/spacelab flight to perform drop dynamics experiments that are impossible to perform in a gravitational field. Examples are (1) study experimentally the problems first proposed by Newton, and never satisfactorily studied of equilibrium figures and the bifurcation processes of a rotating spheroid, and (2) understand the fission and fusion processes in drops that are also applicable to meteorology and nuclear physics. The scope of this work is threefold. First to determine the maximum capability of this facility within the constraints of money and schedule through consultation with the scientific community and investigators. Second to fabricate a flight unit, and third to perform an initial set of experiments (Drop Dynamics), as part of the NASA Physics and Chemistry in Space Program. The scientific community will be invited to participate in experiments informally through international symposia and colloquia. Some scientists will participate with JPL as science associates and consultants. Others will presumably submit experiments in response to NASA AFO's.

W79-70275

750-03-02

Marshall Space Flight Center Huntsville, Ala DEVELOPMENT OF AN INDUCED ENVIRONMENT CONTAMINATION MONITOR (IECM)

Edgar R Miller 205-453-5130

The broad objectives of the Induced Environment Contamination Monitor (IECM) are to conduct an indepth survey of potential contamination to experiments from the induced environment in and around the STS on early flights (LDEF, OFT, Spacelab). A set of contamination measuring instruments will be developed and built. These instruments will be integrated into a self-contained flight package to verify the specified requirements (in Volume X of JSC Document 0770) to identify contamination sources, and to detect and monitor environment contamination during all mission phases, including delivery, deployment, retrieval and landing a free-flying payload.

W79-70276

750-03-03

Langley Research Center, Hampton, Va LASER HETERODYNE SPECTROMETER FOR SPACELAB R J Duckett and P F Holloway 804-827-4571 (506-18-23)

The overall objective is to test a Laser Heterodyne Spectrometer (LHS) instrument on an early Spacelab flight to prove the design of the instrument and demonstrate its capability as a multi-pollutant remote sensing system. This demonstrated capability will provide high specificity, high sensitivity measurements for determining the vertical and horizontal distribution of trace constituents involved in the photochemical processes related to stratospheric ozone depletion. In carrying out this mission the LHS instrument will be operated in the solar occultation mode to measure four gases including HNO₃, O₃, and Freon 11 and 12. The instrument will be designed, developed, and fabricated for this specific mission which is anticipated to last for 7 days. Algorithms will be developed to reduce the data into a format suitable for utilization in global stratospheric pollution models. The data will be compared with existing stratospheric models to provide an evaluation of instrument performance. Subsequent measurements with the LHS instrument will be extended to include other stratospheric species such as ClO, NO_x, CO, and SO₂.

W79-70277

750-03-04

Marshall Space Flight Center, Huntsville, Ala SHUTTLE OPERATIONAL FLIGHT TEST OF THE SOLAR ELECTRIC PROPULSION SOLAR ARRAY L E Young 205-453-2110 (506-23-19)

The objective of this RTOP is to provide overall demonstration of the availability of advanced solar array technology by flight testing the Solar Electric Propulsion (SEP) Solar Array as an experiment on the shuttle. Demonstrating that the array will deploy and retract in a space environment and establishing its dynamic characteristics are objectives which are particularly important. The approach consists of four basic steps as follows: (1) define through study and analysis, the requirements criteria and conceptual design for the solar array system experiment; (2) draw a detailed design, build and test the flight array experiment; (3) install and fly the solar array experiment on Shuttle; and (4) evaluate flight results after return to Earth.

W79-70278

750-03-07

Goddard Space Flight Center, Greenbelt, Md THERMAL CANISTER EXPERIMENT Stanford Ollendorf 301-982-5228

The broad project objectives for the Thermal Canister Experiment is to demonstrate the performance in space of an experimental thermal control canister using heat pipes. The primary specific objectives of the Thermal Canister Experiment are to design, fabricate, and test a Thermal Canister 1m x 1m x 3m weighing 160 kg which when flown aboard Space Shuttle on an OFT mission will verify the ability of a system of heat pipes to provide thermal control, and to maintain canister wall temperature level to 15 C + or - 3 C while dissipating 100 watts at maximum flux conditions (full sun) to 400 watts at minimum flux (earth oriented) conditions. In addition, secondary objectives are to verify performance of the canister at off nominal design points such as (1) operation over a temperature range of 5 C to 25 C and determination of maximum heat rejection and control band at these points and (2) maintenance of + or - 10 C control when operating under passive control. The general design approach is to incorporate elements of thermal control technology such as fixed conductance and variable conductance heat pipes into a canister with radiators for controlling the temperature of simulated instruments and other suitable experiments.

W79-70279

750-03-12

Jet Propulsion Lab, Calif Inst of Tech, Pasadena PROPULSION CONTAMINATION EFFECTS MODULE-PCEM SPACEFLIGHT EXPERIMENT L F Molinar 213-354-4515 (506-21-45)

The Propulsion Contamination Effects Module (PCEM) will be used in tests to measure such rocket thruster exhaust plume characteristics as core flow and back flow efflux (mass and constituents), electrical charge buildup, impingement forces and heating rates, in a series of spaceflight experiments to be flown in the payload bay of the space shuttle orbiter. The PCEM facility will be designed and fabricated to initially accommodate a 110N (25 lbf) monopropellant hydrazine propulsion system provided by MSFC. Design modification kits will enable the PCEM to subsequently accommodate other propulsion systems including a 3870N (870 lbf) N₂O₄/MMH liquid bipropellant system (JPL), 00044N (0.001lbf) and 0.13N (0.03lbf) ion Drive engines (LeRC), a 4450 N (1000 lbf) solid rocket motor (JPL) and a 2225-4450 N (500-1000 lbf) O₂/H₂ liquid bipropellant system (LeRC). The payload category of the PCEM is attached experiment space available class B (AE/SA-B). The objectives for the PCEM facility in fiscal year 1979 include the preliminary design effort, a PDR, and the initial safety review. In addition, the flight configuration design for the facility will be evolved during FY-79. The technical approach is to design and fabricate a propulsion system test facility for a series of rocket thruster plume experiments in the payload bay of the Space Shuttle Orbiter. The facility will be designed to accommodate various types of propulsion systems and will include the basic science instrumentation systems for measurement of plume parameters. In parallel

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with the above the propulsion systems will be designed as a package to be integrated into the facility. The flight experiments and the reports will be the third phase of the project.

W79-70280 750-03-13

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
SPACELAB II SUPERFLUID HELIUM EXPERIMENT
 David H Swenson 213-354-5110

An experiment to investigate the properties of superfluid helium in zero gravity is proposed for flight on Spacelab II in early 1981. The experiment will determine the mechanical and thermal properties of superfluid helium in sufficient detail to enable the design of high performance space qualified superfluid cryogen systems. A companion experiment will study the properties of low velocity capillary waves in thin films of superfluid helium. These waves cannot be observed in the earth's gravity. Their study will increase scientific understanding of the interaction of normal and superfluid helium. The experiment will consist of an instrumented cryostat, an experiment package mounted inside the cryostat and an electronics control and data processing electronics package. It will be mounted on a Spacelab pallet and will interface with the Spacelab Command and Data Management System. Interactive control with experimenters on the ground will permit optimization of scientific results by real time modification of experimental conditions and parameters.

W79-70281 750-03-14

Langley Research Center, Hampton, Va
FEATURE IDENTIFICATION AND LOCATION EXPERIMENT (FILE)
 W L Howel and J E Stitt 804-827-3551
 (506-19-23)

A landmark classification experiment to classify, in real time, the content of scenes observed by earth-viewing systems is proposed for evaluation aboard an early shuttle flight. The instrument as proposed will classify scene content into vegetation, bare earth, water or clouds. This classification is based on ratios of spectral signatures in the 0.65 and 0.85 micron bands. The results will not only provide an instrument to use in the classification of scene content in future missions, but will also provide data for the further development of a landmark tracker for tracking the boundaries of these interfaces.

W79-70282 750-03-18

Lewis Research Center, Cleveland, Ohio
CRYOGENIC FLUID MANAGEMENT
 Robert R Lovell 216-433-4000
 (506-21-12)

A shuttle spacelab flight experiment will be developed to obtain data on the storage and supply of subcritical cryogenic fluids in a low-g environment.

W79-70283 750-03-20

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
SPACE CALIBRATION OF SOLAR CELLS
 L B Sidwell 213-354-5489
 (506-23-15)

The objective of this program is to continue the solar cell calibration program taking advantage of the space environment of Spacelab and to correlate these data with those obtained from balloon flights. The Spacelab program will provide the opportunity to evaluate existing calibration procedures as applied to current and new types of photovoltaic devices being developed for future space solar power applications. In FY-78 the rescope Space Calibration of Solar Cell experiment definition was completed, and a project plan developed. Work to be accomplished in FY-79 includes design of the experiment including ground support equipment. At completion of the design a design review will be held. The contract for the data system including the recorder, will be placed and fabrication of the experiment and GSE will begin. Fabrication of the experiment will be completed and system and environmental testing will be started and completed in FY-80. The safety and preintegration reviews will be held. During the last quarter of FY-80 the experiment will be ready for integration with Spacelab. Integration support will be provided during FY-81 with the flight expected during the

last quarter. The RP funded balloon flight will take place during the last quarter of this FY. On completion of both flights the RP funded data reduction will begin with completion and final report expected by the end of the first quarter FY-82. Candidate test solar cell specimens will be selected in advance of the Spacelab flight with similar solar cells to be flown on a concurrent scheduled high altitude balloon flight calibration experiment for comparative analysis.

W79-70284 750-03-25

Lewis Research Center, Cleveland, Ohio
SPACELAB O-G COMBUSTION FACILITY
 Robert R Lovell 216-433-4000
 (750-01-52, 506-21-42)

A Spacelab facility will be developed to provide a capability to perform combustion experiments in the low-g environment of space. This effort will involve the user community throughout the design phase in order to make the facility as universal as possible.

W79-70285 750-03-26

Marshall Space Flight Center, Huntsville, Ala
GEOPHYSICAL FLUID FLOW EXPERIMENTS ON SPACE-LAB

George H Fichtl 205-453-0875
 (750-01-59)

This effort has, as its objective, the successful performance of geophysical fluid flow experiments on the first and third Spacelab missions with scientific team members Profs John E Hart (PI) and Juri Toomre (CI) of the University of Colorado, Dr Peter Gilman (CI) of the High Altitude Observatory, National Center for Atmospheric Research, and Drs George H Fichtl (CI) and William W Flowis (CI) of the NASA/MSFC. An experiment is viewed by the PI/CI team as being composed of the scientific theoretical and groundbased laboratory studies of PI/CI team members, the flight of the Geophysical Fluid Flow Cell (GFFC) (the instrument within which the experiments shall be performed) and the postflight analysis in which experimental and theoretical results will be analyzed, compared and correlated by the PI/CI team and other members of the scientific Geophysical Fluid Dynamics (GFD) community. The scientific approach for accomplishing the GFD experiments shall be to use a spinning spherical capacitor (in Earth orbit to eliminate background gravitational forces) with a dielectric fluid and an imposed radial electric field across the capacitor gap to simulate radial gravitational force field to, in turn, simulate GFD systems like the convective zone of the sun, planetary atmospheres, etc. With this experimental arrangement the vector relationship between the simulated gravitational field and the rotation vector consistent with solar and planetary flows will be obtained. The programmatic approach will be a balanced effort involving (1) experiment instrument definition, (2) science definition and support, (3) instrument design, fabrication and test, (4) flight of the instrument on the Spacelab, (5) postflight data analysis and comparison and correlation of results with theoretical predictions.

W79-70286 750-03-27

Marshall Space Flight Center, Huntsville, Ala
TRIBOLOGICAL EXPERIMENTS IN ZERO GRAVITY
 R L Gause 205-453-1500

The following paragraphs summarize the technical scope of two tribological experiments selected for development for flight on Spacelab. The experiment entitled, Tribological Studies of Fluid Lubricated Journal Bearings in Zero Gravity, proposes the operation of a conventional journal bearing and of a journal bearing which utilizes ferrolubricants. Basic behavior characteristics of journal bearings operating in zero gravity should be provided by this experiment. The experiment entitled, Wetting Spreading and Operating Characteristics of Bearing Lubricants in a Zero Gravity Environment, will monitor the wetting process for selected lubricant-surface combinations and provide an understanding of the mechanism of properly maintaining lubricant films and the effect of surface wettability on bearing performance and life in a space environment.

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W79-70287

750-03-29

Marshall Space Flight Center, Huntsville, Ala
IN-ORBIT CALIBRATION OF MESA LOW-G ACCELEROMETER

Robert F Harwell 205-453-2338

The objective of the Miniature Electrostatic Accelerometer (MESA) experiment is to evaluate the accelerometer's performance in a low-g environment and to compare the results with ground-based data. The proposed program will thus provide information regarding Spacelab 2s vehicle dynamics and its capability as a low-g test facility and will define the space shuttle's acceleration environment. It is proposed to utilize a flight-qualified MESA low-g accelerometer with minor modifications to provide three-axis, acceleration-measurement capability. In-orbit calibration will be accomplished by using a slowly rotating table from which a large number of different acceleration levels can be produced by changing rotation speed. Vehicle angular rates and orbital drag are frequency modulated and may be easily separated from the table's steady-state, centripetal acceleration. The proposed experiment involves a minimum of development effort and is considered low-risk because of the extensive operational flight and qualification history of the MESA.

W79-70288

750-03-30

Langley Research Center, Hampton, Va
SEMICONDUCTOR MATERIALS GROWTH IN LOW G ENVIRONMENT

R K Crouch 804-827-3661
(506-18-10, 179-10-10)

The objective is to utilize the microgravity environment available on STS in such a way as to eliminate or minimize the segregation of constituents and to minimize the influences of thermal convection on the growth of semiconductor materials usable in making infrared detectors. Studies in a 1-g environment will optimize growth procedures and analysis will include detailed comparison of space grown and earth grown crystals to provide data on important growth parameters needed to improve state-of-the-art earth based processing.

W79-70289

750-03-31

Jet Propulsion Lab., Calif Inst of Tech., Pasadena
SHUTTLE ON-BOARD SAR PROCESSING EXPERIMENT DEFINITION

R Piereson 213-354-3322
(506-20-25, 656-44-04)

The objective of this RTOP is to conduct an experiment definition study leading to a shuttle on-board synthetic aperture radar (SAR) processing experiment. The basic experiment will comprise demonstration of real-time on-board SAR processing using technology being developed as part of the NASA NEEDS program (see related RTOP's). A key technical issue in the shuttle experiment will be to devise and test real-time SAR processor adaptive control techniques necessary to accommodate variations in the shuttle altitude, attitude, velocity, and latitude. Studies will be performed during FY79 to validate the conceptual design, to define experiment details, and to prepare a detailed implementation plan which will define the technical and programmatic requirements for the experiment effort.

W79-70290

750-04-01

Lyndon B Johnson Space Center, Houston, Tex
OEX (ORBITER EXPERIMENTS) PROJECT SUPPORT
P D Gerke 713-483-3987
(750-04-02)

The OEX Program has been initiated in support of OAST to utilize the Space Shuttle as a research vehicle. The program objective is to collect data in the technology disciplines that will augment the research and technology base for future spacecraft design. The data will be collected by utilizing the currently planned DFI configuration, by modifications and/or augmentations to the present OFT baseline instrumentation and by development of experiments beyond the DFI capabilities for flight on the orbiter. The primary goal of this activity is a more efficient utilization of the STS capabilities to obtain data with which to advance spacecraft technology. This RTOP includes the effort associated with project initiation, project support,

experiment development initiation, experiment compatibility assessments, experiment integration activities and integration hardware development initiation. The experiment development effort is the subject of additional RTOP's from the appropriate NASA Centers.

W79-70291

750-04-02

Langley Research Center, Hampton, Va
SHUTTLE ENTRY AIR DATA SYSTEM (SEADS)
P M Siemers 804-827-3984
(506-26-33)

The objective of this RTOP is to extend the knowledge of aerodynamics, aerothermodynamics and basic fluid mechanics into flow regimes previously inaccessible to the investigator through extraction of flight data during routine operation of the shuttle orbiter. This knowledge will be applied to verify and increase the reliability of sophisticated computational prediction codes, to develop procedures to extrapolate wind-tunnel data to flight conditions, to improve the performance and operational capability of the STS and to provide a data base for studies of future aeronautical and aerospace vehicles. The design, development, and calibration of the Shuttle Entry Air Data System will be accomplished through in-house (LaRC) analysis and test programs supported by contracted studies. An instrumented nose cap incorporating the Shuttle Entry Air Data System will obtain flight data during each orbiter flight. These data in conjunction with inertial data, development flight instrumentation data, and data obtained by specialized instrumentation packages will be utilized to verify aerodynamics and aerothermodynamic performance as well as resolve many basic fluid mechanic questions.

W79-70292

750-04-03

Lyndon B Johnson Space Center, Houston, Tex
ACIP (AERODYNAMIC COEFFICIENT IDENTIFICATION PACKAGE) EXPERIMENT
E L Weeks 713-483-4661

The objectives of the proposed system are twofold: (a) acquisition of high quality flight data for post-flight aerodynamic coefficient estimation and (b) provide flight dynamic state variable data which would support other technology areas such as aerothermal or structural dynamics. The proposed experiment consists of an instrumentation package and baseline orbiter data which will provide flight mechanics data for the determination of aerodynamic coefficients from orbiter flight data. The data from the system will also provide appropriate reference conditions for other aerothermal and flight dynamics experiments. This experiment would require power, time correlation, environmental support and a suitable structural location from the orbiter.

W79-70293

750-04-04

Langley Research Center, Hampton, Va
SHUTTLE INFRARED LEESIDE TEMPERATURE SENSING (SILTS)
J C Dunavant 804-827-3984
(506-26-13)

To extend the knowledge of the basic aerothermodynamics of leeside flow fields and heat transfer on large lifting vehicles into flow regimes which are inaccessible to investigations in ground facilities through sensing of leeside surface temperatures during shuttle orbiter entry with an infrared scanner. These data will permit development of improved leeside flow field and heat transfer prediction techniques which are required to reduce considerably the weight and cost of thermal protection systems on the leeside of future space vehicles. This experiment utilizes a highly developed infrared scanner and recording system which will be qualified for the severe ascent environment in a development program at the Langley Research Center. The instrumentation and supporting equipment will be installed in a pod and tested by the Langley Research Center; the structural pod will be manufactured by the shuttle orbiter contractor, and the experiment will be installed in Orbiter 102 at KSC. The SILTS experiment will be flown on a number of early orbiter flights.

W79-70294

750-04-05

Ames Research Center, Moffett Field, Calif
INFRARED IMAGERY OF SHUTTLE

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

B L Swenson 415-965-5263

The object is to design, develop and conduct an experiment to be used in conjunction with the first orbital flights of Shuttle. The experiment is part of the Orbiter Experiments program (OEX) and will obtain measurements of surface temperature of the lower and side surfaces of Orbiter by means of remote high resolution infrared imagery. This imagery is obtained on board the C-141 Airborne Infrared Observatory (AIRO). The experimental equipment to be developed consists of an acquisition telescope and appropriate servo system, a cryogenically cooled focal plane and detector array, and a data handling and storage system.

W79-70295

750-04-06

Ames Research Center, Moffett Field, Calif
OEX THERMAL PROTECTION EXPERIMENTS
H K Larson 415-965-5369
(506-16-41)

The objectives of these experiments will be (1) the flight demonstration of advanced thermal protection systems (TPS) materials for the Shuttle Orbiter and (2) to obtain a better understanding of TPS re-entry heating effects that may permit TPS cost and weight reductions for Shuttle and advanced Space Transportation Systems. Three separate experiments will be flown as test panels or tiles replacing baseline TPS on the Shuttle Orbiter during Orbital Flight Tests (OFT) and operational flights. These experiments will take advantages of the real entry heating environment that cannot be fully simulated in ground facilities to demonstrate advanced TPS materials for possible orbiter retrofit and to investigate TPS heating effects. Temperature data will be obtained with existing and follow-on orbiter instrumentation. Baseline TPS procedures and tooling will be used and none of the experiments will impact orbiter operations. The experiment will be designed and fabricated by both in-house and contract efforts and experiment hardware will be provided as GFE.

W79-70296

750-05-01

Marshall Space Flight Center, Huntsville, Ala
SHUTTLE TECHNOLOGY PAYLOADS PROGRAM SUPPORT
W R Mixon 205-453-3437

Technical and programmatic support will be given the OAST Shuttle/Spacelab Payloads Office in the following areas of the Office's responsibility: (1) identification of R&T program efforts that can be advanced through Shuttle-borne space experiments, (2) selection of efforts warranting definition studies, (3) review of definition study results and project plans, (4) preparation of announcements of opportunity and evaluation of experiment proposals subsequently received, (5) preparation of supporting data to be utilized in the selection of experiments and payloads, (6) maintenance of an experiment/payload data bank, (7) determination of mission/payload feasibility, (8) preparation and justification of mission models, (9) verification of Space Transportation System (STS) accommodations and requirements for planned missions, and (10) assurance that experiment development/implementation phase efforts remain compatible with mission requirements and STS accommodations. To aid in the experiment acquisition efforts, MSFC will furnish the chairman for peer evaluation groups and the executive secretary to the OAST Experiment Review Subcommittee. Remaining support activities will be furnished by normal MSFC organizational activities.

W79-70297

750-06-01

Lewis Research Center, Cleveland, Ohio
FLIGHT TEST OF AN ION AUXILIARY PROPULSION SYSTEM (IAPS)
Rodney M Knight 216-433-4000
(506-22-12)

The objectives are (1) to conduct in-situ tests of a one millipound mercury-ion thruster auxiliary propulsion system over a representative duty cycle and time period, (2) to acquire engineering design information by which to determine the systems compatibility with host spacecraft, (3) to demonstrate to potential users the technology readiness of mercury-ion thruster systems for auxiliary propulsion applications aboard operational space-

craft and (4) to fly the experiment as part of the USAF/Space Test Project P80-1 (Teal Ruby) spacecraft.

Energy Programs

W79-70298

776-91-02

Lewis Research Center, Cleveland, Ohio
SMALL DISPERSED SOLAR SYSTEM APPLICATIONS
Roger S Palmer 216-433-4000
(776-54-01, 776-52-41)

The objective of this RTOP is to define small solar power system applications for remote or isolated communities, in the US and in developing countries, which can utilize solar photovoltaic and wind energy power technology to meet specific community needs. Two tasks will be utilized to carry out this objective. First a study will be implemented in conjunction with DOE and USAID as appropriate, to define applications in remote communities of the US and selected developing countries, which could be served by photovoltaic and/or wind energy systems. Domestic applications will include those judged responsive to the anticipated needs of DOE's domestic solar programs. Foreign applications will include those responsive to USAID's programs for human need as well as DOE's international efforts. To complement the study, a second task conducted in-house, will investigate and experimentally verify a limited number of candidate energy systems and typical load devices suitable for remote community applications.

W79-70299

776-91-09

Marshall Space Flight Center, Huntsville, Ala
SMALL DISPERSED SOLAR SYSTEM APPLICATIONS
H Weathers 205-453-2054

The objectives are (1) to assess the requirements for power systems in remote areas of the US and in lesser developed countries, (2) to determine the feasibility and potential of integrating existing solar energy technology into complete small power systems to meet these requirements, and (3) to develop a comprehensive program plan which will define specific target areas and solar power systems suited for those areas. The approach will be to use existing, on-going efforts through contracted studies in various forms of solar energy with major emphasis on the selection of types of solar power systems suitable for specific applications in remote areas. Parallel to these technical hardware oriented studies will be a contracted study to select remote areas for potential application of these systems to define the individual power requirements in these areas.

W79-70300

778-10-02

Lewis Research Center, Cleveland, Ohio
STATIONARY POWER RESEARCH AND TECHNOLOGY
L I Shure 216-433-4000

This effort will identify and evaluate national needs with respect to stationary power generation that can be solved by use or application of NASA's existing technology developed from aerospace programs in power and propulsion. Particular emphasis will be given to cogeneration applications. This will be accomplished through (1) preparation of energy R&T plans proposed for implementation by DOE on a reimbursable basis that are responsive to their projected needs, and (2) the improved analysis capability and the conduct screening of advanced concepts for potential application to stationary power with emphasis on cogeneration.

W79-70301

778-14-05

Jet Propulsion Lab., Calif Inst of Tech., Pasadena
INDUSTRIAL COGENERATION ANALYSIS
E P Framan 213-577-9265

With the completion of previous general studies and the current JPL specific study of a petroleum refinery, the potential for industrial cogeneration has been assessed in some breadth and depth. Major emphasis required in FY-79 is to provide the information needed to assist in initiation of industrial cogeneration effort using near-term energy conversion technologies. The

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FY-79 effort will include analysis of the refinery plant design (developed in FY-78) to determine its validity in representing the refining industry's cogeneration opportunities. From this analysis, and other recently completed studies, a methodology to aid in evaluating and selecting cogeneration projects and demonstrations will be established. In addition, the results of the plant design indicate the technical limitations on the utilization of the abundant low-grade heat available. The problems and alternative technical solutions in exploiting low-grade heat will be analyzed for several industries considering improved methods of collecting the heat and comparisons of cogeneration with alternative uses for the heat. Recently completed analyses of fuels transitions will be used to establish technology requirements for fuels production and utilization required to implement the fuels transition. Technology requirements and JPL capabilities and interests will be matched to establish a fuels program plan.

W79-70302

Lewis Research Center, Cleveland, Ohio
STIRLING ENGINE TECHNOLOGY
Donald G. Beremand 216-433-4000

The objective of this activity is to identify and verify advanced Stirling engine component technology and engine concepts for stationary power applications relevant to R&D programs of DOE and other organizations. These efforts are directed towards defining and developing an improved NASA posture in programmatic areas of nonautomotive Stirling applications. The efforts shall specifically include: (1) the preparation of energy R&T plans, for implementation on a reimbursable basis by NASA, that are responsive to program objectives and needs of DOE and other organizations; (2) the preparation of a technical approach document for stationary Stirling engines that will include technical aspects, a procurement strategy, and an approach to developing system and component requirements; (3) the improvement of Stirling engine analysis capability and the conduct of screening studies of advanced concepts for applications of interest to DOE and other organizations (such as cogeneration and total energy systems); and (4) the conduct of tests of advanced component and/or engine concepts.

W79-70303

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GRAPHITE COMPOSITE AUTOMOTIVE VEHICLE STRUCTURES
G. W. Meisenholder 213-354-4058

The U.S. automotive industry is actively engaged in evaluating the potential and problems in the use of graphite composite materials in heat engine vehicles. These materials offer considerable promise as an approach to improving the fuel efficiency and reducing emissions of heat engine vehicles by permitting the weight of these vehicles to be substantially reduced. The applications of composites to electric and hybrid vehicles may have even greater impact in that improvements in range, acceleration, on-board power requirements, etc., associated with reduced vehicle weight could be essential to the viability of these systems. However, there are uncertainties that exist concerning the use of these materials. The objectives of this RTOP will be to monitor and assess the progress of industry in the application of graphite composites to automotive vehicles, to assess the implications of the results of the Government-wide study program on the effects of accidental release of graphite into the environment on automotive applications, and to provide inputs for recommendations by NASA on the use of graphite composites in reimbursable electric and hybrid vehicle and heat engine vehicle systems programs. Plans for augmenting reimbursable automotive system development programs will be formulated, if appropriate.

W79-70304

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STIRLING LABORATORY RESEARCH ENGINE
G. W. Meisenholder 213-354-4058

The overall technical objective of this RTOP is to provide the experimental and analytical data and end-use requirements necessary to establish a viable approach to the commercialization of a versatile Stirling Laboratory Research Engine (SLRE) which

will (1) be available to researchers in academic industrial and government laboratories as a laboratory research tool which can be used to study the Stirling cycle, (2) stimulate research relative to Stirling cycle machines with the goal of broadening the technology base within the United States, and (3) provide a tool for developing and evaluating improved component technology. The approach for FY-79 consists of the following: (1) conduct performance tests of the preprototype SLRE, (2) validate the design concept of a research tool by means of a cooperative effort with a University researcher, (3) continue development of the first generation analytical model using experimental test results, (4) establish end-use requirements of the SLRE by conducting a survey of potential users, (5) conduct a conceptual design layout of the next generation prototype engine, and (6) develop a plan leading to the commercialization of the SLRE. In addition, a proposal will be prepared and submitted to potential sponsors for support of the completion of the overall SLRE project.

W79-70305

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
COAL UTILIZATION SYSTEMS
A. J. Murphy 213-577-9476

The general objective of this RTOP is to identify and verify new coal processing technologies that reduce the costs of coal gasification, coal liquefaction, and coal beneficiation while concurrently improving the environmental characteristics of the resultant fuels. It is proposed that the coal conversion enhancement by the use of monolithic catalysts development activity be continued from FY-78. Verification of this concept could provide near term improvement to several national liquefaction and methanation processes already at the pilot plant scale. This activity, which has application to both coal-derived liquid and gas, was started in FY-78 with the design, fabrication, and initial checkout of a small laboratory scale, flow type reactor. The concept involves configuring conventional catalysts for most liquefaction processes on a monolithic structure in place of the usual pellet bed catalyst mode. Baseline pellet catalyst testing will be completed first. The activity characteristics of monolithic catalysts are planned for early FY-79. After preliminary examination, only one process, methanation or gasification, will be pursued for the remainder of the year. It is considered that catalysts can be exchanged into zeolites which are bound to monolithic supports. The zeolite framework is expected to provide a selective pathway for reactants to reach the catalyst but which will not allow entry of the catalyst poison hydrogen sulfide. Testing early in the year will determine the feasibility of this most important area for methanation. The high pressure flow reactor also provides long range potential for coupling it to a coal extruder feed system.

W79-70306

Lewis Research Center, Cleveland, Ohio
COMBUSTION TECHNOLOGY
R. J. Priem 216-433-4000

The objectives of this work are to identify and verify NASA-LeRC's aeronautical and space-related combustion technologies for application to selected combustion needs of DOE and other organizations. These objectives will be attained through experimental studies to demonstrate technical feasibility of combustion concepts for energy projects, analysis of combustion designs for different applications, and design studies to determine the need, requirements approach, etc. The work will include: (1) continuing the operation of the Pressurized Fluidized Bed (PFB), performing combustion tests related to understanding the effects of PFB combustion variables on effluents and turbine materials, and assessing the feasibility and resources required to modify the PFB to serve as a Simulator of a low Btu Gasifier; (2) continue the preparation and initiate operation of a high-temperature transient combustor test cell, prepare a plan for use of the high-temperature transient combustor test cell for technology identification and verification activities and fabrication of combustors required for technology identification and verification activities, and (3) prepare reimbursable combustion technology plans as may be required.

W79-70307

Lewis Research Center Cleveland Ohio
MATERIALS TECHNOLOGY
 S J Grisaffe 216-433-4000

The objectives of this RTOP are (1) to identify those critical components of ground electric power conversion or ground propulsion systems that can benefit from the application or extension of aerospace materials technology (2) to verify, to some extent the technical feasibility of using aerospace materials for such applications, and (3) when shown feasible, to use the information developed to formulate a detailed plan aimed at transferring the technology to the component or application of interest through a DOE reimbursable program. Materials are sought which offer improved critical component performance, extended life in corrosive environments, reasonable repair procedures, and low initial/life cycle costs. Short study efforts (1-2 years) will incorporate initial screening experiments. If it is required to provide unique environmental simulation outside the scope normally required for aerospace material development, laboratory screening-type test facilities will be designed, installed, and operated.

778-83-02**W79-70308**

Jet Propulsion Lab Calif Inst of Tech, Pasadena
ENERGY R&T PLANNING
 G E Nichols Jr 213-354-5532

The objective of this RTOP is to support the initial problem definition and the subsequent preparation of approach papers preliminary project plans etc., for activities in the area of energy conversion systems.

778-90-05

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

Technical Consultation and Support Studies

W79-70309

Jet Propulsion Lab Calif Inst of Tech Pasadena
SPACE APPLICATIONS CCIR/WARC SUPPORT
 N F De Groot 213-354-3768
 (311-03-21)

643-10-01

The objective of this RTOP is to determine the technical and operational techniques that will allow effective space applications of the radio spectrum and of earth orbits while providing for equitable frequency and orbit sharing between services concerned and to actively support NASA/OSTA NTIA FCC and DOS in gaining the necessary national and international acceptance of these techniques for efficient frequency and orbit utilization and sharing. The approach will be to determine the requirements and technical factors affecting each user, and then to develop an orbit and spectrum utilization design that allows effective operation and sharing by each user while minimizing undesirable interactions and interference with other users. Without excluding others, the primary emphasis will be placed on the Broadcast Satellite and the Earth Exploration Satellite Service in the frequency bands that they share with other users. The information gained will be incorporated in reports suitable for use at World Administrative Radio Conferences (e.g. 1979 WARC) and Regional Planning Conferences (e.g. 1982 BCSAT) where the international agreements necessary to a workable design must be negotiated. This effort will be closely coordinated with NASA, NTIA FCC DOS and other agencies as appropriate. In addition, under this RTOP active participation will be provided in the CCIR, in the WARC's and other national and international organizations, as applicable.

W79-70310

Lewis Research Center, Cleveland, Ohio
TECHNICAL CONSULTATION AND SUPPORT STUDIES
 R E ALEXOVICH 216-433-4000

643-10-01

The objective is to provide technical consultation services support in the areas of high powered broadcast satellite technology

and fixed service communications satellite technology in preparation for the 1979 WARC (World Administrative Radio Conference) and the 1982 RARC (Regional Administrative Radio Conference) perform overall systems studies to evaluate alternate system configurations for broadcasting and fixed satellites, identify requirements of future systems and develop system concepts and approaches and conduct studies technical assessments, and where necessary measurements in the areas of high powered broadcast satellite technology and fixed service communications satellite technology culminating in technical papers required for CCIR SG's on frequency utilization and broadcasting (sound/television). Following an assessment of the more important issues to be considered in the 1979 WARC, in-house studies will be performed studies contracted where necessary, to support possible United States positions and to determine the trade-offs associated with each position. Principle emphasis will be given to keeping available a range of options for broadcasting satellite implementation. In preparation for the 1982 RARC, in-house and contract studies will be performed to establish possible United States positions and participate in national and international groups preparing for the RARC.

W79-70311

Goddard Space Flight Center, Greenbelt Md
TECHNICAL CONSULTATION AND SUPPORT STUDIES
 John E Miller 301-982-5885

643-10-01

The objective is to perform studies and collect corroborative data supporting frequency allocations for space applications leading to efficient orbit-spectrum utilization and providing technical support to NASA's Technical Consultation Services Program. The major elements are (1) orbit-spectrum utilization studies (2) propagation and RFI modeling and measurements and (3) special studies. This RTOP supports (1) NASA's advanced communication technology program (2) NASA application satellites (LANDSAT, SEASAT, search and rescue, ATS-6 CTS etc.) (3) active and passive microwave/millimeter wave sensors, (4) data collection and (5) NASA technical support to FCC and national preparation for the 1979 G-WARC and 1983 RARC-BS. These in turn support the following end objectives: (1) frequency allocation/coordination for NASA applications satellites, (2) NASA and U S positions for the 1979 G-WARC and 1982 RARC-B and (3) promote the development and efficient utilization of space telecommunications systems.

W79-70312

National Space Technology Labs Bay Saint Louis, Miss
COMMUNICATIONS SATELLITE APPLICATIONS SYSTEMS STUDIES
 W L Hopkins 601-688-2125

643-10-02

The objectives are to conduct a comprehensive experiment in the application of satellite communication technology to rural and remote health care in Alabama Mississippi, and Louisiana, perform a technical, economic and functional performance evaluation of the experiment, perform a functional and technical needs assessment, define network operational problems, and provide cost comparison of terrestrial vs satellite vs hybrid systems. The Alabama Louisiana and Mississippi satellite emergency communications will be expanded to provide a total of five (5) emergency vehicles in Mississippi, three (3) emergency vehicles in Alabama and four (4) portable systems in Louisiana to enable emergency medical technicians to transmit advanced life support data with two-way voice communication to centralized hospital facilities in each state. The training and evaluation process will be expanded by the Southern Regional Medical Consortium.

W79-70313

Goddard Space Flight Center Greenbelt, Md
COMMUNICATIONS SATELLITE APPLICATIONS SYSTEMS STUDIES
 John J Woodruff 301-982-5908
 (543-10-01, 650-20-17)

643-10-02

The objective is to ensure compatibility of NASA's narrowband communications flight programs with other space and terrestrial services and define characteristics of narrow band systems required including regulatory support. Narrow band systems are expected

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to share services with terrestrial systems. An overall system approach is therefore required which includes fitting in with existing services. Studies of sharing modulation antenna size and directivity, frequency reuse bandwidth and traffic will be undertaken.

Advanced Communications Research

W79-70314

650-10-13

National Space Technology Labs, Bay Saint Louis Miss
DATA COLLECTION SYSTEM DEVELOPMENT
W L Hopkins 601-688-2125
(650-10-14)

The objectives of this RTOP are to provide a continuing, interagency project of technical assistance, technology development, applications demonstration, testing and evaluation to support and advise satellite-aided communication users in three primary areas: (1) user application assistance through demonstration and application testing of NASA's communication systems technology, (2) user oriented Data Collection System (DCS) enhancements to design, develop and test improvements and modifications to ground system components, and (3) component development for specific user needs to address specialized system requirements. The approach to meeting these objectives is to use NASA/NSTL's background and experience in communications technology to establish a program of specific projects which address identified user needs. Activities have been selected as baseline projects to provide support to and/or cooperation with the following agencies: U.S. Army Corps of Engineers, U.S. Geological Survey, NOAA/NESS and NOAA/DATA Buoy Office.

W79-70315

650-10-17

Goddard Space Flight Center, Greenbelt, Md
CIVIL APPLICATIONS OF THE GLOBAL POSITIONING SATELLITE SYSTEM
Ralph E Taylor 301-982-6380
(505-07-13)

The technical objectives are to determine and analyze the civil community requirements for improvements in navigation/position determination and traffic control services during the 1980's, and evaluate the use of the GPS system, in comparison to other satellite and non-satellite concepts, to meet the above requirements. The approach is to perform a survey of the civil community to determine their future needs for improvements in navigation, position location and a traffic control system. Develop low-cost GPS civil user hardware as required, analyze the GPS system to meet these requirements and, if needed, recommend modifications to GPS user hardware and/or additions to the system to meet user needs, and conduct preliminary system and cost-benefit studies of equipment additions to other spacecraft if required to meet civilian user needs in the 1980's. These additions should accomplish a two-fold purpose: (1) retransmission of user received GPS signals to a ground reception station, and (2) reduction of user equipment cost and improvement in operations. Tests and demonstrations to work with the initial GPS will be proposed.

W79-70316

650-10-20

Lewis Research Center, Cleveland, Ohio
GLOBAL DISASTER COMMUNICATIONS
James J Ward 216-433-4000
(646-22-00)

This plan describes a program of analytical and experimental activities that is intended to lead to the implementation of a global disaster relief communications system using commercial satellites. The purpose of the program is to improve the communication flow between disaster areas and relief organization centers so that suitable actions can be undertaken in a timely fashion to provide the maximum aid possible to victims of the disaster. Specific activities in FY-79 will include determination of communication modes suitable to meet the information flow requirements, established in conjunction with the Agency for International Development (AID), Office of Foreign Disaster

Assistance addressing the technical and institutional constraints associated with introduction of the system and development of a plan for implementation of the system through the service phase. It is also anticipated that FY-79 funding will be provided by the Office of Foreign Disaster Assistance (OFDA) of AID to procure equipment necessary for experimentation with commercial satellites and to initiate development activity directed toward achieving readily deployable ground terminals.

W79-70317

650-20-16

Lewis Research Center, Cleveland, Ohio
30/20 GHZ WIDEBAND SYSTEM PROJECT DEFINITION
James J Ward 216-433-4000
(650-20-01, 650-60-17, 650-60-18)

The catalytic action of NASA involvement in a 30/20 GHz satellite system technology effort will enhance the likelihood of emergence of commercial systems in this frequency band in the late 1980's or early 1990's. The objective of the tasks described herein is to define an appropriate NASA involvement including a clear, comprehensive and rational plan for the development of a flight system necessary to verify the advanced technology associated with the 30/20 GHz frequency band employing multibeam antennas and satellite switching to facilitate efficient use of the allocated spectrum. This will include preparation of a Phase B Statement of Work for a flight test verification system and completion of all activities necessary to support a NASA new start in a 30/20 GHz wideband technology flight verification program for FY-81.

W79-70318

650-20-17

Goddard Space Flight Center, Greenbelt, Md
NARROWBAND SYSTEM FEASIBILITY STUDIES
J P Brown 301-982-5717
(650-60-19, 650-20-18)

The objective is to determine the narrowband satellite communications system technology which would be the basis for a potential new start for a NASA technology test program. The approach is to analyze data on the size and type of present narrowband systems, generate conceptual designs for needed new and expanded narrowband services utilizing space systems, examine the market potential of these new space services, identify the required critical enabling new space technology for such future systems, determine the space tests required for verification of the new technology, and define a narrowband technology flight verification space mission for flight test and demonstration of the critical new technology.

W79-70319

650-20-18

Lewis Research Center, Cleveland, Ohio
SYSTEMS NETWORK ANALYSIS
James J Ward 216-433-4000

The activity described herein is the first of several steps necessary to establish the technical, economic and institutional viability of large geostationary platforms which serve as vehicles for the aggregation of communications, navigation and scientific payloads. Specifically, the study will deal with platform-delivered communications payloads. The study will be conducted in a parametric fashion with the objective of bounding the platform communications capacity and service costs. Additionally, market demand information that will be available from studies now underway by communication carriers under contract to NASA-LeRC will be utilized to investigate the time frame in which platforms might be of interest. During the study, potential institutional barriers to the introduction of platforms will also be identified and a strategy developed to address these issues.

W79-70320

650-20-18

Marshall Space Flight Center, Huntsville, Ala
SYSTEMS NETWORK ANALYSIS (GEOSTATIONARY PLATFORM)
William T Carey 205-453-3424
(643-10-01, 650-10-15, 650-20-16, 650-20-17, 650-60-16, 650-60-18)

The objectives of this RTOP are to study and assess the technical and institutional feasibility and benefits of utilizing large geostationary platforms as a means of accommodating future

communications and other applications missions and payloads in lieu of the traditional individual satellite approach and to participate with the Office of Space Transportation Systems (OSTS) in the definition and analysis of geostationary platforms. Preliminary studies done by NASA, NASA contractors and independent industrial organizations over the past several years have pointed favorably toward the idea of using large multidiscipline geostationary platforms as a more efficient and effective means of accommodating future communications and other applications missions in lieu of the traditional approach of flying numerous specialized satellites. Two such approaches/concepts are the 'Orbital Antenna Farm' by COMSAT Labs and the 'Switchboard in the Sky' by NASA. Such platforms would be host to a wide spectrum of mission payloads primarily antennas and transponders for communications missions. Observational payloads in meteorology and earth resources, and scientific investigations are also potential candidates.

W79-70321**650-20-18**

Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena
SYSTEMS NETWORK ANALYSIS
 J. G. Smith 213-354-3828
 (650-20-16, 650-20-17)

The objectives of this RTOP are to establish the technical, economic, and institutional feasibility of alternate systems concepts for the collection and integration of several diverse satellite-based communication functions into a single system and to develop new expertise within NASA on switching and network techniques. The approach is to investigate all satellite-based communications services from a network standpoint to determine the outline for an integrated satellite communications system. This integrated system is capable of economically providing existing and planned services plus developing attractive new services, while at the same time conserving frequency spectrum and orbit. Alternate network/switching concepts are studied and analyzed for thin route rural telephony, mobile telephony, video teleconferencing, electronic facsimile exchange and personal communications. As the integrated communications system is more fully developed it is necessary to investigate and compare the technical and economic feasibility of a platform-based communications system with alternative approaches such as individual satellites. This tradeoff leads to the study of intersatellite relay links between satellites providing different types of communications services. A procedure will be developed which provides for the orderly transition from the existing satellite communication systems to the higher performance integrated communications system without interference to either.

W79-70322**650-20-18**

Goddard Space Flight Center, Greenbelt, Md.
SYSTEMS NETWORK ANALYSIS (LARGE ORBITING PLATFORMS)
 S. H. Durrani 301-982-4384

The objectives are to establish technical, economic, and institutional feasibility of aggregating satellite-based communications on Large Orbiting Platforms (LOPs) and to develop switching and network techniques for use in conjunction with LOPs. The study will identify several groups of wideband and narrowband services, each group being suitable for aggregation on a large platform. Some possible groups are international fixed and mobile (e.g., maritime) services, domestic fixed two-way and one-way services, experimental services or combinations of these, e.g., domestic plus experimental services. For each group the system configuration will be developed and technical tradeoffs conducted. Transition from and interfacing with existing systems will be examined. Techniques of on-board switching and beam interconnection on a platform and between different platforms will be investigated. The cost savings, if any, of using large platforms will be determined.

W79-70323**650-20-20**

Goddard Space Flight Center, Greenbelt, Md.
ORBITING STANDARDS STUDY
 John J. Woodruff 301-982-5908
 (650-10-18)

The objective is to evaluate the need for, and utility of

standards in geostationary orbit which provide stable frequencies, timing and related reference signals for use in calibration and measurement. The approach is to investigate the parametric capability requirements and various means for supplying required services from space through consultation with users, active groups, committees and Headquarters. The RTOP supports the following major problems: (1) antenna system calibration, (2) shortage of available frequencies, (3) shortage of geosynchronous parking space, and (4) atmospheric effects. These in turn support the following end objectives: (1) understand RF environment, (2) maximized use of frequencies, (3) atmospheric effect data base, (4) spaceborne calibration system, and (5) maximized use of geosynchronous orbit.

W79-70324**650-60-10**

Ames Research Center, Moffett Field, Calif.
ADVANCED VIDEO SYSTEMS
 S. Knauer 415-965-6440

Two levels of complexity in teleconference quality video compression will be subjectively tested by building two sets of coder/decoder units and testing them in the field. The first, an intraframe coder, is being built and debugged at present and operates between 9 and 16 megabits per second while maintaining quality suitable for teleconferencing. It removes only the redundancy within a frame and hence is not overloaded by motion. When the first processor is complete, a copy of it will be built for use in joint demonstrations with JPL and for further subjective testing. The original coder will then be augmented by additional hardware to combine the 2-D 8x8 intraframe transform coding with interframe conditional replenishment coding in the temporal direction. The second coder will trade off spatial resolution for motion resolution, reflecting the fact that the eye does not need to see both simultaneously. The bit rate of this coder is 8 to 24 megabits per second. The best 'simply implemented' video compression algorithms will be simulated and compared. ('Simply implemented' implies that the overall cost is low, 50-100 MSI chip breadboard.) The Ames video processing system will be used to simulate a large number of simple systems thoroughly, varying algorithm parameters and test scenes extensively. The algorithms tested will be those in literature that have not been well simulated and new ones developed as experiments continue.

W79-70325**650-60-17**

Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena
LARGE MULTIPLE BEAM ANTENNA DESIGN STUDIES
 P. W. Cramer 213-354-3509
 (650-60-18, 650-60-19)

The purpose of this RTOP is to conduct design studies for large multiple beam antennas. Potential users of these antennas include the high capacity direct-to-user and trunking services at the 18/30 GHz band and the thin-route fixed and mobile services below 3 GHz. The classes of antennas to be studied are reflectors and lenses. The technical approach of this work consists of determining basic antenna system design characteristics for CONUS coverage and 50 state coverage as a function of design parameters such as number of beams, beam isolation, beam separation, beam EIRP, frequency reuse plan, and antenna type. The studies will be conducted for frequency bands including UHF, L, S, C, Ku and Ka. Critical design problems associated with antenna structure, feed array, power distribution network, phase shifter, and power amplifier will be identified. Limitations of beam switching or scanning will be investigated. The range of applicability of various RF and structural configurations of large antennas as a function of RF performance will be determined. The impact of CCIR and FCC regulations on antenna system design will also be analyzed.

W79-70326**650-60-18**

Goddard Space Flight Center, Greenbelt, Md.
WIDEBAND 30/20 GHZ SYSTEMS TECHNOLOGY
 V. F. Henry 301-982-2700
 (650-60-17, 650-20-16)

The objective of this research includes the development of new technology as required for the extension of satellite telecommunications into the millimeter wave frequency spectrum, and the determination of the feasibility of developing a 20/30 GHz

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

NASA applications system. The approach is to define the technical requirements and design a wideband system which can meet the communications needs of NASA programs during the 1980's study the technical parameters which require new technology and initiate appropriate development and conduct experiments to demonstrate proof of concepts

W79-70327

650-60-18

Lewis Research Center Cleveland Ohio

WIDEBAND 30/20 GHZ SYSTEMS TECHNOLOGY

R E Alexovich 216-433-4000

The objective is to conduct supporting research and technology development for a 30/20 GHz NASA Applications System Demonstration. The approach is to use the results of on-going work to determine the technology requirements for 30/20 GHz systems that make optimum use of the available frequency and orbit space (RTOP 650-20-01, 'Communications Technology Planning' has two system definitions studies and two service demand studies in progress.) In consonance with the project plan being developed under the RTOP 650-20-16 '30/20 GHz Wideband System Project Definition', conducts analyses and investigations to develop the needed technology, perform technology tradeoffs, and provide proofs-of-concepts where required in the following technical areas: Work on the 20 GHz transmitter includes solid state devices and power combining techniques. TWT amplifier and power processor, analyses design development and testing (Tube transmitter technology at 20 GHz is also being developed under RTOP 506-20-42 'Microwave Amplifier Technology'). An overall 30/20 GHz transponder is being designed. Concepts hardware and software required for onboard satellite signal processing and multibeam antennas are being studied. Concepts, designs hardware and software for high capacity trunking and lower capacity direct-to-user terminals for 30/20 GHz earth stations will also be studied.

W79-70328

650-60-19

Goddard Space Flight Center Greenbelt Md

NARROWBAND SATELLITE COMMUNICATIONS SYSTEMS TECHNOLOGY

Jan A King 301-982-5580

(650-60-11)

The objectives are to define and develop new technology elements to support candidate narrowband communications applications. Known long lead time technology development items required for a narrowband communications satellite system will be defined and development work on promising technologies will be implemented. This RTOP supports the following major problem areas: (1) linear high power RF amplifier technology, (2) spacecraft transponder design optimized for narrowband communications, (3) high density on-board satellite signal processing, (4) very low cost data collection platform, and (5) very low mobile and rural telephone terminals. This RTOP supports and extends work done under RTOP 650-60-11 conducted during FY-78.

OFFICE OF SPACE SCIENCE

Planetary Geology

W79-70329

151-01-20

Lyndon B Johnson Space Center Houston, Tex

PLANETARY SURFACE PROCESSES

W C Phinney 713-483-3816

The broad objective of the study of planetary surface processes is to develop a coherent body of data on planetary surface processes which can be used to design planetary missions, and to interpret data as well as place boundary conditions on planetary evolution. Future exploration of Mars and other planets includes surface analysis and sample return missions. The development of these missions requires suitable instrumentation for analyses on the surface of Mars and analogues of Martian surface material. Analogues not only place boundary conditions on the evolution of Mars but also permit on Earth the evaluation of the characteristics of Martian surface instrumentation. Specific objectives are: (1) to determine through detailed grain-by-grain studies of several terrestrial soils the processes and history that can be deduced through such data; (2) to devise techniques that optimize sample preparation, data collection, and data processing of soils to extract

the maximum amount of information; (3) to characterize the gases released by thermal decomposition of Martian surface analog materials and evaluate the feasibility of accomplishing such analyses in situ; and (4) to simulate the mechanical, chemical and radiative weathering environments on Mars and Venus and study in detail the resulting products of a number of materials subjected to such conditions.

W79-70330

151-01-70

Jet Propulsion Lab, Calif Inst of Tech Pasadena

JPL PLANETOLOGY

R S Saunders 213-354-3815

The Volatile Evolution task continues to be a comparative study of the present occurrence of volatiles in planetary atmospheres on surfaces of planetary objects, and in meteorites. The objective is to decipher the history of solar system volatiles in terms of: (1) the manner of their initial incorporation into solid solar system material and planetary objects; (2) the mechanism of release from the interiors of these objects; and (3) the subsequent chemical evolution of volatiles condensed on planetary surfaces chemically recombined in regolith material or present in planetary atmospheres. This year the objectives include: (1) definition of the role played by CO₂ adsorbed in the Mars regolith in determining the amount of CO₂ in the atmosphere plus cap inventory as a function of time; (2) determining interference of one adsorbed species with adsorption of another species under Martian conditions; (3) determining the constraints placed on Earth degassing history by the isotopic composition of Xe in the atmosphere and interior; and (4) evaluating the theoretical implications of the evolving observational evidence pertaining to Galilean satellites surface composition. The objective of the Fluvial Features task is to define the origin of extensive channelling and fluvial features observed on Mars by delineating rheological properties and hydraulic characteristics of the fluid or combination of fluids which must have created these features to develop fluid instability analysis capable of describing primary and secondary flow patterns in catastrophic floods in fluids of variable viscosity and specific gravity to define and examine specific field areas which possess characteristic fluvial features similar to the observed Martian features and to those predicted from stability analysis.

W79-70331

151-01-80

National Aeronautics and Space Administration Washington D C

PLANETARY GEOLOGIC STUDIES

S E Dwornik 202-755-3645

Planetary Geologic Studies is a program encompassing geology, which is the broad objective of understanding the genesis, distribution, evolution, and inter-relationships of the condensed matter in planets and their satellites, asteroids and other solid materials in the solar system. The geology of the planets bears directly on three basic aims of planetary exploration: determination of the origin and evolution of the solar system; determination of the origin and evolution of life; and clarification of the nature of the processes shaping man's terrestrial environment (National Academy of Sciences, 1966). In order to meet these objectives it is necessary to perform theoretical analysis, instrument development and spacecraft experiments that lead to understanding the nature and properties of the surface regolith crust and core. This knowledge will lead to an understanding of individual planets, the origin of the solar system, interactions between the atmosphere and lithosphere, interactions of the flux of interplanetary materials with planetary bodies and will also aid in the discovery and understanding of the origin of extraterrestrial life. One important result of geological exploration of the planets will be increased knowledge of the Earth. Very little is known of the first 2 billion years of Earth's history.

W79-70332

151-02-60

Ames Research Center, Moffett Field Calif

THEORETICAL STUDIES OF PLANETARY BODIES

J B Pollack 415-965-5330

The objective of this RTOP is to obtain a better understanding of selected problems pertaining to planetary surface phenomena, the composition, structure and evolution of planetary bodies and their satellites, and the origin of the solar system by means of theoretical investigations employing the results of spacecraft and

ground-based experiments. Theoretical knowledge, physical insight, and mathematical modeling techniques are used together with astronomical and geological data to construct self-consistent mathematical descriptions of planetary processes and structure. Analysis and interpretation of the results of these model calculations are applied to such topics as the evolution of Jupiter wind-blown surface features on Mars and the calculation of conditions within the early solar system.

W79-70333

151-02-80

National Aeronautics and Space Administration Washington D C

INSTRUMENT DEVELOPMENT

S E Dwornik 202-755-3645

The goal of this work is the development of spacecraft-borne instruments which should be significantly effective in the study of planetary surfaces. Knowledge of the surface composition of a planetary body is one of the most fundamental areas of information bearing on the origin and evolution of that body and the solar system in general. Science instrument development efforts are being conducted to develop water detection capability, remote sensor type mechanical properties, measurements and imaging system instruments for use on post 1975 flight missions. Feasibility studies of new and unique instrumental techniques are investigated, as well as modification of presently developed planetary instruments. Extension beyond present capability for the exploration of Mars is the near term principal objective in each case, and these specific instruments were selected on their potential for shedding new light on significant questions regarding that planet.

W79-70334

151-04-80

National Aeronautics and Space Administration Washington D C

DATA ANALYSIS - PLANETARY CARTOGRAPHY

S E Dwornik 202-755-3645

The basic objective of planetary cartography is the reduction of photographic and other spacecraft data to produce accurate topographic and planimetric base maps of the surface of the planets. Planetary cartography provides an indispensable reference system for recording and correlating the observations and deductions of all other planetary sciences. Cartography, in a strict definition, is the art of making maps, but planetary cartography will be considered in a broader sense to include the techniques of geodesy and photogrammetry. It provides information on: (1) the basic planetary dimensions, (2) a mathematical figure of reference, (3) a defined system of coordinates, (4) the location of surface points in the defined coordinate system, and (5) topographic and thematic maps, at small scales for synoptic coverage, at intermediate scales for regional coverage and at large scales for spacecraft landing areas and other sites of particular scientific value.

Extraterrestrial Materials Research

W79-70335

152-03-60

Ames Research Center, Moffett Field Calif

STUDIES OF THE DISTRIBUTION OF ELEMENTS AND MINERAL PHASES AMONG METEORITES

H P Klein and S Chang 415-965-5094

The objectives are: (1) to understand the origin and evolution of meteorites through the study of their chemistry and mineralogy, and (2) to gain insight into the conditions and processes that prevailed at the time of the solar system's origin. The abundance, isotopic composition and distribution of selected elements and the occurrence and distribution of various minerals in meteorites will be examined. Systematic searches for elemental, isotopic and mineralogic-petrologic correlations between meteorites and within a meteorite will be made so as to elucidate physical-chemical relationships in the meteorite population. These relationships will be used to test the hypothesis that meteorites originated as condensates from the cooling solar nebula.

W79-70336

152-03-80

National Aeronautics and Space Administration Washington D C

ORIGIN AND COMPOSITION OF METEORITES

B M French 202-755-3760

(195-20-07)

The objective of this program is to increase our knowledge about the nature, composition, age, origin and history of meteorites by means of direct analysis of meteorite specimens and by related theoretical and observational studies. A wide variety of analytical techniques are used to obtain information about meteorite mineralogy, chemical compositions, radiometric ages, cosmic-ray-exposure ages, isotopic compositions, particle track characteristics, etc. This knowledge will improve our understanding of the physical and chemical processes present during formation of the solar system, the nature and history of cosmic radiation in interplanetary space (use of meteorites as space probes) and the genetic relations between meteorites and asteroid families. This research also supports ongoing lunar sample studies by providing important comparative data and by testing and calibrating new analytical techniques.

Planetary Geochemistry and Geophysics

W79-70337

153-01-80

National Aeronautics and Space Administration Washington D C

COSMOCHEMISTRY

W L Quaide 202-755-1602

The objective of this research program is to employ knowledge gained in the fields of meteorite composition and of stellar and planetary evolution to further our understanding of the origin and evolution of the solar system. The study of cosmochemical data is used to construct models of the solar system consonant with the observed chemical values. The present orientation of the research is toward the exploration of isotopic anomalies in meteorites and other matter thought to approximate the primordial solar system's composition. Other cosmochemical approaches currently supported involve classical studies of element abundance and studies of non-equilibrium condensation of materials from plasmas, especially as influenced by particle (jet) streams.

W79-70338

153-02-80

National Aeronautics and Space Administration Washington D C

EXPERIMENTAL STUDIES

W L Quaide 202-755-1602

The purpose of this program is to obtain laboratory data through experimental simulations with materials or chemical systems which likely comprise the moon or other bodies under conditions similar to those which presently or at one time prevailed. These simulations are used to extend results from extraterrestrial materials studies or from geophysical data analyses so as to better understand the nature and origin of solar system bodies or features associated with them. The program approach is to develop in the laboratory techniques or information which can be applied to existing information or to theoretically analogous systems. Most investigations synthesize chemical or mineralogical systems and investigate the properties of those systems. These properties are related to hypothesized processes elsewhere in the solar system or are used to establish constraints on them.

W79-70339

153-03-81

National Aeronautics and Space Administration Washington D C

PLANETARY INTERIORS

W L Quaide 202-755-1602

This program supports gathering of knowledge on the composition, properties and processes involving planetary interiors which will lead to improved planetary models. Since direct observation of the interiors of most planets is infeasible, research in this area lends itself readily to a variety of indirect observation methods. The proposed research falls into three categories reflecting available means of approach: (1) seismic studies, (2) gravity studies, and (3) interior modeling based on existing data. Seismic studies initiate or further analyze planetary seismic data so as to improve comprehensive modeling capability. Mass distribution information (gravity studies) provide insights that contribute to understanding isostatic adjustment, planetary visco-elastic properties, crustal thickness and bulk planetary properties. Interior modeling projects refine and synthesize existing data to address convection, thermal regimes, differentiation, magma migration and other problems.

OFFICE OF SPACE SCIENCE

W79-70340

153-04-81

National Aeronautics and Space Administration Washington D C

PLANETARY MAGNETISM

W L Quaide 202-755-1602

Planetary magnetic studies contribute to our knowledge of the planetary interiors, the origin and nature of magnetic fields, and the interaction of the fields with the solar wind, plasma and planetary atmospheres. The data gathered in this program will also add new information about physical and geochemical properties of the planets. The research is composed of two areas of study. One is the study of magnetic fields and their implication regarding related geophysical processes. The other investigates the mutual effects of magnetic fields coextensive with or impinged upon by another energy source. Theoretical and experimental magnetic field studies permit field strength mapping, conductivity determination, and studies of shock magnetization which assist in the formulation of origin and process models for the core, mantle and crust and the field itself. Derivation of theory capable of accurately modeling magnetic field interactions requires combination of physical chemical and theoretical data. Results have applicability to planetary and atmospheric chemistry and physics as well as to the origin and behavior of the magnetic field.

W79-70341

153-06-80

National Aeronautics and Space Administration, Washington D C

PLANETARY DYNAMICS

W L Quaide 202-755-1602

This RTOP contains a variety of tasks. All seek to examine some aspect or group of aspects of dynamics- orbital tidal accretional, etc - either to obtain more precise information or to develop improved theories of planetary or solar system evolution. The theoretical nature of much of this work lends itself to random event simulation to gain insight into plausible evolutionary schemes for the solar system, orbits, planets and other bodies. Some tasks are specific to a given mechanism while generalized simulations require the incorporation of investigation of many subsidiary mechanical constraints to produce an accurate historical model. Other, more empirical projects refine available data to develop reliable information on present dynamics and physical properties of planets and asteroids.

W79-70342

153-06-70

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

LABORATORY SIMULATION

R S Saunders 213-354-3815

This is a continuing study of the surface optical and irradiation effects properties of lunar-size satellites with emphasis on the Galilean satellites of Jupiter and especially Io. Spectral reflectance properties and irradiation effects on evaporite salts, sulfur, and related minerals are being studied in the laboratory. A detailed surface composition model for Io has been derived that is consistent with the telescopic spectra and other known chemical and physical properties of Io. This model, supporting the evaporite hypothesis, was published in Icarus, vol 31, 1977. An extension of this work has led to a further model that relates Io's well-known modulation of jovian decametric radio emission to possible areal variations in Io's surface electrical conductivity and to periodic changes in orientation of Io's flux tube with its surface. Continuing work will focus on developing a more accurate albedo distribution model in order to establish variations in Io's surface composition and electrical conductivity. Correlations will be drawn between conductivity distribution, flux tube orientation, and decametric occurrence probability data in order to refine our understanding of how Io modulates decametric emission and sweeps up charged particles in Jupiter's magnetosphere. The publications are Nash D B and F P Fenale Io's surface composition based on reflectance spectra of sulfur/salt mixtures and proton irradiation experiment, Icarus 31, 40-80, 1977.

W79-70343

153-06-80

National Aeronautics and Space Administration, Washington, D C

PLANETARY SYNTHESIS

W L Quaide 202-755-1602

The planetary synthesis program is broad scoped and multi-disciplinary. The investigative efforts are designed to synthesize existing information about the planets. The program seeks to develop and utilize techniques to recognize and study correlations between geochemical, geophysical and geologic data obtained by sample studies, remote sensing or analog studies. A substantial number of projects are lunar oriented while others aim at multi-planet or satellite synthesis. While much of the work is still lunar oriented this fact results from the tremendous backlog of lunar information that was collected. Also techniques developed and results obtained from the lunar studies are widely applicable to many solar system objects. Recognition of relationships amongst these data sets will shed light on planetary processes, evolution, physical structure and composition. Analyses of existing data and improvement of data handling and imaging methods will allow many researchers in the program to exchange data and results thus facilitating the rapid exchange of information in future efforts.

W79-70344

153-07-80

Ames Research Center, Moffett Field, Calif

INFRARED FEATURES OF PLANETS, SATELLITES AND ASTEROIDS

P Dyal 415-965-5523

The objectives of the work proposed here are to use infrared spectroscopic and spectrophotometric measurements to (1) determine the mineral composition of the surfaces of satellites and asteroids and (2) determine the distribution and composition of aerosols in planetary atmospheres. The data for this work was obtained from 41,000 feet altitude and are thus unobscured by telluric H₂O absorption features. CO₂ features completely obscure only the wavelengths from 4.2 to 4.35 microns. Information on the composition of solid surfaces and aerosol layers can be derived from the spectral location and shape of infrared absorption bands that are characteristic of particular constituents. For example, water ice has bands centered at 1.5, 2.0, and 3.1 microns, iron bearing minerals have bands at 1.0 and 1.8, silicates exhibit an emission maximum near 8.0 microns, sulfuric acid has bands at 3.3, 5.9, and 7.2 microns, and feldspars have a band near 1.3 microns. Laboratory reflection spectra will be obtained for candidate minerals and the optical properties determined by Kramers-Kronig analysis. From these, synthetic spectra will be generated and compared with the observed spectra.

W79-70345

153-07-80

Ames Research Center, Moffett Field, Calif

INFRARED FEATURES OF PLANETS, SATELLITES AND ASTEROIDS

P Dyal 415-965-5523

The objectives of the work proposed here are to provide (1) a reflection spectrum of Vesta from 0.7 to 4.0 microns and possible identification of mineral absorption features, (2) improved reflection spectra of Galilean satellites particularly from 3.5-5.5 microns and possible identification of features, (3) maps of Venus clouds showing variations in sulfuric acid concentration, (4) low resolution maps of Mars showing the spatial distribution of water of hydration, (5) emissivities from 20 to 200 micrometers of the Moon at a point near the limb and of Mars (globally), and (6) determination of far-infrared lunar properties from a comparison of lunar and solar far infrared spectra. The data for this work were obtained from 41,000 feet altitude and are thus unobscured by telluric H₂O absorption features. CO₂ features completely obscure only the wavelengths from 4.2 to 4.35 microns. Information on the composition of solid surfaces and aerosol layers can be derived from the spectral location and shape of near infrared absorption bands that are characteristic of particular constituents. For example, water ice has bands centered at 1.5, 2.0, and 3.1 microns, iron bearing minerals have bands at 1.0 and 1.8, silicates exhibit an emission maximum near 8.0 microns, sulfuric acid has bands at 3.3, 5.9, and 7.2 microns, and feldspars have a band near 1.3 microns.

W79-70346

153-07-80

National Aeronautics and Space Administration Washington D C

REMOTE SENSING

W L Quaide 202-755-1602

The objective is to increase our understanding of the data and techniques of remote sensing and to apply that knowledge to further study of the solar system through use of microwave imaging radar, IR UV, and visible spectrum remote sensing studies. The bulk of the projects are directed toward increasing the information yield of remote sensing data. Examination and laboratory testing of known materials by remote sensing methods and gathering data on terrestrial features provides useful analogs for study of lesser known bodies. Projects that model the behavior of specific radiation interacting with solid materials of interest are designed to explain observed features of remotely sensed data and to open new avenues for such sensing. Other projects use available techniques to study the surfaces of other planets, satellites and asteroids to determine composition and physical state.

W79-70347

153-08-80

National Aeronautics and Space Administration Washington D C

IMPACT CRATERING STUDIES

W L Quaide 202-755-1602

The impact cratering program carries out work on the physics of cratering ejecta deposition, structural and physical property control of crater morphology and late or post-cratering modification processes. The research has as its aim the complete understanding of cratering processes and attendant phenomena to the extent that the crater record of bombardment preserved on all the terrestrial planets can be interpreted to the fullest extent possible. With a full appreciation of this process, extensive contributions to the knowledge of planetary evolution are possible. The approach taken in these investigations involves experimental studies, primarily through use of the Ames Vertical Gun Facility to define parameters such as particle motions, crater growth, ejection dynamics, material property control of the cratering process and the resultant morphology, scaling properties etc. These, and other parameters derived from explosive cratering projects supported elsewhere then serve as model inputs in computer modeling studies of the process.

W79-70348

153-09-70

Jet Propulsion Lab Calif Inst of Tech Pasadena

JPL PLANETOLOGY INSTRUMENT DEVELOPMENT

R S Saunders 213-354-3815

This RTOP contains three tasks: (1) Mars soil water instruments development; (2) X-ray spectroscopy or Galilean satellites, and (3) Alpha/X-ray analysis using solid-state detectors. The objectives are to: (1) complete the definition of soil water analysis instruments for a Mars rover; (2) demonstrate by experiment and analysis, the feasibility of designing an X-ray spectroscopy instrument to determine the surface chemistry of Galilean and Saturnian satellites which are immersed in the magnetospheric particle fluxes of the parent planets; (3) develop a combined alpha-scattering/X-ray analysis instrument that would provide valuable in-situ geochemical information on Mars. The approach is to: (1) define a conceptual solution for the problem of how best to implement the multiple sampling requirement for a differential scanning calorimeter by use of an array of many unloadable ovens and by use of a single oven which can be unloaded and cleaned; (2) develop an X-ray instrument to measure the surface composition of the Galilean and Saturnian satellites, and (3) use detectors that can be operated at ambient temperatures without active cooling. Studies of these detectors have been made both at JPL and the University of Chicago including recent testing Hg12 detectors using the Caltech tandem Van de Graaff accelerator as the excitation source. Further work will emphasize the use of room-temperature X-ray detectors.

W79-70349

153-09-70

Jet Propulsion Lab Calif Inst of Tech Pasadena

ADVANCED EXPERIMENT CONCEPTS

R S Saunders 213-354-3815

The objective of this program is to undertake scientific studies and long lead-time engineering development in anticipation of an opportunity to chemically map the entire surface of planetary

bodies such as the Moon, Mars and Mercury, from spacecraft placed in a close polar orbit. The experiment is also viable for comet and asteroid rendezvous missions. Reference points include the results of the Apollo 15 and 16 gamma-ray experiment. This program is designed to establish the scientific potential and design requirements of a gamma-ray spectrometer built around a high resolution Ge detector and to develop state-of-the-art subsystems in order to respond to relevant flight opportunities that can be used at other planetary bodies in addition to the moon.

W79-70350

153-09-80

National Aeronautics and Space Administration Washington D C

INSTRUMENT DEFINITION

W L Quaide 202-755-1602

This RTOP includes studies which lead to the definition of new or improved instruments for space flight geophysical and geochemical sensing. Instrument needs are assessed in terms of the Planetary Division's 5 year plan and longer range goals. These needs are addressed by supporting definition studies that will lead to development of instruments up to the breadboard stage. Present support is for gamma ray and X-ray spectrometers and other instruments which are judged to be in need of development. Expansion of this program is anticipated.

W79-70351

153-10-80

National Aeronautics and Space Administration Washington D C

GENERAL OPERATIONS

W L Quaide 202-755-1602

General operations support a variety of institutional and scientific support tasks at Centers and at the Lunar and Planetary Institute that are considered essential for the conduct of research and for the implementation of the Planetary Geochemistry and Geophysics program. Support to the Lunar and Planetary Institute is to provide for the proposal reviewing function, inhouse research, and for the sponsoring of conferences. Support to Centers (JSC) provides for co-sponsorship of conferences, laboratory costs required by visiting scientists using existing facilities, and for cost required to operate common laboratory facilities and to provide for support services.

Planetary Atmospheres

W79-70352

154-10-10

National Aeronautics and Space Administration Washington, D C

COMPOSITION AND STRUCTURE OF PLANETARY ATMOSPHERES

Robert E Murphy 202-755-3660

The objective of this RTOP is to study the composition and structure of planetary and satellite atmospheres in those regions where chemical processes are relatively unimportant compared to dynamical and energy deposition processes. Chemical composition is studied through analysis of spacecraft data, evolutionary models and process studies. Similarly, the vertical and horizontal structure of the atmosphere is analyzed from spacecraft data and theoretical modeling. Research under this RTOP is fundamental to the understanding of the origin, evolution and current state of planetary atmospheres, and it consists primarily of efforts aimed towards the development of comprehensive and unifying theories.

W79-70353

154-10-60

Ames Research Center, Moffett Field Calif

PHYSICS, DYNAMICS AND AERONOMY OF PLANETARY ATMOSPHERES

J B Pollack 415-965-5530

(185-47-66, 170-36-56 198-30-02)

Theoretical modeling is used to determine the properties and physical processes characteristic of certain major features of planetary atmospheres. These features include their dynamics, temperature structure, aerosols, cloud layers, and ionospheres. General circulation models of the atmospheres of Venus and Jupiter are being developed to assess the nature of dynamical processes in these atmospheres. Predictions are tested against available groundbased and spacecraft observations. Radiative

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transfer theory is used to determine the properties of particles in planetary atmospheres and the rings of Saturn and to construct models of their temperature structure. The size distribution and altitude location of cloud material in planetary atmospheres such as that of Venus, are determined from a combination of aerosol growth physics and photochemistry, a protocol that has been successfully used for the sulfuric acid particles of the Earth's stratospheres. Planetary ionospheres are modeled with the combined equations of vertical transport and photochemistry. Emphasis is placed on ionic chemistry and ionospheres formed by high energy particle bombardment (e.g. cosmic rays).

W79-70354 154-20-10

National Aeronautics and Space Administration Washington D C

DYNAMICS OF PLANETARY ATMOSPHERES

Robert E Murphy 202-755-3660

The objective of this RTOP is to understand the dynamical processes which occur in planetary atmospheres. Analytical methods are developed to study specific processes such as wave dynamics and escape. These methods are applied in comprehensive theoretical model studies including 1, 2, and 3 dimensional general circulation models. Spacecraft data are analyzed and interpreted in terms of models to elucidate the physical processes responsible. Comparative studies among the planets are emphasized.

W79-70355 154-20-50

Goddard Space Flight Center Greenbelt Md

DYNAMICS OF PLANETARY ATMOSPHERES

J A Pirraglia 301-982-6783

Planetary missions supplemented by ground based and airborne instruments have greatly increased our knowledge of the atmospheres of Jupiter, Venus, and Mars and planned missions promise more detailed information on Jupiter, Saturn, and their satellites. The planets and their satellites present contrasts in mass, rotation rates, radiative time constants, heat deposition, and topographic influence of the atmosphere and for a better understanding of these disparate atmospheres it is necessary to develop a general approach to theoretical atmospheric dynamics based upon the existing data obtained from the planetary missions. The widely differing conditions permit the isolation of specific phenomena and allow comparisons of different regions of the parameter space associated with a particular phenomenon. An investigation of atmospheric circulation with momentum transport shows that the circulation is strongly affected by the transport terms. The relationship between the mean flow and the waves that contribute to the momentum transport will be investigated from both the points of view of wave instabilities and wave-mean flow interaction. Momentum transport models will be used to compare the circulation of the various planets and to assess the models.

W79-70356 154-30-10

National Aeronautics and Space Administration Washington D C

CLOUDS, PARTICULATES AND ICES

Robert E Murphy 202-755-3660

Clouds and particulates are key indicators of dynamic phenomena in planetary atmospheres and play a major role in the transport of energy and the physical structure of the atmosphere. Ices interact strongly with atmospheres especially in comets and nearly atmosphereless bodies. This RTOP consists of research efforts emphasizing laboratory and theoretical investigations of the radiative and chemical properties of candidate cloud materials. Analysis of spacecraft data and simulation of results is also included as are cloud microphysical studies. Studies of interplanetary dust and certain cometary phenomena are included within this RTOP, especially those dealing with atmospheric dynamic processes.

W79-70357 154-40-10

National Aeronautics and Space Administration, Washington, D C

RADIATIVE TRANSFER IN PLANETARY ATMOSPHERES

Robert E Murphy 202-755-3660

This RTOP consists of efforts which support the research into planetary atmosphere composition and structure, dynamics and clouds. Analytical techniques are developed for the study of radiative transfer in cloudy atmospheres and for non plane-parallel atmospheres. Interpretation of spacecraft data are made and applied to models of atmospheric structure.

W79-70358 154-50-10

National Aeronautics and Space Administration Washington D C

ATOMIC AND MOLECULAR PROPERTIES

Robert E Murphy 202-755-3660

This RTOP supports research under other RTOPs in the planetary atmosphere series through laboratory and theoretical investigations of atomic and molecular properties. Spectral properties of atomic and molecular species are investigated at relevant temperatures and pressures and the results are made available for use in radiative transfer investigations. Laboratory investigations are conducted to facilitate the identification and quantitative measurement of potential atmospheric species. Theoretical investigations are conducted as needed to interpret laboratory measures or to extrapolate to planetary conditions.

W79-70359 154-50-70

Jet Propulsion Lab Calif Inst of Tech, Pasadena

THEORETICAL STUDIES - PLANETARY ATMOSPHERES

M Geller 213-354-2593

A broad program of applied and theoretical studies pertaining to planetary atmospheres will be conducted with the following primary objectives: (1) understanding the properties and determination of the parameters of planetary atmospheres; (2) application of experimental data (laboratory, astronomical and spacecraft) to the understanding and interpretation of spectral features and mechanisms for complex planetary atmospheres; (3) applying these findings toward design of ground based and spacecraft experiment concepts; and (4) interpretation of experimental data to aid in the evolution of valid dynamic planetary atmospheric models. The studies to be conducted in FY-79 pertain to planetary atmospheric modeling, radiative transfer within model Venusian and Jovian clouds, atmospheric circulation, determination of millimeter and submillimeter spectra and theoretical spectroscopic development for the understanding of planetary atmospheres.

W79-70360 154-60-10

National Aeronautics and Space Administration Washington D C

AERONOMY THEORY AND ANALYSIS

Robert E Murphy 202-755-3660

This RTOP contains the fundamental and unifying research efforts into the nature of planet and satellite atmospheres in those regions where chemistry, dynamics and energy deposition are all of major importance. Theoretical models are developed to investigate the composition, including time and spatial variations, the structure and dynamics and the deposition of energy in an atmosphere. Data from past spacecraft missions is analyzed and synthesized. Specific dynamical, chemical and photo processes are investigated.

W79-70361 154-70-10

National Aeronautics and Space Administration Washington D C

EXPERIMENTAL STUDIES IN AERONOMY ENERGY DEPOSITION

Robert E Murphy 202-755-3660

This RTOP consists of laboratory investigations which support the theoretical and interpretative aeronomical investigations under another RTOP. These laboratory studies are conducted to understand the primary processes of energy deposition. Photon processes include photo-excitation, ionization and dissociation. Proton and electron impact processes are investigated. The objective is to accurately measure those reactions of importance to the understanding of planetary and satellite atmospheres.

W79-70362 154-75-10

National Aeronautics and Space Administration Washington D C

EXPERIMENTAL STUDIES IN AERONOMY CHEMISTRY

Robert E. Murphy 202-755-3660

This RTOP consists of laboratory investigations which support the theoretical and interpretative aeronomical investigations under another RTOP. These laboratory studies are conducted to understand the secondary process of chemical transport. Rate constants and mechanisms are investigated for neutral-neutral, ion-neutral and radical reactions of importance. Investigations of chemical excitation in cometary atmospheres is included.

W79-70363

154-75-50

Goddard Space Flight Center, Greenbelt, Md
COMETS AND INTERSTELLAR MATTER
 B. D. Donn 301-982-5014

This RTOP includes several programs to study comets and interstellar matter. The primary objective is laboratory experimentation relevant to the physicochemical behavior of matter in space. Theoretical analysis of astronomical and space problems using experimental and theoretical results is a second aim. A third aspect involves ground based telescopic observations. The last phase uses observations from spacecraft to obtain otherwise unavailable data. The laboratory investigations make use of several new techniques: resonance fluorescence-flash photolysis, tunable laser spectroscopy, and diode laser spectroscopy to study the detection, production and reactions of atoms and radicals from planetary, cometary and interstellar molecules. New condensation techniques are used to study condensation phenomena relating to the formation of interstellar and primordial planetary grains. Theoretical research examines the origin of comets and interstellar molecules and relationships between them. Irradiation of condensed gas mixtures by van de Graaf proton beams is used to determine the effects of cosmic rays on comets in the Oort cloud. Ground based observations of comets continues with emphasis on image intensifier studies of faint comets. A search for newly formed highly rotationally excited CN radicals is underway using high dispersion spectra of bright comets. With the successful launch of IUE investigations of the far ultraviolet spectra of comets and interstellar molecules will be carried out.

W79-70364

154-75-51

Goddard Space Flight Center, Greenbelt, Md
SPECTROSCOPY AND PHOTOCHEMISTRY OF PLANETARY AND COMETARY MOLECULES
 L. J. Stief 301-982-2529

The objectives of this research are to measure the optical and chemical properties of atoms, free radicals and molecules which are important in understanding the composition of planetary atmospheres and comets. Emphasis is placed on those problems which are of immediate concern for interpreting the results of rocket and satellite observations. The flash photolysis-resonance fluorescence apparatus is equipped with a variable temperature cell and the experiment is linked to a computer for real-time data reduction and analysis. The apparatus is being used to measure absolute rate constants as a function of temperature for atom-molecule reactions such as $H + C_2H_4$. A discharge-flow system with variable temperature capability has been constructed and this apparatus and/or the existing flash apparatus will be combined with a tunable CW dye laser to measure absolute rate constants for reactions of free radicals such as NH_2 . Several types of spectroscopic measurements are made. In one photoabsorption and photoionization cross sections are measured. Cross sections are also determined for producing fragments in excited electronic states. Branching ratios are measured for excited states which cascade into lower level excited states via photon emission. Electron impact excitation cross sections are determined. Ultra-high resolution infrared absorption spectra are measured using tunable semiconductor diode lasers.

W79-70365

154-75-61

Ames Research Center, Moffett Field, Calif
LABORATORY STUDIES OF ATMOSPHERIC PROCESSES IN PLANETARY ATMOSPHERES
 E. C. Y. Inn 415-965-5500

The objectives are to determine products, rates, and yields of energy transfer reactions in planetary atmospheres. Solar and galactic radiations interact with the atmospheric constituents to

produce excited and ionized species and free radicals which then react to form other ionized and excited species, and/or neutral unexcited species, and/or reradiate spectral energy. Insight into the nature of planetary atmospheres can be obtained from studies of these processes under controlled laboratory conditions. Investigations in the photochemistry and other atmospheric processes involving optical emission and absorption will be conducted under controlled laboratory conditions. When considered necessary, this study may be carried out under conditions simulating the natural atmospheric environment. This study will consider also the effectiveness of minor constituents in catalyzing or participating in important reactions. Photolysis of CH_4 , NH_3 , H_2O , and COS will be investigated and the quantum yields and fluorescence cross sections determined. These studies will contribute to our understanding of the photochemistry of extraterrestrial planetary atmospheres and may provide scientific support for future planetary exploration.

W79-70366

154-75-70

Jet Propulsion Lab., Calif Inst of Tech, Pasadena
IONIZATION AND RATE PROCESSES IN PLANETARY ATMOSPHERES
 W. T. Huntress 213-354-3238

Laboratory measurements will be made to determine the rate constants and products for ion-molecule reactions of importance in planetary atmospheres. These data are used by other workers in models of the ionospheres of planets and satellites and in the comparison of these models with occultation data and remote sensing data from orbiter/entry missions to the planets and their satellites. Laboratory work is also directed toward the origin of organic species in the atmospheres of the Outer Planets and their satellites. Using electron scattering techniques developed in our laboratory for the measurements of elastic and inelastic cross sections (both from ground state and laser excited species) for photoabsorption and ionization cross sections by high energy electron scattering, and for electron-photon coincidence measurements, it is proposed to carry out measurements on the following atoms and molecules: Na, K, S, He, H_2 , CO, H_2O , CO_2 , CH_4 , and NH_3 . In addition to this work will be initiated to obtain cross sections for $e-S(+)$ collisions. The high resolution (0.02 nm) photoionization mass spectrometer (PIMS) will be used to measure absolute threshold photoionization cross sections to ground and excited states of atomic, molecular and radical ions present in planetary atmospheres. A new photoelectron technique we have developed (threshold photoelectron spectroscopy by electron attachment TPSEA) complements theoretical calculations of excited state cross sections by experimentally normalizing the cross section at threshold, allowing aeronomers to determine in detail the deposition of ionizing UV radiation in the upper atmosphere and to predict airglow emission intensities.

W79-70367

154-80-10

National Aeronautics and Space Administration, Washington, D. C.

EXTENDED ATMOSPHERES AND SOLAR PLANETARY INTERACTIONS

Robert E. Murphy 202-755-3660

The objective of this RTOP is to investigate the physical state and major physical processes in the outer reaches of planet and satellite atmospheres where plasma processes are important. Emphasis is on the interaction of the solar wind with planetary atmospheres. Theoretical modeling studies and analysis of past spacecraft data are used to elucidate primary processes in their mechanisms. Cometary plasma phenomena and planet satellite interactions are included.

W79-70368

154-90-10

National Aeronautics and Space Administration, Washington, D. C.

ATMOSPHERIC EXPERIMENT DEVELOPMENT

Robert E. Murphy 202-755-3660

The objective of this RTOP is to develop the techniques and hardware for future space-borne experiments. Both remote sensing and in-situ methods are developed. Core support for long term development efforts and refinements is provided. New

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technologies are integrated into existing systems to improve sensitivity and to reduce weight and power requirements. New instrument concepts are developed and tested and improvements to analysis techniques are made.

W79-70369

154-90-51

Goddard Space Flight Center, Greenbelt, Md
ABSOLUTE PRESSURE MOLECULAR AND ATOMIC BEAM
CALIBRATION TECHNIQUES FOR MASS SPECTROMETERS

H B Niemann 301-982-4706

The objective of this work is to develop new laboratory techniques to construct facilities for testing and calibration of instruments to measure the neutral particle composition and temperature of planetary atmospheres. The different atmospheric environments encountered in the various planetary and interplanetary missions as well as the different scientific goals set for the study of the planets require an extensive instrument and test facility development program which leads to a satisfactory laboratory capability for evaluation and calibration of flight instrument concepts and subsequently flight instruments. The different chemical properties of the various atmospheric constituents and the various gas dynamic conditions expected in a planetary entry or cometary encounter make it necessary to develop several separate systems each with a limited range of flexibility which together satisfy the test requirements. Static and dynamic pressure calibration systems have been developed for calibration of mass spectrometers with non reactive gases in pressure ranges for 10 to the minus 10th power mb to where those instruments with extended dynamic ranges of plus or minus 10 to the 10th power can be calibrated for detection of minor constituents and precise determination of isotope ratios. Further development is intended in reactive gas test systems and high velocity molecular and atomic beam systems to simulate conditions encountered in high speed planetary entry probes and cometary flyby missions.

W79-70370

154-90-52

Goddard Space Flight Center, Greenbelt, Md
INSTRUMENT DEVELOPMENT FOR NEUTRAL GAS
COMPOSITION AND DENSITY MEASUREMENTS IN
PLANETARY ATMOSPHERES

H B Niemann 301-982-4706

This research plan is concerned with the overall improvement of neutral gas composition measurements planned for the atmospheres of earth, the planets, and comets. In general improvements are sought in two basic areas, (1) sensor concept and application, and (2) optimization of basic instrument parameters in anticipation of restrictive mission constraints. In the first area, sensor development will be directed toward (1) the improvement of ambient gas sampling techniques for high velocity probes into high density atmospheres (e.g., outer planets entry probes), (2) the design of more efficient ion sources of both the 'open' type which provides side-energy focussing, and the 'closed' type which increases the thermalization of the gas being measured, and (3) development of a neutral particle retarding potential analyzer for high velocity probes. In the second area neutral mass spectrometer system development will be directed toward optimizing existing techniques in view of rigorous requirements anticipated in forthcoming planetary and cometary flight opportunities. This work will concentrate on (1) development of smaller, lighter, higher resolution, less expensive mass analyzers, (2) improvement of ion current detectors applicable to digital systems, emphasizing accuracy, sensitivity, and stability, and (3) development of improved digital logic and on-board data processing sub-systems.

W79-70371

154-90-53

Goddard Space Flight Center, Greenbelt, Md
DEVELOPMENT OF MEASUREMENT TECHNIQUES FOR
GAS AND CLOUD PARTICLE COMPOSITION IN HIGH
PRESSURE ATMOSPHERES

H B Niemann 301-982-4706

The objective of this work is to provide a practical technique for the determination of the composition of an atmosphere over a wide pressure range and from percent to parts per billion

concentrations or lower. A mass spectrometer coupled through a fixed or variable leak to the atmosphere and also connected to a specialized enrichment system for trace components comprises the analytical system. The analysis of particulates and aerosols (clouds) present special problems and require a much higher degree of instrument complexity than for a general atmospheric gas analysis. Proven laboratory techniques will be adapted to flight applications where practical and new concepts will be developed as required.

W79-70372

154-90-54

Goddard Space Flight Center, Greenbelt, Md
MINIATURE VACUUM PUMP DEVELOPMENT FOR NOBLE
GAS AND HYDROGEN PUMPING ON ATMOSPHERIC
ENTRY PROBES ON OUTER PLANET MISSIONS

H B Niemann 301-982-4706

The objective of this work is to develop efficient, low weight vacuum pumps for flight application with mass spectrometer experiments on atmospheric entry probes for outer planet exploration. The most abundant gases on the planets presently under consideration for direct probing are hydrogen and helium. While hydrogen can be pumped chemically to a pressure level suitable for mass spectrometer operation, the difficulties encountered in pumping helium effectively and reliably has become a major obstacle in the development of instruments for mass spectrometric composition measurements from atmospheric entry probes. Getter pumps or sputter ion pumps conventionally employed in flight mass spectrometers have no or very limited pumping capability for helium. Moreover when exposed to hydrogen hydrocarbons are synthesized in the pump normally at higher concentration levels than similar compounds expected to be found in the planetary atmosphere. It is proposed to do development work in three areas: (1) developing a low weight getter baffled sputter ion pump with high specific pumping efficiency for helium and minimum hydrocarbon synthesis, (2) develop a miniature turbomolecular pump suitable for flight application which has no specific discrimination for noble gases, and (3) development of a non-evaporable getter pump having a large pumping capacity for hydrogen and other reactive gases.

W79-70373

154-90-55

Goddard Space Flight Center, Greenbelt, Md
ADVANCED TECHNIQUES FOR THE MEASUREMENT OF
ION COMPOSITION AND DRIFT

H A Taylor Jr 301-982-6610

The RTOP objective is to improve ion composition measurement techniques required for successful dynamic plasma measurements for future flight opportunities in planetary and cometary ionospheres or missions such as VOIR and cometary probes. Instrument refinements are prompted by direct measurement limitations identified in the analysis of earth satellite data obtained previously, under conditions of rapidly changing ion drifts, and high velocity passage through the relatively dense lower atmosphere. Drift irregularities result in fluctuating ion velocities (and equivalent energies). High velocity entry results in impact ionization and secondary emission from sensor surfaces. Development of the Bennett RF ion mass spectrometer will emphasize accommodation of dynamic effects influencing ion detection, improvement of trace ion sensitivity and extension of mass range to include heavy ions (greater than 56 AMU). Emphasis will be given to (1) refining servo-controlled ion peak detector response to variable ion drifts, (2) evaluation of electrostatic ion-deflection techniques required for off-ram axis detection of ambient ions in a dense, high velocity, neutral gas beam and (3) implementation of pulse-counting, low current detector techniques. Improved measurement performance will be verified by high velocity ion-beam stimulation of modified sensor designs, coupled with breadboard models of improved detector-logic circuitry.

W79-70374

154-90-57

Goddard Space Flight Center, Greenbelt, Md
X-RAY FLUORESCENCE ELEMENTAL ANALYSIS OF
COMETS

J I Trombka 301-982-5941

The objective detailed is to obtain information about the

chemical composition of the nucleus and the dust grains of a comet in either the rendezvous or flyby mode using the Comet Halley mission profile as a model. To this end an X-ray experiment is being considered based on a concept which enhances the Apollo 15 and 16 X-ray experiment while demanding minimal modification of the instrumentation. The measurement would be made in two modes using the same detector and ancillary equipment. One mode involving the direct measurement of the solar excited X-rays from the comet nucleus and the second phase involves the analyses of collected dust grains by means of selected radioactive excitation sources before and after rendezvous or flyby. The design of the detector system only allowed for the measurements of X-ray emission from elements with atomic numbers greater than $Z = 12$ (Mg). The fluorescence for lower Z materials due to solar excitation should yield measurable emission. These X-rays emitted are rather soft and difficult to measure if the Apollo proportional counters are used. We believe that it may be possible to measure the flux at these lower energies by modification of the detector design.

W79-70375**154-90-60**

Ames Research Center, Moffett Field, Calif

RESEARCH IN SUPPORT OF ATMOSPHERE STRUCTURE EXPERIMENTS FOR PLANETARY PROBES

A Seiff 415-965-5685

(185-47-67)

The purpose of this effort is to provide laboratory, field test and theoretical support for ongoing experiments to define the structure of the atmospheres of Venus and Jupiter. The experiments are part of the science payloads of the four Pioneer Venus probes and Galileo Jupiter probe. The research objectives are to define the aerodynamic characteristics of the entry probes with accuracy in key aspects which affect the extraction of atmospheric structural parameters to develop analytical and numerical techniques for determining atmospheric parameters from experiment data in order to extend and improve the capabilities of the experiments, and to perform laboratory simulations of the measurement aspects of the experiment sensors, in order to characterize and evaluate their abilities to define atmospheric state properties under the given conditions of composition, density, and velocity. The approach is to perform ballistic range tests in the expected atmospheric medium with matched or simulated speed, Reynolds number and configuration. Viking experience showed that these tests must extend to the free-molecular flow limit to characterize the aerodynamics up to the instrument measurement threshold. Drop tests of instrumented probes from aircraft may also be employed. In addition, a method of extracting wind data from the Pioneer Venus data is being arrived at through the use of computer simulations. Similar studies for conditions of the Jupiter probe will be performed.

W79-70376**154-90-70**

Jet Propulsion Lab., Calif Inst. of Tech., Pasadena

ATMOSPHERIC EXPERIMENT DEVELOPMENT

F W Taylor 213-354-5164

The objective of this task is to contribute to NASA's program of planetary exploration by evolving new or improved experiments for the investigations of the atmospheres of the planets by measurements from spacecraft. The emphasis is on remote sensing observations from orbiter or flyby missions using infrared techniques. The approach is by a process of evolution from a detailed definition of the problem, through identification of a useful and feasible experimental approach, computerized numerical studies of expected performance and optimization of the instrument concept, to the development in the laboratory of breadboard hardware and finally, flight experiments. The tools employed in this are sophisticated numerical methods for radiative transfer and for fluid dynamics in planetary atmospheres, remote sensing and data inversion techniques, realistic and up-to-date atmospheric models, research into the spectral properties of planetary atmospheric gases and cloud constituents, and expertise in the design, fabrication and testing of state-of-the-art infrared instruments for spacecraft.

W79-70377**154-90-71**

Jet Propulsion Lab., Calif Inst. of Tech., Pasadena

COMETARY INSTRUMENTATION

R S Saunders 213-354-3815

It is proposed to complete the feasibility studies and development of a spectrometer capable of obtaining both the mass/charge and three dimensional velocity distributions of ions in the coma and tail of a comet on either a rendezvous or a flyby mission. No presently existing energetic ion mass spectrometer has resolution sufficient to separate species which differ by a single mass unit near 40 or 50 AMU/charge. We believe such resolution can be achieved with a new type of spectrometer which combines electrostatic analysis by modulated grids and magnetic analysis by a sector magnet. It is proposed to perform more thorough analyses and experimental tests of this new concept. The resolution and angular response will be determined experimentally and compared with theoretical predictions. A full-scale magnet will be designed, built and tested. A trade-off study of detector systems will be performed together with development of a strategy for the use of the instrument on a cometary mission. Finally, we will investigate methods to survive the dust hazard and perhaps even use the instrument to analyze the composition of dust on a flyby of Comet Halley.

Solar Terrestrial SR&T**W79-70378****170-36-55**

Ames Research Center, Moffett Field, Calif

MAGNETOSPHERIC PHYSICS - PARTICLE AND PARTICLE/FIELD INTERACTION

A Barnes 415-965-5506

(384-47-67, 385-36-01)

Our objective is to improve understanding of the dynamics origin and termination of the solar wind, turbulence in the solar wind and to investigate possible effects of solar and interplanetary phenomena on terrestrial weather and climate. We will conduct theoretical studies aimed at understanding the large-scale dynamics of the solar wind, its acceleration and heating mechanisms, and waves and turbulence in the solar wind. These studies employ known theoretical techniques of plasma physics and magnetohydrodynamics and also often require extensions of basic theoretical plasma and magnetic data as well as to indirect observations of the solar wind. Theoretical studies of possible relations between variations in solar output (radiation and/or charged particles and magnetic fields) and terrestrial weather and climate will be carried out. These studies include investigation of existing data for evidence of sun-weather effects, and search for mechanisms that can produce such effects.

W79-70379**170-36-55**

Goddard Space Flight Center, Greenbelt, Md

PARTICLES AND PARTICLE/FIELD INTERACTIONS

Keith W Ogilvie 301-982-5904

The objective of this research is to increase the knowledge and understanding of non-thermal plasmas occurring in the interplanetary medium and the magnetosphere, and also to improve the theoretical description of their properties. This requires continuous improvement in measurement techniques and interpretation of the results of appropriate space experiments. The interpretation requires corresponding improvements in theory, in numerical techniques, and in methods of data display. Instrument development activity is concentrated on advanced concepts for plasma detectors, magnetometers and radio and plasma wave analyzers.

W79-70380**170-36-55**

National Aeronautics and Space Administration, Washington D C

SPACE PLASMA PHYSICS - PARTICLES AND PARTICLE/FIELD INTERACTIONS

OFFICE OF SPACE SCIENCE

E R Schmerling 202-755-3685

The objectives of this RTOP are to increase our knowledge and understanding of hot, tenuous space plasmas and the interactive processes in which they participate. Included are the propagation of the solar wind, the interaction of the solar wind with solar system bodies to produce magnetospheres with the detailed features to be found there, and the consequences of variations in the incident flux. Areas of investigation include the acceleration, deceleration and trapping of particles, interactions involving electric and magnetic fields, coupling of convective hot plasmas to cool co-rotating plasmas and the generation of electromagnetic waves. The approach will be to (1) develop instruments for measuring neutral and charged particles from several eV to several tens of MeV, dc magnetic fields from below 0.1 gamma to several oersted, electric fields and VLF and plasma wave activity, (2) develop the theory needed to understand the magnetosphere, the auroras, the interplanetary regions and the observed boundary effects, down to roughly the plasmopause and (3) investigate energy transfers, convective motions, plasma instabilities and related phenomena.

W79-70381

170-36-55

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

MAGNETOSPHERIC PHYSICS: PARTICLES AND PARTICLE/FIELD INTERACTIONS

R W Davies 213-354-4156

The Vector Helium Magnetometer is being developed for use on future missions, especially to the outer solar system where extremely weak interplanetary or interstellar fields will be measured and where intense planetary fields may also be encountered. JPL scientists and engineers carry out tests and experiments to establish the fundamental principles of the magnetometer operation and design. Improved components are developed; the design is changed to yield improved performance; and new modes of operation are investigated. When appropriate mission opportunities are announced, the scientific requirements are established and a scientific proposal submitted. The basic objective is to provide continuing theoretical support for JPL's and NASA's observational space plasma programs. A theoretical study of the variation of solar wind properties with distance from the sun will be continued with emphasis on the roles of electron heat conduction and shock thermalization in determining the temperature and dynamics of corotating interaction regions. Another continuing effort is the study of similarities between stellar X-ray bursts and magnetospheric substorms. The interaction of the solar wind with the ionospheres of weakly magnetic and non-magnetic and non-magnetic planets and with comets will also be studied, with emphasis on flow dynamics, induction of magnetic fields, and ion-molecule reactions.

W79-70382

170-36-55

Marshall Space Flight Center, Huntsville, Ala.

PARTICLE AND PARTICLE FIELD INTERACTIONS

C R Chappell 205-453-3036
(385-36-01)

The objectives of this RTOP are to develop space plasma instrumentation for automated spacecraft and sounding rocket payloads. To accomplish these objectives, the following tasks will be performed: (1) The integration and testing of a multi-headed light ion mass spectrometer for the DOD SCATHA spacecraft will be completed. (2) The development of a differential ion flux probe to be used for the measurement of multiply-directed, low-energy ion streams will be continued. This technique has been applied in laboratory plasma wind tunnel studies and will be upgraded for applications to sounding rockets, automated satellites, and Spacelab. (3) Design of a swept angle retarding ion mass spectrometer (SARIMS) for the measurement of low-energy plasma distribution in the magnetosphere will be initiated.

W79-70383

170-36-56

Goddard Space Flight Center, Greenbelt, Md.

PARTICLE AND PARTICLE/PHOTON INTERACTIONS (ATMOSPHERIC-MAGNETOSPHERIC COUPLING)

James P Heppner 301-982-4797

The objective is to develop experimental and theoretical

approaches for studying and understanding the processes which provide strong coupling between the neutral atmosphere, the collision-dominated ionospheric plasma and the collisionless magnetospheric plasma. Within the framework of this overall objective, specific sub-objectives are identified in terms of having (1) key significance, (2) goals which are attainable with limited resources, and (3) close ties to future projects and programs. Emphasis is placed on the primary forces, electric fields and neutral winds and the associated transport and energization of particles. Related topics include electric fields in the earth-ionosphere cavity and their relation to weather processes, electric current systems and associated magnetic field disturbances, the generation of thermospheric winds and gravity waves, atmospheric chemical composition anomalies, the transformation of atmospheric ions to trapped radiation, auroral particle acceleration mechanisms, plasma instabilities producing ionospheric irregularities, etc. New instrumentation is being designed and developed for observations of tracer chemicals and for measurements of low energy particles. Properties of double probes in low density plasmas are to be studied with the SCATHA satellite. Models for the diffusion of tracer particles are to be developed for planning future chemical release experiments. The closure of magnetospheric electric fields within the earth-ionosphere cavity is to be studied in support of low and middle atmosphere electric field investigations.

W79-70384

170-36-56

National Aeronautics and Space Administration, Washington, D.C.

SPACE PLASMA PHYSICS - PARTICLES AND PARTICLE/PHOTON INTERACTIONS

E R Schmerling 202-755-3685
(188-36-57)

The objective is to investigate the absorption of solar photons and particles in the earth's upper atmosphere, the processes by which the absorption products are dissipated, and the effects which arise therefrom. Included are the collisional, photochemical and electromagnetic interactions coupling with neutral constituents and dynamic motions which are found in the upper atmosphere, the ionosphere and the inner magnetosphere. These investigations are also applied to the atmospheres, ionospheres and inner magnetospheres of the planets. The approach is for the development of instruments for the direct and indirect measurement of near-thermal plasmas, neutral gaseous constituents, electric and magnetic fields. Coordinated investigations to be conducted for cause-and-effect studies, together with the development of the appropriate theories. The region covered extends roughly from the lowest ionosphere to the plasma-pause.

W79-70385

170-36-57

Goddard Space Flight Center, Greenbelt, Md.

PARTICLE ACCELERATOR FACILITY MAINTENANCE AND OPERATION OF A CALIBRATION FACILITY FOR MAGNETOSPHERIC AND SOLAR-TERRESTRIAL EXPERIMENTS

James H Trainor 301-982-6282

The GSFC Sciences Directorate operates a nuclear particle calibration facility consisting of a 2 MeV Van de Graaf and a 250 KeV electrostatic accelerator. The facility provides particle energies from 50 eV to 2 MeV, and protons via reactions to approximately 20 MeV. Particle beams available range from electrons to Kr84, with fluxes from approximately 1 particle/sq cm sec to approximately 10 to the 9th power particle/sq cm sec. It is a unique facility in the world in this low energy region. For several years, all work in this facility has been in support of magnetospheric and solar-terrestrial research. In FY 77 and 78, the work concerned ISEE-A, B and C experiments, the Voyager LECF, the GEOS particle experiment (MPI/Lindau), Tiros-N (NOAA/Ford Aerospace), and various particle detector developments (U MD, APL, NOAA, MPI, etc.), as well as several sounding rocket payloads. The facility operates normally on all working days, but the requirements of the experimenters in the past several years have often required operation 6 or 7 days per week and 12-16 hours per day. That, coupled with the declining manpower in Code 660, has forced the facility to rely heavily on contractor manpower for maintenance and operation.

Demand for the facility remains high with requests received for time allocation into 1979 already

W79-70386 170-38-57
National Aeronautics and Space Administration Washington D C

RADIO SCIENCE - SPACE PLASMA PHYSICS
E R Schmerling 202-755-3685
(170-36-56)

The objective is to investigate the interplanetary medium the environments of the earth the moon the planets, and the sun as well as celestial mechanics and relativity by the propagation or scattering of radio waves to investigate the interactions between plasmas and waves and the origins of electrostatic and electromagnetic emissions from plasmas. The approach is to develop techniques for interpreting the refraction scattering polarization rotation and phase shifting of radio signals occurring naturally or generated artificially in terms of physical properties of the intervening medium. To develop instruments for generating electromagnetic waves in space and measuring the effects of the medium together with the appropriate theory. To model in the laboratory the plasma interactions resonances and other emissions observed in space and to test the theories developed to explain them. To investigate the interaction between radio waves and energetic particles in the environments of the sun, moon and planets.

W79-70387 170-38-51
Goddard Space Flight Center Greenbelt, Md
DEVELOPMENT OF SOLAR SPACELAB EXPERIMENT AND HARDWARE
R D Chapman 301-982-5101

The objective of this RTOP is to develop payloads which contribute toward the solution of well defined solar research problems. These payload activities will proceed with the ultimate objective of flying on the shuttle Spacelab. In such problem-oriented Spacelab missions a payload of instruments is assembled which by simultaneous observations of a phenomenon such as a solar flare or the outflow of the solar wind at the base of the corona, provides in complete detail the physical data needed for a cogent model of the phenomenon. An example of such a mission is SMM for solar flare research. This spacecraft will be retrieved by the shuttle and flown again with refurbished instrumentation. Additional research problems will form bases for series of missions using the shuttle. One of these will be a study of coronal structures contributing to the solar wind and the interplanetary plasma. A second will be a study of the sources of high energy particles on the sun, emphasizing instrumentation that could not be accommodated and may be supplementary to the SMM instruments. Missions emphasizing the phenomenon of coronal heating and mass and energy balance in the chromosphere are also contemplated. In each case a number of different instruments covering a wide range of wavelengths is required. They will be selected on the basis of making comprehensive measurements in their specific wavelength regions in a format which is coordinated with and complementary to the other instruments in the payload.

W79-70388 170-38-51
National Aeronautics and Space Administration Washington D C

DEVELOPMENT OF EXPERIMENTS AND HARDWARE FOR SOLAR PHYSICS RESEARCH
J David Bohlin 202-755-8490

The objective of this area is to develop experiments and instrumentation for space observations or laboratory applications directly related to solar physics research. Additional objectives are the development of critical technology items which are needed for new or significantly improved solar observations.

W79-70389 170-38-51
Marshall Space Flight Center, Huntsville, Ala
INSTRUMENT DEVELOPMENT - QUARTZ CRYSTAL PYRHELIOMETER
M J Hagyard 205-453-0118
(750-03-02)

The objective of this research program is to measure variations of the solar constant with a precision of 0.004%. This will be accomplished by completing the development of a quartz crystal pyrheliometer and performing verification testing from the ground and from aircraft as a part of the NASA Airborne Astronomy Program.

W79-70390 170-38-52
Goddard Space Flight Center Greenbelt Md
GROUND BASED OBSERVATIONS OF THE SUN
Robert W Hobbs 301-982-2591

The major objective is the measurement of solar radiation at those wavelengths accessible from the ground with resolution (spatial spectral temporal, velocity) suitable for supporting investigations of solar phenomena (flares, active regions, wave motion, velocity fields, and magnetic fields) carried out in the EUV, X-rays and gamma rays by solar Maximum Mission and other flight missions in the NASA Solar Physics Program, and for basic research on the sun. Other objectives are (1) the analysis of comet-tail photographs to determine the velocity field of the solar wind, and (2) high resolution radio observations of the sun. Several observatory facilities are supported and maintained for this purpose. The Vacuum Tower Telescope and multichannel spectrometer at the Sacramento Peak Observatory will no longer be operated by the Laboratory for Astronomy and Solar Physics. However the Laboratory will begin to provide support for the Vacuum Tower Telescope at Kitt Peak which specifically provides HeI 10830A Spectroheliograms and magnetogram. The Zeiss Filtergraph at the GSFC Optical Site has been modified to record and analyze solar chromospheric velocity fields.

W79-70391 170-38-52
National Aeronautics and Space Administration Washington D C

GROUND-BASED OBSERVATIONS
J David Bohlin 202-755-8490

Ground-based observations of the sun in wavelengths for which the terrestrial atmosphere is transparent are carried out at a number of suitable observatories and ground stations throughout the United States. The purpose of these ground-based observations is to obtain information on the solar atmosphere from the photosphere and sun spots to the chromosphere and the corona, and on the fine and gross structure of the solar atmosphere, and activity in it. This information is then used in conjunction with observations from sounding rockets OSOs, ATM and other spacecraft to determine the physical conditions in the objects studied and to understand the physical mechanisms at work in them. Of particular importance in the coming year will be the continuation of a series of coordinated ground based observing programs planned in collaboration with the OSO-8 mission. Steps will also be taken to define an appropriate ground based observing system (visible and radio wavelengths) to support the Solar Maximum Mission.

W79-70392 170-38-53
Goddard Space Flight Center, Greenbelt, Md
EXPERIMENT DEVELOPMENT - LABORATORY AND THEORETICAL SOLAR PHYSICS
R D Chapman 301-982-5101

The objective is to develop fundamental techniques which support ongoing programs. These techniques ultimately are both experimental (applicable in the areas of design of flight instruments) and theoretical (analysis of returned data). However, at the initial level of investigation fundamental physical processes must be investigated and defined before development of solar models based on these processes can be proposed or executed. Likewise, fundamental understanding of spectra observed on the sun is confirmed if not originally suggested by laboratory and theoretical work. Among such work is the identification of spectra lines in high energy spark discharges, the calculation of the transition probabilities of atomic transitions, and the development of techniques for the analysis of spacecraft observations. Each of these areas is investigated in the context of ultimate application to instruments or theoretical modeling of the solar atmosphere carried out by members of the laboratory. Included in the theoretical work is the development of techniques for the

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solution of atomic collision problems involved in processes occurring in the plasmas of the solar atmosphere as well as in other astrophysical plasmas

W79-70393

170-38-63

National Aeronautics and Space Administration Washington D C

LABORATORY AND THEORETICAL SOLAR PHYSICS

J David Bohlin 202-755-8490

Laboratory and theoretical studies are performed on problems in solar astronomy, solar physics and in important and relevant areas of atomic and molecular physics. These investigations contribute basic information which is necessary for the analysis, interpretation, and understanding of data about the sun which is obtained from space and from the ground. Theoretical studies of the sun include the following types of activity. The first type is the analysis of ground-based and space data to produce models of the solar atmosphere and to understand the underlying physical conditions and mechanisms. The second is the prediction of future events on the sun, such as prediction of coronal structures from features observable on the disk of the development of future active regions from magnetic and H-alpha features, and the occurrence of flares from magnetic field complexity and configuration. The third involves theoretical studies of the production of magnetic fields in astrophysical bodies.

W79-70394

170-78-60

Goddard Space Flight Center Greenbelt Md

ORIGIN OF PLASMAS IN THE EARTH NEIGHBORHOOD (OPEN)

William Hibbard 301-982-2697

The objective of this RTOP is to develop the scientific and technical basis for a Solar Terrestrial Multi-satellite mission to be proposed for flight in FY-84-86. The objective of this mission is to provide simultaneous coordinated measurements of the role of plasmas in the transport, storage and dissipation of energy in the solar wind and the terrestrial magnetosphere. The approach will be to conduct preliminary system design studies (feasibility) in the areas of sensors and/or instrument requirements, design, mission analysis, system definition and design, and ground data processing systems to meet requirements established by the Solar Terrestrial Program Office and its appointed science working group. These studies will form the basis for the publication of a Preliminary Execution Phase Project Plan (PEPPP) in FY-79. Another product of this effort will be the preparation of a Mission Need Statement to meet the requirements OMB Circular A-109 which, together with the Preliminary Systems Design Group (PSDG) study activity, will form the basis for the RFP requesting alternate system design concepts from industry.

W79-70395

170-78-60

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

SOLAR PROBE MISSION - ADVANCED TECHNICAL DEVELOPMENT

J E Randolph 213-354-2732
(506-16-45)

The overall objective is to further the development and readiness of the solar probe mission identified during the FY-78 study. Specific objectives are to (1) review and update the scientific objectives and requirements for the first solar probe mission, (2) provide guidance and support to several technology developments (thermal control, drag compensation, communications, and celestial mechanics analysis, all under separate RTOPS) upon which the implementation of the solar probe mission depends, and integrate the results of this research into the spacecraft and mission designs, (3) develop the spacecraft and mission designs in greater detail than done in FY-78, (4) identify cost-risk trades for the mission, (5) prepare guidelines for use by scientists in developing instruments for the mission, (6) define a baseline first mission consistent with the above objectives, and (7) if all the objectives cannot be achieved by the first mission, define the series of missions required. A Science Definition Group will be formed. It will meet several times during the year to provide guidance and information on scientific matters. The Solar Probe Study Team, consisting of science, spacecraft and mission analysis personnel, will continue to meet weekly. This

team will work with both the Science Definition Group and JPL's technical divisions to achieve the objectives listed above.

W79-70396

170-78-61

Goddard Space Flight Center, Greenbelt Md

SOLAR CYCLE AND DYNAMICS MISSION (SCADM) SCIENCE STUDY FOR A SOLAR SATELLITE MISSION

D Suddeth 301-982-2697

The objective of this RTOP is to develop the scientific and technical basis for an earth-orbiting Solar Study satellite mission to be proposed for flight in the FY-87 time period. This mission is to make continuous observations of the sun with high resolution of time and images and to make coordinated observations with other spacecraft such as the Solar Polar Mission, which would greatly enhance the value of the solar data thus obtained. It may also prove cost effective to utilize refurbished portions of the Solar Maximum Mission spacecraft currently scheduled for retrieval in late 1981. The approach will be to conduct preliminary system design studies (feasibility) in the areas of instrument requirements and design, mission analysis, systems definition and design, and data processing systems to meet requirements established by the Solar Terrestrial Program Office and its appointed science working group. The studies include both in-house Preliminary Systems Design Group (PSDG) and out-of-house (contract/grant) activities in the areas critical to proof of feasibility or of cost effectiveness of alternate approaches including such areas as science, mission analyses, engineering studies, information handling systems and management guidance. These studies will form the basis for the publication of a Preliminary Execution Phase Project Plan (PEPPP) in FY-80. Another product will be a Mission Need Statement to meet the requirements of OMB Circular A-109 which, together with the PSDG study activity, will form the basis for the RFP requesting alternate system design concepts from industry.

Astrophysics SR&T

W79-70397

188-41-51

Goddard Space Flight Center Greenbelt Md

UV AND OPTICAL ASTRONOMY

A Boggess 301-982-5103

The objective is to pursue a long range program in astronomical research with emphasis on optical observations, theoretical astrophysics, and specific instrumental topics of special interest to NASA. The effort includes operation of ground telescopes, development of new instrumentation for ground and rocket use, data interpretation and theoretical studies. Spectroscopic and photometric data are obtained from ground telescopes in order to analyze the properties of stellar atmospheres, nebulae and the interstellar medium. Non-equilibrium model atmospheres are being investigated to interpret spectral observations from space and ground observatories. Theoretical investigations are carried out on the evolution of stellar interiors, variable stars, novae and planetary nebulae.

W79-70398

188-41-51

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

UV AND OPTICAL ASTRONOMY

R W Davies 213-354-4156

Laboratory work will be conducted to measure the products and rate constants for ion-molecule reactions leading to the synthesis of molecules and ionic species in interstellar clouds. The laboratory data will be applied to the construction of theoretical chemical models for the formation of molecular species in interstellar clouds. These results are compared with observed molecular abundances in order to unravel the chemistry occurring in interstellar clouds and to understand the mechanisms leading to the formation and destruction of interstellar molecules. This work is SR & T supportive of observational work on interstellar molecules to both explain and predict abundances of interstellar molecules and to describe molecular evolution in astrophysical environments. Electron-molecule interactions (elastic, rotational, vibrational, dissociative and electronic excitation) and photon

emission processes which play an important role in interstellar chemistry will be investigated. Specifically, differential integral and momentum transfer cross sections will be measured for CO and H₂ and will be initiated for atomic sulfur. High resolution (0.2nm) UV photoionization studies will be carried out on interstellar gases. A new technique for measuring threshold photoelectron spectra will be used to (1) study electronic structure of atomic molecular and radical ions produced by UV radiation from hot stars and (2) measure absolute threshold photoionization cross sections for states of atomic molecular and radical species important in ionization equilibrium models.

W79-70399**188-41-51**

Marshall Space Flight Center, Huntsville, Ala
UV AND OPTICAL ASTRONOMY
 C. R. O'Dell 205-453-3033

We will continue to pursue an observational and interpretative program of astronomical spectroscopy using the Echelle grating nebular spectrograph. This will include a program of observations and data interpretation concerning internal velocities in HII regions. The research will provide data on the heliocentric velocities, electron temperatures, internal turbulence and microturbulence of these nebulae. The method of post-development image enhancement of photographic film by means of autoradiography will be further developed to select optimal films for ground-based and Spacelab astronomical experiments. The observation of identified and candidate optical counterparts to X-ray sources will be continued, with the objective of providing a more complete understanding of the nature and distribution of the X-ray sources. Methods of high time resolution photometry and spectrophotometry will be applied utilizing among other observational equipment, the integrated digital video detector system and photon counting equipment.

W79-70400**188-41-53**

Goddard Space Flight Center, Greenbelt, Md
INTERACTIVE ASTRONOMICAL IMAGE ANALYSIS
 Daniel A. Klingensmith, III 301-982-6541

The purpose of this RTOP is to develop interactive digital computer software techniques for correcting and analyzing astronomical images obtained from two dimensional sensing devices. There are two types of images that can be considered astronomical scenes (star fields, extended sources, comets, etc.) and two dimensional spectra (echellograms). There are several steps that must be taken in order to correct an image and obtain useful astronomical information. The major steps are noise pattern recognition and removal, electrical and optical distortion detection and removal, and photometric transformations and resolution enhancement. Software techniques exist for small and medium size images (up to 1,000,000 elements). Larger images and a larger volume of images requires that there be a selection of a best image and even a best part of the image to be studied. This RTOP will attempt to develop the software techniques needed to do this selection.

W79-70401**188-41-54**

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RELATIVITY
 F. B. Estabrook 213-354-3247

Research is being performed on the interaction of gravitational radiation with Doppler spacecraft tracking measurements and on various possible detection methods for gravitational radiation. Feasibility studies are being made on precision tracking experiments utilizing the unique experimental capabilities of the Deep Space Network. It has been shown that an observational window exists for radiation of periods between 20 sec and 3000 sec, in this range Doppler measurements are possible to the sensitivity limits set by H-maser timekeeping. Catastrophic collapse of distant galactic or quasar nuclei and collision between supermassive black holes in them may generate pulses of radiation in this range, and these pulses would produce a unique response in the Doppler tracking record. Forthcoming interplanetary missions are being considered. The possibility of missing matter in the universe is being studied by computer integration of evolutionary models of the intergalactic medium. This research will support interpretation of data on intergalactic

matter, its composition, excitation and ionization history which will result from far ultraviolet quasar spectra taken with the IUE satellite. Predictions will result of distortion of the spectrum of the cosmic microwave background radiation and for the extragalactic X-ray background which will support other future missions such as COBE.

W79-70402**188-41-54**

Marshall Space Flight Center, Huntsville, Ala
RELATIVITY AND CELESTIAL MECHANICS
 Richard A. Potter 205-453-3431

The objective of this activity is to develop through a coordinated program the technology and research required to support the flight of the gyro-relativity experiment. This experiment will be a fundamental and unique test of the general theory of relativity. The feasibility of this experiment centers around the development of a cryogenic gyroscope several orders of magnitude more precise than any existing and the ability to maintain these gyroscopes and record their precessions while in Earth orbit, over a period of three months or more. The work requiring advancement in several disciplines is being accomplished by complementary efforts at MSFC, Stanford University and the University of Alabama in Huntsville. This work is a well coordinated, theoretical, experimental and engineering program oriented toward a satellite flight that will establish the validity of the General Theory of Relativity.

W79-70403**188-41-54**

National Aeronautics and Space Administration, Washington, D. C.
RELATIVITY
 N. G. Roman 202-755-3649

The primary objective is to make experimental tests of the theory of relativity and thereby elucidate the interrelationship among space, time and gravity. In particular, the test of Einstein's General Theory of Relativity is paramount. This formulation is fundamental and of high scientific interest. Experimental verification is difficult but the ability to orbit large, complex and extremely precise apparatus, shielded from deleterious perturbations should obviate them. In addition to the scientific goals, improvements and innovations in the technological areas of cryogenics, gyroscope design, and precision clocks are expected. Specific objectives include the development and operation of a flight qualified cryogenic gyroscope, complete gyroscope system error analysis, and the consideration of various theoretical formulations of relativity and their subsequent experimental implications. Possible future benefits apart from the scientific ones include timing for navigation, communication and geodesy as well as cryogenic systems capable of extended operation in space.

W79-70404**188-41-55**

Ames Research Center, Moffett Field, Calif.
THEORETICAL ASTROPHYSICS
 D. C. Black 415-965-5527

The objective of this work is to conduct theoretical studies on important fundamental problems in astrophysics. Infrared astronomy. Although a wide range of astrophysical phenomena are under investigation, research efforts are primarily directed towards infrared astronomy and computational astrophysics. Theoretical work in infrared astronomy includes modeling of circumstellar shells in Be stars, analysis of infrared observations of late type stars and interpretation in terms of cool star atmospheres, studies of fragmentation of interstellar clouds and subsequent collapse to the main sequence, investigation of the structure of molecular clouds, modeling of dusty HII regions, as well as data interpretation of airborne infrared observations. The computational astrophysics program underway encompasses a broad spectrum of hydrodynamic and stellar dynamic problems in astrophysics including pre- and post-main sequence evolution, galaxy formation and evolution, accretion, and the dynamics of gas acceleration near QSO's. A variety of other astrophysical problems are being investigated.

W79-70405**188-41-55**

Goddard Space Flight Center, Greenbelt, Md

OFFICE OF SPACE SCIENCE

INFRARED AND RADIO ASTRONOMY

M J Mumma 301-982-6994
(196-41-54 198-10-01, 389-41-01)

The scientific objective of this program is to provide better understanding of the energetics, dynamics, compositions, excitation conditions, and evolution of solar system objects, stars, proto-stars, dust clouds, HII regions, galactic emissions and extragalactic objects. This is achieved by observations of these objects at wavelengths from 1 micrometers - 10 cm and at spectral resolutions $\lambda/\Delta\lambda$ from approximately 1,000,000. Since atmospheric opacity and emissivity prohibit or severely limit ground-based observations at certain wavelengths (4-8 micrometers), high altitude observational platforms such as the C-141, balloons, or satellites must be used. High sensitivity composite bolometers are being developed in the far infrared to take maximal advantage of low background conditions achievable at these altitudes. A balloon-borne 12 m telescope is being developed to conduct a high sensitivity, low spatial resolution, multicolor photometric survey of Galactic sources of submillimeter radiation, and at least a partial survey of extragalactic sources at these wavelengths. Infrared and millimeter/sub-millimeter coherent (heterodyne) spectrometers are used to measure completely resolved intensity profiles for neutral and ionized molecular and atomic lines. Millimeter lines are primarily rotational transitions, while infrared lines are mainly vibrational transitions.

W79-70405

188-41-55

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

RADIO ASTRONOMY

R W Davies 213-354-7782

In the observations task, we propose to begin a program of ground-based millimeter wave spectroscopy observations using the new 10 m antenna at Owens Valley Radio Observatory (OVRO). We also plan to continue as guest observers of the Kuiper Airborne Observatory (KAO) and the National Radio Astronomy Observatory (NRAO). Observations using the Deep Space Network (DSN) will also be continued. The laboratory program's catalog of rotational transitions of astrophysical molecules now contains 28 molecules and 50 isotopic variations. Additional astrophysical molecules will be entered in FY-79. A subsidiary catalogue of promising molecules not yet detected in space will be started. If additional funds are approved, laboratory measurements will be made for astrophysical molecules on which existing data are inadequate or non-existent. We are proposing a new task: the Tidbinbilla Interferometer. This interferometer linking the 64 and 26 m DSN antennas at Tidbinbilla has a measured sensitivity of 16 mJy. It is expected that 1 arcsecond position accuracy can be achieved on 100 mJy sources. We propose to develop a catalogue of precise positions for southern radio sources. We have proposed a separate, supporting RTOP (Submillimeter Receiving System) in order to construct a millimeter receiver for astronomical research at OVRO and on the KAO. (Presently, we are borrowing a receiver for the Upper Atmosphere Program.) As additional funds become available, we will extend the capabilities of this receiver.

W79-70407

188-41-55

National Aeronautics and Space Administration, Washington, D C

INFRARED ASTRONOMY

N W Boggess 202-755-3688

The objective is to advance stellar and galactic astronomy in the spectral region between 1 and 1000 microns through observational and theoretical programs. Observations in the infrared portion of the electromagnetic spectrum are particularly important for an understanding of the early and late stages in stellar evolution, interstellar matter, galaxies and quasistellar objects and the energy mechanisms associated with them, and the residual radiation of the universe. A balanced program including observation, technique and instrumentation development, and theory is required to insure the advances needed for full utilization of future platforms in space. The approach includes the following elements: (1) support observational programs using ground-based telescopes, balloons, and airplanes, and (2) promote the development of infrared techniques and apparatus. Special

emphasis is placed on far IR narrow band filters, spectral interferometers, modulation techniques, and multiple detector arrays in order to enhance the information content of an observation, and more recently, on development of cryogenic and low-background telescopes.

W79-70408

188-46-56

Goddard Space Flight Center, Greenbelt, Md

PARTICLE ASTROPHYSICS AND SHUTTLE EXPERIMENT DEFINITION

F B McDonald 301-982-4801

The objective is to study the properties of the cosmic radiation in order to understand its origin and propagation, and to study the properties of the sites in which element synthesis takes place. The particles observed are the nuclear and electronic species of the cosmic ray particles: their energy spectra, their charge and isotopic composition, and their distribution in space. Some of these objectives can be met through the imaginative use of short duration observations on balloons. Many will require heavier large-area payloads for which the space shuttle will be an ideal observation platform especially in the sortie mode. Observations of solar cosmic rays and energetic particles, of interplanetary origin, allow more direct studies to be made of the processes of particle acceleration and transport in a magnetohydrodynamic environment. Supporting these objectives is both the development of new detector systems for studying the particle properties and the associated development of theoretical studies relating to the sites of origin, models for acceleration, mechanisms for particle transport, etc., related to these experiments.

W79-70409

188-46-56

Marshall Space Flight Center, Huntsville, Ala

PARTICLE ASTROPHYSICS

Thomas A Parnell 205-453-5133

The program consists of observations and interpretation of data to determine the origins and source mechanisms of heavy cosmic ray nuclei (Z is less than 2) and cosmic gamma rays between 0.1 and 10 MeV. Emphasis is also placed on the improvement of instrumentation and data analysis techniques for further measurements of these particles and for application to Spacelab-era experiments. Observations of the nuclei and gamma rays are performed on balloon flights and measurements of detector response are made in the laboratory and at particle accelerators. Calculations concerning sources of particles, local background, and detector response are carried out and verified by measurement.

W79-70410

188-46-56

National Aeronautics and Space Administration, Washington, D C

PARTICLE ASTROPHYSICS

Albert G Opp 202-755-8493

The objective of this RTOP is to study the isotopic and charge composition and energy of galactic and solar cosmic rays. The primary galactic radiation represents the direct penetration of material from the galaxy into the solar system. The study of the nuclear composition and energy of this material provides direct evidence of the stellar processes responsible for the cosmic radiation and information on the processes responsible for the cosmic radiation. The observation of solar cosmic rays provides information on the abundances of different elements in the sun, and information on the solar processes that accelerate energetic particles to their observed energies. The design, construction and test of cosmic ray detectors is the prime activity supported by this RTOP.

W79-70411

188-46-57

Goddard Space Flight Center, Greenbelt, Md

GAMMA RAY ASTRONOMY

C E Fichtel 301-982-6281

The technical objective is to develop the most appropriate detector systems for the observation of the astrophysical sources of very energetic photons. The first approach to the general problem of gamma ray astronomy was the development of a large high energy telescope using digitized spark chambers. Many major improvements to this basic telescope system are still being

pursued and other approaches to detector systems are now being developed for the high energy gamma rays intermediate gamma ray studies and low energy gamma ray observations. In the low-energy gamma ray region 0.03 to 10 MeV much of the radiation may consist of monoenergetic line components therefore high resolution spectrometers are being developed which will be capable of sufficient precision to resolve lines as narrow as may be found in nature. In the medium energy interval (10 to approximately 50 MeV) a first generation gamma ray detector was built and flown on a balloon and a second generation experiment is now being assembled. In the high energy region improvements in the track imaging chamber systems are continuing and special attention in the track imaging chamber research is now being directed at building a chamber of significantly larger size. At the same time several approaches are being explored to improve angular resolution, including techniques to concentrate on higher energy photons. Time-of-flight systems are being developed to improve the rejection rate of events which are not gamma rays. Associated theoretical gamma ray astrophysics activity is being pursued both to aid in interpreting results and to suggest promising new areas of study.

W79-70412**188-46-57**

National Aeronautics and Space Administration Washington, D C

GAMMA RAY ASTRONOMYAlbert G Opp 202-755-8493
(188-46-59)

The objective of this RTOP is to measure the characteristics of energetic photon emission from celestial sources, and to understand the physical processes responsible for the emissions. This RTOP includes photonic radiation from approximately 10 keV in energy upward to as high as can be measured that is from hard X-rays to ultra-high energy gamma rays. Several sources have been identified which have spectra extending into the hundreds of MeV or higher. The spectra of discrete sources and the spectra and distribution of the diffuse background will provide information on the physical processes active in stars, pulsars, galaxies and interstellar space. Gamma ray photons result from a number of physical processes. These processes can furnish information on the synthesis and distribution of elements in the universe on the magnetoplasma environment of a star on the interaction of cosmic rays with interstellar material, as well as other astrophysically important parameters. Gamma rays, which are undeflected by magnetic fields travel directly from their sources and anisotropies in the direction of arrival of the photons gives information on the location of the gamma ray sources.

W79-70413**188-46-57**

Jet Propulsion Lab Calif Inst of Tech Pasadena

GAMMA-RAY ASTRONOMY

A S Jacobson 213-354-6263

This describes the JPL program in X- and gamma-ray astronomy, part of which is a cooperative effort with UCSD. The primary objective of the program is to observe nuclear gamma-ray line spectra from extraterrestrial sources in the 0.2 to 10 MeV energy range. Such observations could provide important information on nucleosynthesis, galactic history and the physical nature of various celestial objects including cosmic X-ray and gamma-ray sources, both constant and transient. Under this program an existing high resolution gamma-ray spectrometer balloon system will be used in a series of astronomical observations. Additionally, development of a new significantly larger balloon system will begin. The specific objectives for this program for FY-79 are to begin the design of the next generation high spectral resolution gamma-ray telescope, initiate the procurement of several large volume high purity germanium crystals and conduct observational balloon flights from Palestine Texas with the existing detector system.

W79-70414**188-46-59**

Goddard Space Flight Center Greenbelt Md

X-RAY ASTRONOMY

E A Boldt 301-982-5853

Celestial X-ray sources have introduced us to rich new aspects of astronomy ranging from the millisecond bursts of hard X-rays

coming from the innermost orbits of matter falling into a black-hole to the beamed emission associated with accretion of matter onto a rapidly rotating high magnetized neutron star. The combination of large sensitive area, low detector background, high temporal resolution and non-dispersive spectroscopy over a broad bandwidth has been our approach in discovering and exploring these phenomena. The power of this approach is being well demonstrated. Extending it with improved spectral resolution and broad-band imaging is a major area of development now indicated. This involves the creation and evaluation of new systems incorporating low noise ionization counters of optimum resolution, large area X-ray concentrators and imaging devices. Dispersive spectroscopy is introduced in a new task for the development of a conical crystal spectrometer.

W79-70415**188-46-59**

National Aeronautics and Space Administration Washington D C

X-RAY ASTRONOMYAlbert G Opp 202-755-8493
(188-46-56 188-46-57)

The objective is to investigate and understand the nature of sources of X-ray emission. The number of such sources detected has been increasing by virtue of the active observational program being conducted with balloons, rockets, and satellites. As experimental techniques have been refined, a number of point sources have been identified with unusual optical objects both galactic and extragalactic in origin. In addition, X-ray variability of different characteristic forms has been found. Some sources are analogous to the radio and optical pulsars. The general cosmic X-ray background, as well as the point sources, need further study in order to elucidate the emission mechanism and the cosmological significance of these objects. Specific objectives are the detection of additional sources, spatial mapping of the background, accurate positional determination and correlation with optically identifiable objects. These objectives are met by supporting laboratory studies, flight programs and theoretical work. Research and development of advanced detectors, shielding systems, and focusing optical systems are being conducted. Data processing methods are being refined.

W79-70416**188-46-62**

Goddard Space Flight Center, Greenbelt Md

HIGH ENERGY ASTROPHYSICAL COSMOLOGYF W Stecker 301-982-2280
(188-46-56, 188-46-57)

The objectives are (1) to conduct fundamental theoretical research in cosmology and astrophysics covering a broad range of astrophysical phenomena but with particular emphasis on the cosmological implications of high energy astrophysics and related areas. This work will be generally pertinent to the overall research program of the Laboratory for High Energy Astrophysics and other work being carried out in the Space Sciences Directorate. (2) to publish in scientific literature and to present at professional meetings, the significant results of such research. (3) to collaborate and support theoretical research of research associates, graduate students and possible senior faculty members on leave from academic institutions, such work also being relevant to the goals of the Laboratory and the Directorate, and (4) to provide theoretical advice and support in planning satellite experiments and in providing a theoretical framework for interpreting the results of such experiments. The work should thus help strengthen the overall program of the Laboratory and the Directorate. Work carried out will be on the forefront of knowledge in the fields of cosmology, high energy astrophysics and related fields of astrophysics. Work will utilize, in particular, new advances in high energy physics and particle physics. The cosmological implications of high energy astrophysics observations will also be studied.

W79-70417**188-46-51**

Marshall Space Flight Center Huntsville Ala

INTERDISCIPLINARY SPACE SCIENCE RESEARCH

C R O'Dell 205-453-3033

The objectives are to conduct space science research in various scientific and technical disciplines related to the astrophysics

OFFICE OF SPACE SCIENCE

ics programs of NASA, and to provide a quick-reaction capability of supporting research tasks unforeseen or which encounter unexpected difficulties and which enhance the in-house scientific capabilities of the MSFC. Under the direction of the Associate Director for Science, research is initiated in astrophysics related scientific and technical areas that support the scientific missions of the Center. Research tasks selected for funding under this RTOP will contribute to the advancement of in-house capabilities and the state of the art.

W79-70418

188-78-51

Goddard Space Flight Center, Greenbelt Md ADVANCED TECHNOLOGICAL DEVELOPMENT, GENERAL SIGNAL AND DATA PROCESSING ELECTRONICS, SOLID STATE DETECTORS

James H Trainor 301-982-6282

The objectives of this research project are to develop and test new on-board signal handling data processing storage, computing and auxiliary electronics circuitry for use in energetic particle and astrophysics experiments on spacecraft, rockets balloons etc as well as special test and analysis equipment applicable also for both ground and shuttle usage. The growing complexity of experiments and the often corresponding increase in the volume of data obtained have made signal handling, data processing and data transmission capability-limiting factors. To reduce the transmission of unnecessary data it is necessary to increase the experiments on-board signal handling and data processing capability. This program is approached through (1) the investigation and development of new techniques for signal shaping and handling, data processing and auxiliary circuitry and (2) the modification of existing techniques by the application of advanced technology and materials including MOS/LSI technology, thick film techniques multiple chip techniques, and microprocessors. The technical objective of the research project is to conduct a program of research and development, and device test and evaluation in the field of silicon and germanium nuclear radiation detectors with emphasis on (1) the improvement of detector technology, (2) the understanding of the radiation damage effects on device operation and lifetime, (3) the understanding of the effects on these detectors of chemicals commonly used near or on spacecraft, (4) the establishment of technology for the fabrication of specialized devices not available from industry and (5) continuation of pragmatic life testing.

W79-70419

188-78-51

Marshall Space Flight Center, Huntsville, Ala LOW GRAVITY SUPERFLUID HELIUM ADVANCED TECH- NOLOGY DEVELOPMENT

Richard A Potter 205-453-3431

Several experiments are currently being developed which will require a low temperature environment for their proper operation in space. Superfluid helium will undoubtedly be used for many of these applications. Immediate application to experiments are to be found in cosmic ray relativity and infrared astronomy. The purpose of this RTOP is to investigate theoretically and experimentally, where possible, the properties of superfluid helium to be expected when liquid helium dewars are flown into space. The properties of superfluid helium in this near zero gravity environment will be assessed and methods will be investigated whereby problem areas may be resolved and/or controlled. The goal of this effort is to support the development of liquid helium dewar technology for space.

W79-70420

188-78-60

Goddard Space Flight Center, Greenbelt Md GAMMA RAY OBSERVATORY (GRO)

Jeremiah J Madden 301-982-2593

The objectives of the Gamma Ray Observatory (GRO) is the study of the most energetic photons originating in our galaxy and beyond. These photons provide the most direct means of studying the largest transfers of energy occurring in astrophysical processes. Specific studies will include the dynamic high energy processes occurring in compact objects, examination of supernovae to determine if there has been nucleosynthesis, a search for X-ray point sources and their properties, X-ray bursts, and the detection and examination of other galaxies. A definition

project will be established within GSEC to carry out the system definition phase activities. These activities will include in-house and contracted studies to prepare the GRO Project for the execution phase. At the conclusion of the definition phase a project plan will be submitted to Headquarters.

W79-70421

188-78-60

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

GRAVITATIONAL EXPERIMENTS IN SPACE

J D Anderson 213-354-3956

The objectives are to define a set of space missions that will yield data on the nature of gravitation, describe in quantitative terms the contribution of each mission to experimental gravitation, and specify any new or peculiar technological requirements that gravitational experiments will impose on future space missions. A comparison of the proposed Solar Probe and Mercury Orbiter Missions is a primary objective of this investigation. Recommendations on the relative merits of the two missions from the viewpoint of experimental gravitation, will be delineated as clearly as possible. Existing software will be used to perform a covariance analysis for the Solar Probe and for Mercury Orbiter. In addition to the important Newtonian parameters for each mission it will be necessary to include several post-Newtonian parameters (PPN) in the analysis as well as the solar gravitational quadrupole J₂, and possible time variations and nonisotropic terms in the gravitational constant G. The analysis will be conducted within a framework of realistic technological constraints on both missions.

W79-70422

188-78-60

Marshall Space Flight Center, Huntsville, Ala

ADVANCED MISSION STUDY - ADVANCED X-RAY ASTROPHYSICS FACILITY

James O Ballance 205-453-3431

The Advanced X-ray Astrophysics Facility (AXAF) will provide a means to make X-ray observations to study stellar structure and evolution, large-scale galactic phenomena, the nature of active galaxies, and rich clusters of galaxies of cosmology. The telescope will extend these observations to the coronas of main sequence and giant, late type stars and to peculiar stars. It can resolve clusters of galaxies at extreme distances. This initial study will develop the necessary design for a long life (approximately 10 years), high angular resolution (approximately 0.5 in.), greater sensitivity grazing incidence telescope facility. This large free flying spacecraft will be designed for refurbishment and replacement of instruments as well as the supporting subsystems. Specific major trade activities will include the optical design parameters, surface materials and fabrication techniques, image plane alignment, etc. Support modules to provide basic requirements such as those developed for the Space Telescope on the Multi-Mission spacecraft will be considered for the observatory.

Planetary Biology

W79-70423

192-55-45

Ames Research Center, Moffett Field, Calif

BIOINSTRUMENTATION

H P Klein 415-965-5094

The objectives are to develop instrumentation and techniques for the characterization of Mars surface material for species related to the evolution of chemical and biological activity on that planet. The Unified Experiment for chemical and/or biological characterization of Mars surface material has been developed. With hardware concepts and results derived from Viking, advanced concepts are being studied for detection of important chemical species on Mars. In-house research including support of interpretation of the results of the Viking Biology experiment using the IBM hardware, has continued.

W79-70424

192-55-61

Ames Research Center, Moffett Field, Calif

CHEMICAL EVOLUTION

H P Klein 415-965-5094

(192-55-66)

The objective is to understand the origins and chemical evolutionary pathways of organic matter in the cosmos which led in the case of earth, to the emergence of life but which in extraterrestrial environments may have taken divergent paths. Chemical evolution research encompasses the study of the evolutionary path of carbon and its compounds from the primal fireball through interstellar clouds to formation of solar systems to the beginning of life on earth. In experiments conducted under conditions designed to simulate the putative environments of cooling solar nebulae, cometary heads and tails, and primitive contemporary planetary atmospheres and surfaces the extent and nature of abiotic synthesis of organic matter is determined. Natural evidence bearing on the validity and generality of the chemical evolution hypothesis is sought through organic and inorganic analyses of materials having extraterrestrial (e.g. meteorites, lunar samples, interstellar dust grains, Martian soil) and ancient and recent terrestrial origin. The intimate association of minerals with organic matter everywhere in the cosmos and their necessary co-genesis and co-evolution make it essential to understand the influences of one on the other. Through combined study of the organic geochemistry and the mineralogy and petrology of natural samples will come the firm understanding of the geochemical and geological constraints that will permit reconstruction of ancient and prebiotic environments.

W79-70425 **192-55-61**
National Aeronautics and Space Administration, Washington, D C

CHEMICAL EVOLUTION
R S Young 202-755-3732
(192-55-62, 192-55-67)

The objective is to understand the prebiological chemistry which led in the case of the earth to the formation of organic compounds and the origin of life but which on extraterrestrial bodies may have taken divergent paths. Chemical evolution encompasses the study of the evolutionary path of carbon and its compounds from the primal fireball through interstellar dust clouds to formation of galaxies, solar systems and planets, to the beginnings of life on the earth. In the laboratory the syntheses of organic compounds related to terrestrial biochemicals are explored in experiments which simulate the putative environments of interstellar dust clouds, cooling solar nebulae and planetary atmospheres and surfaces. This research will provide an experimental basis to evaluate the hypothetical sequence of events beginning with the synthesis of organic compounds from simple components in the atmosphere of the primitive earth and ending with the origin of life.

W79-70426 **192-55-62**
National Aeronautics and Space Administration, Washington, D C
ORGANIC GEOCHEMISTRY
R S Young 202-755-3732
(192-55-61)

Organic geochemistry is the study of ancient terrestrial rocks for organic molecules and inclusion of biological origin. The objective is development of techniques for the isolation of organic matter and distinguishing organic matter of biological origin from that of non-biological origin. The applications of such technology to returned extraterrestrial samples.

W79-70427 **192-55-63**
National Aeronautics and Space Administration, Washington, D C
PLANETARY SOIL MICROBIOLOGY
R S Young 202-755-3732

The objective is to develop techniques for the detection and characterization of life and life-related molecules. There are a variety of techniques which can be used to determine the presence or absence of life in a given sample of soil on the earth. These techniques have application to extraterrestrial environments as well. The purpose of this RTOP is to determine which methods of detecting life or life-related organic chemicals have the highest probability of performing unambiguously either in situ on other planets or in a terrestrial laboratory.

W79-70428 **192-55-64**
National Aeronautics and Space Administration, Washington, D C
BIOLOGICAL ADAPTION TO EXTREME ENVIRONMENTS
R S Young 202-755-3732

The objective is to study terrestrial microorganisms which have adapted to life under environmental extremes as (1) models for organisms which may be found on other planets (2) possible terrestrial contaminants of other planets and (3) examples of organisms which may be present in samples returned from Mars in the future. On the Earth life is virtually ubiquitous. There are terrestrial microorganisms which live in conditions of high and low temperatures, low humidity, high radiation flux, acidity, alkalinity and salinity--all parameters which must be considered in assessing the likelihood of finding life on any of the planets and satellites of our solar system. The environmental limits to which terrestrial organisms have adapted will be identified and the changes in the structure and function of their cellular components which enable them to endure harsh environments investigated.

W79-70429 **192-55-65**
National Aeronautics and Space Administration, Washington, D C
BIOINSTRUMENTATION
R S Young 202-755-3732

The broad objective of the effort is to develop instrumentation and techniques for the detection and characterization of life on other planets. The primary emphasis of the program is directed at the exploration of Mars but consideration will be given to the application of instrumentation to other planets. Development of operational breadboard models and prototype hardware for the Unified Biology Experiment and Wet-Chemistry Amino Acid to (1) assess the reliability of current experimental designs, (2) determine if the instruments can accomplish the scientific goals for which they were designed and (3) identify engineering problems which require additional design and development efforts.

W79-70430 **192-55-66**
National Aeronautics and Space Administration, Washington, D C
PLANETARY ENVIRONMENTS - BIOLOGICAL COMPATIBILITIES
R S Young 202-755-3732

Analytical methods will be developed for the determination of biologically important planetary environmental characteristics such as composition of the atmosphere, presence or history of water and occurrence of organic emissions. The methods and instruments so developed for planetary exploration will be useful in assessing a planet's ability to sustain a biota.

W79-70431 **192-55-66**
Ames Research Center, Moffett Field, Calif
PLANETARY ENVIRONMENTS-ORGANIC CHEMISTRY
H P Klein 415-965-5095
(192-55-61, 192-55-67)

The objective is to provide specific compositional information on the terrestrial and outer planet atmospheres and surface matter, comets, and asteroids to better construct tentative models of planetary chemical evolution and status which are required for understanding the conditions necessary for the origin of life in our solar system and for establishing the probability of life in the universe. Methods and instruments are being developed for in situ and remote analyses of planetary atmospheres and surface materials from instrumented probes, penetrators, landers, flybys and orbiters as well as for samples returned from meteoritic and planetary sources. Concepts are being formulated and tested in the laboratory to (1) detect and measure candidate constituents for each of the prospective planetary atmospheres, (2) detect and measure extant extraterrestrial organisms and their activity, or fossil remnants, in soils, and (3) detect and measure chemical potential, organic and biogenic substances in soils. Advanced plans are being formulated in which critical concepts will be tested for developing a containment facility for the analysis of returned planetary samples.

OFFICE OF SPACE SCIENCE

W79-70432

192-55-67

National Aeronautics and Space Administration Washington D C

ORIGIN AND EVOLUTION OF LIFE

R S Young 202-755-3732

(192-55-64, 192-55-61)

The objective is to understand the sequence of events and the mechanism(s) by which the first living systems originated from a complex milieu of organic molecules on the primitive earth and to apply this knowledge to assess the likelihood of such events occurring now or in the past on other planets. Studies on the origin of life focus on the interactions of complex organic molecules that may have been present during the later stages of chemical evolution on the primitive earth their organization into systems with one or more characteristics of living cells, and their eventual evolution into metabolizing, self-replicative systems. Research is pursued which investigates the origin of the genetic code protein synthesis cell membranes, and important metabolic processes involved with energy capture and utilization.

W79-70433

192-55-67

Ames Research Center, Moffett Field, Calif

ORIGIN AND EVOLUTION OF LIFE

H P Klein 415-965-5094

(192-55-61, 192-55-66)

The objectives are to develop background information on which to base plausible models for the origin and evolution of life, to explore the mechanisms, processes, time periods and environments that may have been necessary for the formation of life, to use this information to assess the probability of the development of life on other planets, both within and outside of the solar system and to use this same information to establish the likelihood of biological contamination of other planets with terrestrial organisms or of Earth with life from other planets. Several crucial points in the origin and evolution of life have been identified as deserving of extensive investigation. In sequence they are the concentration, selection and polymerization of biological monomers, the transmission of information that specifies function between different types of polymers, the initiation of adapter molecules, such as t-RNA, and the origins of the genetic code, the enclosure of self-replicating systems within membranes, the utilization of cross membrane chemical and electrical potential as a source of biological energy, the influence of oxygen in the evolution of organisms, the identification of evolutionary relationships among proteins of possible sites of evolutionary divergence, and of cases of possible evolutionary convergence.

W79-70434

192-55-68

National Aeronautics and Space Administration Washington, D C

SUPPORT ACTIVITIES

R S Young 202-755-3732

AIBS Advisory Panels for OSSA was established to perform the following functions: (1) evaluate the Scientific Merits of research proposals submitted by Program Chief(s) OSSA and advise Program Chief(s) on the scientific merits of said proposals, and (2) plan, conduct, and coordinate meetings of the panels providing necessary secretarial service, including minutes of the meeting.

W79-70435

192-55-69

Ames Research Center, Moffett Field, Calif

BIOLOGICAL AND BIOCHEMICAL ASPECTS OF ECOSYSTEMS

H P Klein 415-965-5094

The objective is to define the parameters affecting the behavior of ecosystems, particularly how closure affects the composition and stability of ecosystems. These data will provide the background necessary to design life support systems capable of supporting long term human activities in extraterrestrial environments. The stability of ecosystems and the effects of closure on the properties of ecosystems will be studied using heterogeneous microbial populations. Plants will be grown utilizing synthetic and processed wastes and seedling growth will be correlated with the

chemical and microbial properties of the waste solutions. The potentially harmful interaction between plants will be examined with the goal of identifying the volatile products that inhibit plant growth. The concept of a closed ecosystem will be mathematically modeled so that ecosystems of varying degrees of complexity may be examined for their behavior using any number of desired inputs as variables.

Planetary Protection

W79-70436

193-58-70

National Aeronautics and Space Administration Washington D C

PLANETARY PROTECTION

R S Young 202-755-3732

The objective is to protect the environments of planets of biological interest (including earth) against harmful contamination that may potentially occur in the course of conduct of space exploration. Analytical and experimental research conducted over the last decade helped to establish PP policy and requirements along with adequate implementing procedures all geared toward supporting the overall objective of the program. Planetary Protection is a continuing challenge. As the emphasis in space exploration shifts from the inner to the outer planets and as new knowledge becomes available, established PP requirements and guidelines should be reviewed and modified and new requirements should be generated. In the coming year, PP requirements for Mars will be reevaluated in light of the Viking experience, explicit guidelines will be established for the outer planets and unique PP issues relating to sample return missions will be studied. The Space Transportation System (STS) will be examined in terms of its interactions with planetary spacecraft and PP activities.

Planetary Astronomy SR&T

W79-70437

196-41-30

Marshall Space Flight Center, Huntsville, Ala
COMETARY OBSERVATION AND THEORY
C R O'Dell 205-453-3033

(188-41-51)

The objective is to obtain cometary spectra with intermediate spectral resolution between 350 to 820 nm with emphasis on the longer wavelength and to analyze rovibronic structure of the observed comets and spectra of comets in terms of a corrected resonance-fluorescence mechanism. An Echelle spectrograph employing an S-20 fiber optics image tube with an F/2 Schmidt camera will allow a spectra resolution of approximately 0.5 Angstroms to be obtained on photographic plates. Standard data reduction by densitometry will be employed. A review of laboratory and cometary spectra will provide the initial suggestions to correcting the resonance-fluorescence mechanism (e.g., NH₂).

W79-70438

196-41-40

Lyndon B Johnson Space Center, Houston, Tex
REMOTE SENSING OF PLANETARY SURFACES
W C Phinney 713-483-3816

Spectroscopic techniques can be applied over a broad range of the electromagnetic spectrum to probe the chemistry, mineralogy and structure of planetary surfaces. Remote sensing phenomena currently being studied at JSC include gamma ray emission, reflection of solar radiation and thermal emission. Activities include instrument development, laboratory experiments, and Earth-based telescopic observations.

W79-70439

196-41-50

Goddard Space Flight Center, Greenbelt, Md
GROUND-BASED INFRARED ASTRONOMY
V G Kunde 301-982-5693

The scientific objective is to determine information on astrophysical objects, such as molecular clouds, interstellar lines,

molecular and circumstellar components in stellar atmospheres and planetary atmospheres from high spectral resolution ground-based measurements in the intermediate infrared. A spectrometer system employing a Michelson interferometer capable of operating at liquid N₂ (77K), is being developed to meet the simultaneous requirements of high spectral resolution, a wide free spectral range and high sensitivity. An optical retardation up to 25 cm will provide an unapodized spectral resolution up to 0.2 cm to the minus one power in the 400-2000 cm to the minus one power range. A post-dispersed detection system is being developed to reduce source noise and background noise from a warm telescope system and the atmosphere at the detector, thus allowing the multiplex advantage of the interferometer to be retained. The cooled instrumentation with the post-dispersed detection system, operating with a low background infrared telescope at a favorable infrared site will allow maximum sensitivity to be attained for an interferometer system at a ground-based site. The sensitivity level for a measurement in the 1000 cm to the minus one power (10 micrometers) region with a 122 cm diameter telescope, an integration time of 60 minutes and a spectral resolution of 0.2 cm to the minus one power is approximately 6×10^{-10} to the minus 25 power watts sq m hz.

W79-70440

196-41-51

Goddard Space Flight Center Greenbelt Md
RADIO AND RADAR PLANETARY STUDIES
J K Alexander 301-982-5461

The objective of this program is to obtain information on the nature, extent, and dynamical behavior of planetary magnetic fields, trapped radiation belts, and magnetospheres by studying the nonthermal radio emissions from the planets. The major approaches to this investigation are (1) synoptic observations of Jupiter's decametric radiation via a global network of monitoring instruments and (2) theoretical analysis of the generation and propagation of nonthermal radiation in a planetary magnetosphere. The Jupiter Monitor Network is providing unique data relative to the rate and stability of the magnetic field rotation, energetic particle trapping and precipitation processes and the physics of satellite-plasma interactions in the magnetosphere and correlative data both for other ground-based observations and fly-by in-situ measurements. The major emphasis in the coming year will be on full time operation of the four-station monitoring network in support of flight radio measurements from the Voyager spacecraft and on detailed analysis of new merged data catalogs compiled from the long series of joint decametric measurements obtained by the NASA network, the University of Florida, the University of Texas, and the University of Colorado. This study utilizing the most comprehensive data set ever assembled will seek to understand the behavior of relatively weak, low-independent emissions and to determine reliably whether there are solar wind correlations with the occurrence statistics.

W79-70441

196-41-52

Goddard Space Flight Center Greenbelt, Md
IMAGING STUDIES OF COMETS
J C Brandt 301-982-4701

This RTOP provides for the operation of a small high altitude observatory, Joint Observatory for Cometary Research (JOCR), for imaging research on comets and their interactions with solar radiation and the solar wind. In addition, when suitable bright comets appear, radio observations will be made at existing national facilities. The observatory site in central New Mexico is one of the darkest sites left in the continental U.S. Extensive photography of comets Kohoutek, Kobayashi-Berger-Milon and West has been carried out. These photographs show extensive features in the plasma 0.1 AU from the head which have been analyzed for phase speed and estimates of the tail magnetic field. Recently, we have convincingly associated a structure in comet Kohoutek on January 20, 1974 with a specific excursion in the polar solar-wind speed; this is a first. The Physical Sciences Committee Report on Supporting Research and Technology and Data Research (May 1976, p. 69) notes that the JOCR has "considerable potential at modest cost," a fact supported by the "possibility of a cometary flight mission in the 1980's."

W79-70442

196-41-54

Goddard Space Flight Center Greenbelt Md
ADVANCED INFRARED ASTRONOMY AND LABORATORY ASTROPHYSICS
M J Mumma 301-982-6994
(188-41-55 198-10-01 185-47-55)

The objective of the advanced infrared astronomy program is to study the molecular constituents of solar system objects (e.g. planetary atmospheres and comets) through observations of their IR/MM line spectra and so to further our knowledge about (1) molecular abundances (2) kinetic vibrational and rotational temperature distributions (3) kinetic velocity shifts (winds), (4) vertical and spatial distributions and (5) ambient gas densities and to carry out comparative studies of these objects. The physical information we seek is contained in the intensity profiles of isolated spectral lines and can be obtained by inversion of the observed line shapes. The measurement of spectral line shapes has recently become a tractable problem at IR wavelengths and line shapes can now be measured by infrared heterodyne spectroscopy and by mm-wave coherent spectroscopy. The approach is to develop and employ coherent detection line receivers for use in the infrared and millimeter wavelength regions. The infrared front end has been built for use with gas lasers or semi-conductor diode lasers as local oscillators and HgCdTe photo-mixers while the mm-wave front end features Klystron local oscillators and Schottky diode mixers. Both feed into a GSFC standard spectral line receiver which analyzes, displays, and outputs the spectral lines. Initial observations with these systems have been from the ground but both systems have been developed with an eye toward flights on the NASA C-141 and in space.

W79-70443

196-41-67

Ames Research Center, Moffett Field, Calif
PLANETARY ASTRONOMY AND SUPPORTING LABORATORY RESEARCH
R W Boese 415-965-5501

The composition of planetary atmospheres and surfaces and the abundance, temperature and pressure of certain atmospheric constituents can be determined by spectroscopic observations from ground-based and from airborne observatories. Such data are necessary for the preparation of valid model atmospheres which are needed to evaluate the possibilities of life on the planets and to design systems for exploratory missions and for the preparation of evolutionary models of planetary interiors. The objectives of this work are to obtain, study and analyze spectroscopic observations of the planets and their satellites to obtain and analyze, in the laboratory, spectra appropriate for valid interpretation of planetary observations and to develop the analytical and computational techniques necessary to interpret planetary spectra in terms of real planetary atmospheres and surfaces. The objectives will be pursued by measuring in the laboratory basic molecular parameters such as absorption line and band intensities, absorption line half-widths, vibration-rotation interaction constants, and line pressure induced shifts and absorption. The dependence of these parameters on pressure and temperature will be obtained by using long path gas cells, cooled and heated gas cells and high resolution spectrometers and interferometers operating primarily in the infrared. Spectra of the planets and their satellites will be obtained by using airborne and ground-based telescopes and will be analyzed to obtain information about the composition and structure of their atmosphere and the composition of their surface.

W79-70444

196-41-68

Ames Research Center, Moffett Field, Calif
SEARCH FOR EXTRASOLAR PLANETS
D C Black 415-965-5527
(790-40-35)

The objectives are to obtain high-precision radial velocity and astrometric observations of nearby stars in search of perturbations on the motion of those stars due to planetary or stellar companions to begin development and testing of a Multichannel Astrometric Photometer (MAP) for use as a detector on an astrometric telescope, and to ascertain the feasibility, limitations, and scientific soundness of ground-based planetary

OFFICE OF SPACE SCIENCE

detection techniques. Observations will be carried out by selected University researchers. Development, and testing of the MAP will be performed by a selected University research group and the feasibility study will be accomplished by means of a "Woods Hole" type workshop involving experts in various aspects of astronomy, instrumentation and atmospheric sciences.

W79-70445 196-41-71
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GROUND-BASED OPTICAL ASTRONOMY
T. V. Johnson 213-354-7427

The overall objective of the ground-based optical astronomy task is astrophysical study of planets and their satellites, by means of ground-based observations at visible and near-infrared wavelengths (approximately 0.3 to 2.0 microns). This task consists of several subtasks as follows: (1) planetary spectroscopy which investigates the physical and chemical properties of the upper tropospheres of Venus, Jupiter, Saturn, Uranus and Neptune through high resolution astronomical spectroscopy; (2) the Sodium D-Line Patrol which investigates the temporal and spatial behavior of the Na D-line emission from the Jovian satellite Io (J-1) through a synoptic program of spectroscopic observations; and (3) the spectroscopy which investigates the physical state and bulk motions of the neutral sodium cloud associated with Io, through a variety of advanced high resolution spectroscopic techniques. In addition to these primary subtasks, the ground-based optical astronomy task provides limited operational support (equipment maintenance and set-up observing assistance) at Table Mountain Observatory (TMO) to programs supported from other sources. Among such programs are: (1) lunar multispectral imaging and (2) outside observers from the academic community who use the TMO optical astronomy facilities from time to time.

W79-70446 196-41-72
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GROUND-BASED INFRARED ASTRONOMY
R. Beer 213-354-4748

The objective of this program is to understand the physical and chemical state of planetary atmospheres by means of chemical and isotopic abundance analyses as determined by remote sensing methods in direct support of ongoing and planned planetary missions. The principal approach employed is that of high resolution, near infrared (1-6 micrometers) astronomical spectroscopy using a Connes'-type Fourier spectrometer at the coude foci of large telescopes. For the past several years, we have used the 2.7 m telescope at McDonald Observatory. After a period of upgrading, we plan to use the new 3 m infrared telescope at Mauna Kea for all future programs.

W79-70447 196-41-73
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RADIO AND RADAR PLANETARY STUDIES
S. Gulik 213-354-5708

The ongoing objective of the radio astronomy task is to conduct comprehensive studies of the atmospheres, magnetospheres, and surfaces of planets and their satellites. Theoretical models are constructed and radio astronomical observations are made to test the models and provide input for theoretical refinements. Primary interest is currently focused on Venus, Mercury, and the four major planets and their satellites. The observational experiments are conducted at JPL's Table Mountain Observatory (TMO), the Deep Space Network Tracking Stations, Caltech's Owens Valley Radio Observatory (OVRO) and other observatories as required by specific needs of the program. Research programs at these facilities are planned in order to take full advantage of the unique capabilities of the individual systems, especially the 36 GHz interferometer at TMO and the 64 m antennas and advanced low-noise receivers at the DSN stations. The objective of the DSIF radar astronomy task is to obtain radar data on the planets for determining properties of their surfaces, orbits and spins, with Venus, Mercury, Mars, Saturn's rings and Jovian Satellites as prime goals. This work employs the unique facilities of the DSIF and exploitation of synthetic aperture techniques. The microwave radiometer development effort is supportive of the radio astronomy task. The objectives are to design, construct, and maintain advanced

microwave and millimeter radiometer systems and associated digital systems for use at the Table Mountain Goldstone Owens Valley and other radiotelescope facilities that are used by the group.

W79-70448 196-41-75
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GROUND-BASED LARGE INFRARED TELESCOPE SUPPORT
Robert E. Covey 213-354-5590

The objectives of this RTOP are to provide NASA Headquarters with reviewing, monitoring, and consultative support on the Infrared Telescope Facility (IRTF) Project. Overall management and subcontracting responsibility is assigned to the University of Hawaii. JPL will provide, when requested by the Spaceflight Science and Support Facilities Division (BXE), monitoring and consulting support to that office. This support includes but is not limited to review of documentation furnished by UH for approval. JPL is to provide a JPL detailee as Project Manager to the University of Hawaii for a period of approximately three years beginning January 1976. The Project Manager detailee reports to and is responsible directly to the Director of the Institute for Astronomy (DIA), University of Hawaii, for the project as a whole. As Project Manager, he is responsible for the overall control of all day-to-day activities of the Project. He organizes and supervises the activities of a specially organized Project Office and provides a direct interface between NASA, KPNO, ITDC, JPL, and Change Control Board (CCB). He has direct responsibility for the day-to-day management and operation of the Project. He directly supervises all the Project-related work of the Project Office staff in addition to such regular Institute staff members as may be designated by the DIA to work fully or in part on the Project.

W79-70449 196-41-76
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
COMETS AND ASTEROIDS
R. S. Saunders 213-354-3815

This RTOP contains two tasks to further the understanding of asteroids: their origins, compositions and relationships to other planets and satellites. (1) The Physical Properties of Asteroids task is an observational and theoretical study of compositions, spectral albedoes and histories of comets and asteroids. We plan to continue our survey of asteroids at mid-infrared wavelengths (1.65 and 2.2 micrometers) as our earlier data have confirmed the great value of these observations to compositional classification and the study of asteroid surface morphology and processes (see Johnson et al., 1975; Matson et al., 1976, 1977). Objects of unusual interest from the survey will be followed up at additional wavelengths from 1.25 to 12.5 micrometers. For example, observations of the water of hydration band from 3 to 4 micrometers will be used to study the volatile content of the largest carbonaceous asteroids. (2) The Origin of Asteroids and Small Bodies task has as its objectives to understand the morphology of the belt, identify and study the fragments of asteroid collision events called families, investigate the orbital evolution of special objects, understand the means by which asteroid collision debris may reach the earth, and provide support for the study of asteroids passing near the earth. The studies of belt morphology and asteroid families previously performed under this contract can be extended to objects discovered since that study. Certain families, particularly those showing internal structure, deserve more detailed studies than have been carried out to date. The dynamical evolution of unusual orbits can be studied through numerical integration. Resonances will be the principal subject studied. One type of resonance is being studied for its possibilities in delivering asteroidal collision debris to the earth as a source of meteorites. Rapid orbit determination and ephemeris support will continue to be supplied to the Palomar search for planet crossing asteroids so that the physical properties of these objects can be studied during their brief periods near the earth.

W79-70450 196-41-78
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH BASED LUNAR OBSERVATIONS

R S Saunders 213-354-3815

The work is aimed at investigating lunar chemical and physical properties using a variety of ground-based techniques. The lunar multispectral imaging task utilizes the Silicon Imaging Photometer System (SIPS) to acquire multispectral data of lunar regions. The basic objectives are to study the variation of surface composition parameters and soil maturity to relate to lunar stratigraphy and correlate spectral data with other orbital and ground based data sets to solve lunar problems such as mare basalt composition variation with time and the distribution of anomalous materials such as KREEP rich soils. A large part of the effort is directed toward exploring data handling and display techniques designed to make optimal use of spectral data in synthesis. Near infrared lunar imaging is a task involving the use of a variety of techniques to obtain near infrared lunar images, including line scan techniques and the modification of an existing CCD (Charge Coupled Device) camera for lunar observations. The objective of the Alsep/Quasar VLBI task is the acquisition of intercontinental delta VLBI observations between lunar ALSEP transmitters and extragalactic radio sources (ERS). The ALSEP-quasar observations employ a 4 antenna technique in which the differential phase is obtained with no integer cycle ambiguities by continuous observations of both extragalactic source and a number of ALSEP transmitters on the lunar surface.

W79-70451

196-41-80

National Aeronautics and Space Administration Washington D C

GROUND-BASED OPTICAL PLANETARY ASTRONOMY

William E Brunk 202-755-3660

The objective is to increase our knowledge of the planets, their satellites, asteroids and comets through the use of astronomical observations made with telescopes and other optical instruments located at ground-based observatories. The observations will be made throughout the visible and infrared portions of the spectrum. Reduction, interpretation, analysis, and publication of the data thus obtained are included as part of the objective. The approach is to utilize the interest, experience and facilities of scientists outside of NASA to obtain data needed to support and supplement the planetary flight program. The program included under this RTOP covers observational studies of the planets, their satellites, asteroids and comets in the optical and infrared portions of the spectrum made from ground-based observatories. The results of these studies are published in the open literature. The planetary science expertise and observational facilities required for this program are in general not available within the NASA centers.

W79-70452

196-41-82

National Aeronautics and Space Administration Washington D C

GROUND-BASED RADIO AND RADAR PLANETARY ASTRONOMY

William E Brunk 202-755-3660

The objective is to determine planetary properties by observations from ground-based observatories at radio wavelengths. Both passive (radio) and active (radar) observations will be performed. The program will include the reduction, analysis, and interpretation of the observations. The approach is to utilize the interest, experience, and facilities of scientists outside of NASA to obtain data needed to support and supplement the planetary flight program. The program included under this RTOP covers observational and the associated theoretical studies of the planets, their satellites, and other members of the solar system in the radio portion of the spectrum made from ground-based observatories. Both passive, radio astronomy and active, radar astronomy observing techniques are included under this RTOP. The results of these research programs are published in the open literature.

W79-70453

196-41-84

National Aeronautics and Space Administration Washington D C

LABORATORY SUPPORTING STUDIES (ASTRONOMY)

William E Brunk 202-755-3660

The objective is to obtain laboratory data required for the

analysis and interpretation of planetary observations made from the vicinity of the Earth. The data obtained will be of two types: first, detailed study of gases and other materials known to exist on a planet; and second, study of the properties of many possible materials to try to explain unidentified features detected in planetary observations. The data obtained under this program will be published as well as being used directly in the interpretation of new observations. Principal Investigators on tasks under RTOP 196-41-80 frequently find that there is insufficient laboratory data on the spectra of the molecular constituents they are observing. Needed are data for specific molecules at conditions and wavelengths not normally encountered in laboratory studies. It is therefore necessary to obtain the needed data using specialized very long path absorption cells at a range of temperatures and pressures.

W79-70454

196-41-85

National Aeronautics and Space Administration Washington D C

THEORETICAL PLANETARY ASTRONOMY

William E Brunk 202-755-3660

The objective is to provide theoretical support for the planetary astronomy program by predicting what data should be observed and by explaining the observational results both predicted and unexpected. The program also involves the integration of observational and laboratory results from many sources to provide an explanation of planetary phenomena. Thus, this program provides an important link between the observational and laboratory programs and an understanding of the planets. Based on prior knowledge of the planets and existing physical laws, programs are under taken to predict the observational data on the planets. As an example, theoretical atmospheric spectra are generated using assumed knowledge of the planetary atmospheric constituents, the spectral effects produced by a scattering atmosphere containing aerosols, and the dispersion of the observable spectra. Comparison of the observed spectra with the theoretically calculated spectra tests the assumptions used in the theoretical calculations.

Upper Atmospheric Research

W79-70455

196-10-00

National Aeronautics and Space Administration Washington D C

UPPER ATMOSPHERIC RESEARCH - FIELD MEASUREMENTS

S G Tilford 202-755-3766

The principal goal of the Field Measurements program is to provide the data required for development of an organized, solid body of knowledge of the physics, chemistry and dynamics of the Earth's stratosphere and mesosphere. Specific measurement goals are (1) improvement and validation of photochemical models, (2) determination of the location and strengths of the sources and sinks for upper atmospheric constituents, (3) improvement of understanding of upper atmospheric dynamics and transport, (4) determination of the locations and strengths of troposphere-stratosphere exchanges, (5) observations of changes in the distribution and total amount of ozone, (6) determination of the mean distribution of long-lived species and (7) determination of solar UV variations and of the accuracy of radiative transfer calculations. The data obtained are required for improvement and validation of theoretical models and for assessment of the effects of natural and man-related perturbations on the atmosphere. A variety of in-situ and remote sensing techniques are used with ground-based balloon aircraft, rocket and satellite platforms. Development or extension of experimental techniques are required to meet some of the measurement goals and coordinated measurements of key parameters are emphasized due to the highly coupled nature of atmospheric processes.

W79-70456

196-10-01

Goddard Space Flight Center Greenbelt Md

UPPER ATMOSPHERE RESEARCH - FIELD MEASUREMENTS

OFFICE OF SPACE SCIENCE

R Hudson 301-982-5001

The principal goal of the Upper Atmosphere Research Program at GSFC is to develop an organized solid body of knowledge of the physics chemistry and transport processes in the stratosphere and mesosphere. The several objectives leading to the overall goal of the program and the approach to be taken are (1) determine the specific local chemical and physical interactions in the atmosphere by a combination of theoretical studies and coordinated in-situ measurement campaigns from balloon rocket and aircraft platforms (2) investigate the variations and perturbations of the chemical and physical state of the atmosphere i.e. variations with altitude solar conditions season latitude, and perturbations from volcanoes tropical storms industrial and agricultural activity (by combined theoretical studies and experimental investigations involving instruments at various balloon and rocket launch sites and from aircraft and long-duration balloons), and (3) develop and calibrate selected instruments for local and remote investigations of the atmosphere

W79-70457

198-10-02

Lyndon B Johnson Space Center Houston Tex
VERTICAL PROFILES OF OZONE AND TOTAL CHLORINE IN THE UPPER STRATOSPHERE
D E Robbins 713-483-6121

The objectives are (1) to determine ozone concentration profiles over the range 10km to 44km for the purpose of establishing natural variations and baseline data for the 1978/1979 time period this data will assist in detecting reductions by chlorofluoromethanes near 40km where the greatest percentage change is predicted, (2) to provide simultaneous in-situ measurements of ozone for correlation with measurements of stratospheric species made by other investigators and (3) to obtain measurements of total chlorine (regardless of molecular form) in the range 20km to 44km and study variations to determine effects due to photochemistry and atmospheric dynamics. Periodic (every couple of months) measurements are made of ozone from a balloon platform. The instrument measures ozone in-situ by employing the strong UV absorption of ozone at 2537A. It is a modification of a laboratory instrument built by the Dasibi Environmental Corp and is capable of making measurements every 10 seconds with a precision of + or - 3%. The total chlorine experiment collects a whole air sample (by cryogenically freezing it out) in the stratosphere. About 10 liters STP are collected. The sample is analyzed for total content of chlorine nuclei (regardless of molecular form) by neutron activation analysis. The research reactor at Texas A&M University is used for irradiation of the sample by neutrons

W79-70458

198-10-04

Ames Research Center Moffett Field Calif
INSTRUMENT SYSTEMS FOR MEASUREMENT OF TRACE GAS CONSTITUENTS IN THE STRATOSPHERE
I G Poppoff 415-965-5027

The objective is to develop, flight test and utilize airborne instrument systems for measurement of important gas species in the stratosphere. Several multiple species instrument systems for making accurate measurements of the minor gas constituents in the stratosphere are being developed for integration onboard aircraft and balloon platforms. The ability to make coordinated simultaneous measurements on a routine basis is being emphasized. Techniques such as chemiluminescence and IR spectroscopy are being employed. Goals will be to study the geographic and seasonal variations of the measured species and respond to and participate in cooperative stratospheric rendezvous and collaborative experiments

W79-70459

198-10-05

Ames Research Center, Moffett Field Calif
STRATOSPHERIC AEROSOL CHEMISTRY AND PHYSICAL STATE
N H Farlow 425-965-5493
(175-40-10)

Stratospheric aerosols may be indicators of both tropospheric-stratospheric exchange processes and chemical interactions with trace constituents. Evidence is accumulating that suggests young,

growing aerosols are forming in the tropical stratosphere near the intertropical convergence zone then as they mature are circulating throughout the lower stratosphere. During this process traces of tropospheric materials such as sea salts and volcanic debris react with and are incorporated into the particles as granular inclusions. Trace nitrogen oxide gases in the stratosphere also may be interacting with the aerosol sulfur compounds to form nitrosyl sulfates providing a reservoir of nitric oxide chemically combined with the aerosols. If these aerosols encounter regions of excess moisture both in the stratosphere and troposphere the nitrogen oxide gases can be released for further interactions. Thus by identifying the particle size history physical state and chemical composition of stratospheric aerosols versus altitude and latitude important clues to circulation processes and interactive chemistry can be obtained. This study utilizes both aircraft and balloon sampling techniques to collect aerosols in situ for later analysis in the laboratory. Collections are made in the tropical, temperate and polar zones from below the tropopause to the mid-stratosphere. Special unique analytical methods are used to reveal detailed chemical composition physical state particle sizes and probable origins of stratospheric aerosols

W79-70460

198-10-06

Ames Research Center Moffett Field Calif
DEVELOPMENT OF NEW INSTRUMENT SYSTEMS FOR DETECTION OF TRACE CONSTITUENTS IN THE STRATOSPHERE

I G Poppoff 415-965-5027

The objective is to develop new airborne instrumentation to measure trace gas constituents in the stratosphere. This includes performing applied research necessary to develop fundamental principles and sensor techniques to a level of feasibility for making routine in-flight measurements. A study of many new techniques for measuring trace gas constituents in the stratosphere has been in progress for several years. This study has yielded promising results for several species such as the halocarbons methane chlorine compounds and hydroxyl radicals. Airborne systems based on these techniques are being developed for in situ measurements

W79-70461

198-10-06

Jet Propulsion Lab Calif Inst of Tech, Pasadena
STRATOSPHERIC RESEARCH, FIELD MEASUREMENTS PROGRAM
W T Huntress 213-354-3238

The primary objectives of the Stratospheric Field Measurements program at JPL are to respond quickly with existing capabilities to the needs for measurements of stratospheric species identified as critical to ozone chemistry by the Upper Atmospheric Research Program in the NASA Office of Space Sciences, and to continue to develop the instrumentation and experimental techniques in those areas where more sensitive specific, or extended measurement capabilities are needed. The five distinct methods used at JPL for performing stratospheric measurements are (1) high-resolution spectroscopy in the near- and middle-infrared spectral region, (2) laser heterodyne radiometry at mid-infrared wavelengths, (3) pressure-modulator radiometry at selected infrared wavelengths (4) microwave and submillimeter radiometry, and (5) direct laser absorption. Instruments developed at JPL based on these techniques either have or will soon have the capability of measuring species including HCl ClONO2, ClO HNO3, N2O NO2 NO, H2O, H2O2 O3, CH4 CH3Cl, CFC13, CF2Cl2 and possibly HO2, HO2NO2 and N2O5. The proposed program for FY-79 involves field measurements using all of the above instruments, via balloon flights mainly from Palestine, Texas. Each flight will have a specific goal in accordance with the NASA Upper Atmospheric program objectives, and collaboration with other NASA centers and non-NASA organizations will be emphasized when such collaboration would provide important additional benefits

W79-70462

198-10-06

Lewis Research Center Cleveland, Ohio
GLOBAL ATMOSPHERIC SAMPLING PROGRAM (GASP)
Donald A Petrash 216-294-6684

Data sets consisting of the concentrations of minor atmos-

phic constituents and meteorological parameters will be generated. The species concentrations will be utilized as tracers of atmospheric motions. The data sets will be utilized to determine the variability produced by mesoscale waves and their instabilities for subgrid scale parameterization in mesoscale models. The variability of the trace constituents and their intercorrelations and comparisons with zonal means will also permit the determination of the synoptic scale meridional eddy flux. These eddy processes dominate the mass exchange between the stratosphere and troposphere at middle to high latitudes, and their magnitudes and variability are necessary inputs and tests for 2-D or 3-D numerical atmospheric models. Sampling of trace species concentrations representing a stratospheric source, O₃, and tropospheric source CO, H₂O and condensation nuclei will be done continuously with automated sampling systems on GASP equipped airliners. Filter samples will be collected over periods of about 50 minutes during the continuous sampling mode and analyzed for 7-Be, SO₄⁻, and NO₃. The 7-Be will provide a tag on the synoptic scale for stratospheric air. The SO₄⁻ and NO₃ represent the sink species for the photochemical processes in the stratosphere for formation of aerosols and NO_x attack on the ozone layer.

W79-70463**198-10-10**

Ames Research Center Moffett Field Calif
AIRBORNE PLATFORM SUPPORT FOR STRATOSPHERIC SAMPLING PROGRAM

I G Poppoff 415-965-5027
(198-10-04, 198-10-06, 176-10-11)

The objective of this research is to obtain observational data regarding the vertical transport into the stratosphere of tropospheric species (such as CFM's, N₂O, sulfur compounds, and water vapor) and the latitudinal and downward transport of stratospheric species (such as NO_x, ClO_x, O₃, and nitric acid). Of particular interest, currently, is the important vertical transport that is thought to occur in tropical meteorological events such as active Intertropical Convergence Zone (ITCZ) periods and Asian monsoons. The approach is to form experiment working groups composed of theoreticians and experimenters to design the appropriate observational missions, to participate in making and analyzing measurements and to evaluate the results of the missions. Inasmuch as the regions of interest are the upper troposphere and the lower stratosphere, aircraft are excellent platforms. Typical experiments use a medium-altitude aircraft, such as the CV-990 or Learjet, and a high altitude aircraft, the U-2. Each of the aircraft carries several instruments in order to measure all the species of interest. Ancillary meteorological data are collected by special balloon soundings from neighboring weather stations, and from meteorological satellite coverage.

W79-70464**198-20-00**

National Aeronautics and Space Administration Washington D C

UPPER ATMOSPHERIC RESEARCH - LABORATORY STUDIES

S G Tifford 202-755-3766

The principal goals of the Laboratory Studies program are (1) to provide the kinetic, photochemical, and spectroscopic data needed for developing an organized solid body of knowledge of the physics, chemistry, and dynamics of the Earth's upper atmosphere and (2) to support the Field Measurement and Theoretical Studies programs. Laboratory measurements of atmospheric reaction and photo-process rates, particularly those related to ozone photochemistry, and spectroscopy of atmospheric constituents using conventional and new laser-related techniques are emphasized. Advanced laboratory techniques are developed to permit study of highly reactive species under upper atmospheric conditions. Laboratory studies of advanced sensor concepts and techniques are focused upon potential development of the highly sensitive instruments needed for upper atmospheric field measurements.

W79-70465**198-20-01**

Ames Research Center, Moffett Field Calif
HETEROGENEOUS CHEMISTRY FOR AEROSOLS
R C Whitten 415-965-5498

The objective is to increase the understanding of the roles played by heterogeneous chemical processes in the structure of the stratosphere. This goal will be attained through laboratory studies in three major areas: (1) association reactions, (2) heteromolecular clustering of neutral species, and (3) investigation of the role of aerosol surfaces on the formation and destruction of certain gas-phase species of primary importance to the chemistry of the stratosphere. The results of this work will be applied to important stratospheric problems by Ames scientists, principally by means of the Ames stratospheric aerosol models.

W79-70466**198-20-01**

Goddard Space Flight Center Greenbelt Md
UPPER ATMOSPHERIC RESEARCH - LABORATORY MEASUREMENTS

R Hudson and N W Spencer 301-982-5001

The principal goal of the Upper Atmosphere Research Program at GSFC is to develop an organized solid body of knowledge of physics, chemistry and transport processes in the stratosphere and mesosphere. This RTOP covers two basic areas of study, (1) a chemical kinetics laboratory program and (2) the preparation of periodic reports assessing the current state of knowledge of the stratosphere. The objective of the laboratory effort in chemical kinetics is to use existing equipment of unique capability for the purpose of measuring absolute rate constants of reactions of importance in current models of the stratosphere. Rate constants will be measured as a function of temperature and pressure, direct measurements will be made at stratospheric temperatures and under conditions in which the number of atoms is much less than the number of molecules.

W79-70467**198-20-03**

Ames Research Center Moffett Field Calif
QUANTITATIVE INFRARED SPECTROSCOPY OF MINOR CONSTITUENTS OF THE EARTH'S STRATOSPHERE
R W Boese 415-965-5501

Remote detection and measurement of stratospheric species via spectroscopic techniques is being routinely employed to develop a better understanding of this portion of our atmosphere and man's effect upon it. Proper interpretation of these measurements relies strongly on having the correct laboratory data. The objective of this work is to obtain laboratory measurements of basic molecular parameters, such as rotational line intensities and half-widths, absorption band intensities, vibrational and rotational constants, vibration-rotation interaction constants, line position measurements including pressure induced shifts and Franck-Condon factors. The determination of these parameters, and their dependence on pressure and temperature, will be obtained by using long path gas cells cooled and heated cells, and high resolution interferometers and spectrometers.

W79-70468**198-20-03**

Jet Propulsion Lab, Calif Inst of Tech, Pasadena
CALIBRATION SPECTRA
W B DeMore 213-354-2436

A program of laboratory studies will be conducted in (1) kinetics of stratospheric reactions, (2) photochemical studies, (3) analysis of atmospheric reaction schemes, and (4) ionic processes in the upper atmosphere. The program will be designed to provide data needs and guidance for both chemical models and field measurements. Primary emphasis will be on the acquisition of kinetic data including reaction rate constants, temperature dependences, and product formation. Photochemical quantum yields, absorption cross sections, and product distribution will be measured. A broad base of data knowledge in all the foregoing areas will be maintained through literature surveys and through contact with other groups active in these areas. Atmospheric reaction schemes will be examined both experimentally and analytically for possible errors or omissions. Laboratory studies will be conducted on ionic processes in the upper atmosphere and on the means of both production and detection of important ionic and metastable excited species both in the laboratory and in-situ.

W79-70469**198-20-03**

Langley Research Center, Hampton, Va

HIGH RESOLUTION INFRARED MEASUREMENTS OF ATMOSPHERIC TRACE GASESR S Rogowski and P F Holloway 804-827-2818
(176-10-32)

High resolution infrared spectra will be measured for atmospheric trace gases to obtain spectral parameters required for interpretation of data from remote sensing instruments. Diode lasers which are narrow band and tunable will be used as sources so that complex molecules can be studied at high resolution with minimum distortion of line shapes. Line positions, strengths and broadening coefficients will be measured and absorption lines will be identified by the quantum level involved in the transition. Transient and unstable gases can be generated in a flow/reactor system that has been successfully operated for high resolution infrared studies of ClO. This facility can be used to produce other gases of importance to stratospheric chemistry by simply changing the reactant species. The systems will be used to synthesize other gases and is currently being applied to the production of ClONO₂ which may be a sink for Cl and NO_x. Species concentrations in the absorption cell are monitored by UV absorption measurements which can be made simultaneously with the IR observations.

W79-70470**198-30-00**

National Aeronautics and Space Administration Washington D C

UPPER ATMOSPHERIC RESEARCH - THEORETICAL STUDIES

S G Tilford 202-755-3766

The principal goals of the Theoretical Studies program are to (1) provide the framework for developing and understanding an organized, solid body of knowledge of the physics, chemistry and dynamics of the Earth's upper atmosphere, (2) analyze important data from upper atmospheric flight programs, and (3) predict and assess the effects of natural and man-related perturbations on the atmosphere. Development and utilization of 1-, 2- and 3-dimensional models simulating the upper atmosphere provide the mechanism for relating measurement data to physical concepts and allow predictions about atmospheric phenomena which are not readily measured. Data analysis efforts allow efficient handling and inversion of large measurement data sets. Prediction and assessment activities utilize the modeling and analysis capability to provide advance knowledge of potentially hazardous threats to our atmospheric environment. Support of timely workshops and symposia to assess our current state of knowledge and future needs in upper atmospheric research and support of information transfer and data catalogue efforts provide an on-going examination and summary of our progress in understanding the upper atmosphere.

W79-70471**198-30-01**

Ames Research Center, Moffett Field, Calif

MOLECULAR PROPERTIES OF STRATOSPHERIC CONSTITUENTSD M Cooper 415-965-6213
(198-30-02)

The objective is to provide basic molecular data required to identify and measure absolute concentrations of trace constituents in the stratosphere. These data include spectroscopic parameters such as vibrational and rotational constants as well as radiative transition parameters such as absolute band strengths, photodissociative cross-sections, and predissociative lifetimes for molecules of stratospheric importance such as ClO, NO and OH. These parameters will be determined by experimental and/or theoretical techniques. The experimental investigations will be performed in a shock-tube facility. Either absorption or emission measurements can be used to determine the desired spectroscopic and radiative parameters. The theoretical studies will use Self-Consistent Field plus Configuration Interaction Calculations to determine electronic and vibrational wavefunctions and derived radiative parameters.

W79-70472**198-30-01**

Goddard Space Flight Center Greenbelt, Md

UPPER ATMOSPHERE RESEARCH - THEORETICAL STUDIES

R Hudson 301-982-5001

The principal goal of the Upper Atmosphere Research Program at GSFC is to develop an organized solid body of knowledge of the physics, chemistry and transport processes in the stratosphere and mesosphere. The several objectives leading to the overall goal of the program, and the approach to be taken, are (1) determine the specific local chemical and physical interactions in the atmosphere by a combination of theoretical studies and coordinated in-situ measurement campaigns from balloon, rocket and aircraft platforms, (2) investigate the variations and perturbations of the chemical and physical state of the atmosphere, i.e., variations with altitude, solar conditions, season, latitude and perturbations from volcanoes, tropical storms, industrial and agricultural activity, (3) study the physical and chemical processes of the whole atmosphere, the global distributions, transport, seasonal and long-term variations of the atmosphere and determine the cause-effect relationships of these variations.

W79-70473**198-30-02**

Ames Research Center Moffett Field, Calif

STRATOSPHERIC RESEARCHI G Poppoff 415-965-5027
(198-20-03)

The objectives are (1) to understand the composition, structure, and dynamics of the earth's stratosphere and mesosphere, and the important chemical and physical processes which occur there, (2) to assess the effects on important stratospheric properties (e.g., ozone abundance and radiation balance) of man-caused and natural perturbations, and (3) to collaborate with the academic community to advance new model development. Several types of chemical and dynamical models of the stratosphere have been or are being developed to provide improved descriptions of the complex processes which occur in the upper atmosphere. These models, which are each addressed to specific types of problems, contain varying degrees of complexity with respect to chemistry and atmospheric motions. Development will continue such that each one is optimized according to its potential applications to fundamental and applied problems. Collaboration with scientists in the academic community is continuing.

W79-70474**198-30-02**

Goddard Space Flight Center, Greenbelt, Md

UPPER ATMOSPHERE RESEARCH - 3D MODELLING

N W Spencer 301-982-5001

The principal goal of the Upper Atmosphere Research Program at GSFC is to develop an organized solid body of knowledge of the physics, chemistry and transport processes in the stratosphere and mesosphere. The objective of this RTOP is to develop the modelling and analysis capability to (1) help determine the role of 3-D atmospheric motions in the physics and chemistry of the stratosphere, particularly the effect of 3-D motions on perturbations of atmospheric composition, and (2) study the couplings between the stratosphere and global climate. The approach is to modify the general circulation model in use at GSFC/GISS for use in stratospheric problems by employing coarser horizontal resolution in order to obtain a computing time of not more than a few minutes for a simulated day. The model has been improved by the addition of more accurate radiation terms, resulting from the work on a one-dimensional radiative model, and the incorporation of more realistic boundary conditions. In addition, the vertical coordinate system has been modified to permit adequate resolution in the stratosphere. Simplified chemistry is being introduced based on the results of one and two dimensional models.

W79-70475**198-30-02**

Langley Research Center, Hampton Va

STRATOSPHERIC THEORETICAL DATA INTERPRETATION AND MISSION ANALYSIS STUDIES

R H Tolson and P F Holloway 804-827-2530

The objective of this RTOP is to conduct theoretical studies of stratospheric phenomena, analyses and interpretation of stratospheric measurements, computational chemistry studies of reactive stratospheric molecules, and advanced satellite mission

analysis and system design. Specifically, theoretical studies will be performed of three-dimensional dynamics and chemistry changes in temperature and constituents due to UV variability, and one-dimensional photochemistry including temperature coupling and scattering. Data analysis studies will be performed to interpret the effects on stratospheric properties of solar variability and atmospheric transport and also to determine relationships between families of species. Computational chemistry studies will focus on the ClOO and ClOOO molecules. Mission analysis efforts will continue to evaluate sensor techniques orbit geometry and sampling strategy for the UARS mission. The approach is to use existing analysis and computational capabilities to address the above areas of research. Such capabilities include one- two- and three-dimensional atmospheric models, empirical modeling methods including spectral analyses, spherical harmonic analysis and time series analysis techniques, a new computational chemistry generalized valence bond program, and numerous mission design and sampling study programs.

W79-70476**198-30-03**

Jet Propulsion Lab., Calif Inst of Tech., Pasadena

THEORETICAL STUDIES/STRATOSPHERIC RESEARCH

S S Prasad 213-354-6423

Our objective is to understand the physical processes that determine the upper atmospheric response to solar UV variability and particle precipitation. We shall continue our current studies of the chemical compositional changes in the upper atmosphere due to relativistic electron precipitation and solar proton events with emphasis on (1) refining several potentially important ideas involving excited N₂, O⁺, and ionic reactions emerging out of our current studies, and (2) role played by the atmospheric motion in the global development of the initial changes that take place in the high latitude region during the solar proton events. In the area of solar UV variability we shall concentrate on the UV variations induced by solar rotation and shall emphasize (a) the proper coupling between the chemistry and energetics, (b) possible seasonal dependences specifically in high latitude and (c) role played by Sigma K sub p enhancement with a 27-day periodicity and persistent flux of energetic protons (both of these factors are associated with solar rotation).

W79-70477**198-30-04**

Goddard Space Flight Center, Greenbelt Md

UPPER ATMOSPHERE RESEARCH SATELLITE (UARS) DEFINITION PHASE STUDY

R Muller 301-982-5402

The UARS mission objective is to understand (1) the mechanisms that control the upper atmosphere structure and variability, (2) the response of the upper atmosphere to natural and anthropogenic perturbations, and (3) the role of the upper atmosphere in climate. To achieve these objectives the UARS will study (1) the energy input and loss in the upper atmosphere, (2) the global upper atmospheric photochemistry, (3) the dynamics of the upper atmosphere, and (4) the coupling among processes and between atmospheric regions. The objective of this RTOP is to perform the necessary studies that will explicitly define the two UARS spacecraft and their ground analysis requirements. They will integrate the instruments (selected by AO in early FY-79) and the mission design of the Preliminary Execution Phase Project Plan (PEPPP) into the Execution Phase Project Plan. All documentation for a FY-80 new start execution phase will be prepared. During early FY-79, technical support of the Headquarters AO selection process will be provided. Study contracts will be issued to each chosen investigator to further define his instrument, its interface to the UARS satellite and its data analysis requirements. Contracts will be issued for various supporting study activities such as cryogenic lifetime and resupply. The results of the various studies and the PEPPP will be taken and the Execution Phase Project Plan will be produced. By solving technological concerns early, the studies will ensure an on-schedule and within cost project.

Life Sciences SR&T**W79-70478****199-00-00**

Lewis Research Center, Cleveland, Ohio

CATARACT SURGICAL TOOL DEVELOPMENT - SUPPORT FOR KRESGE EYE INSTITUTE

Herman Mark 216-433-4000

The objective of this work is to develop a surgical instrument which can quickly and safely remove any type of human cataract through a small corneal incision while controlling pressure inside the eye. The basic tool is an air turbine driven miniature cutter-blender-pump that is used to liquefy and pump the cataract lens from the eye. Prototype tools will continue to be evaluated in the laboratory in preparation for clinical trials under the sponsorship of the National Eye Institute. A new medical research group - Kresge Eye Institute/Wayne State University - will join the program and receive training from Eye Research Institute/Retina Foundation and NASA on how the tool is used. After acquiring sufficient laboratory experience, Kresge doctors will participate in clinical evaluation with volunteer patients.

W79-70479**199-01-00**

Ames Research Center, Moffett Field, Calif

CARDIOVASCULAR DECONDITIONING

H Sandler 415-965-5744

The overall goal of this program is an understanding of the cardiovascular changes that regularly occur with space flight and their impact on present and future crew and passengers. Specific aims are to (1) define the underlying mechanisms of cardiovascular deconditioning, (2) develop methods for predicting deconditioning susceptibility, (3) provide appropriate countermeasures for susceptible individuals, and (4) provide the background for development and implementation of space flight experiments. To accomplish these goals, ground-based studies on both human and animal subjects will be carried out. Specific activities will include (1) the use of provocative orthostatic stress tests such as centrifugation and altered external pressure to determine the effects of deconditioning on cardiovascular regulatory processes, (2) the development of predictive indices for deconditioning susceptibility, including detection of latent disease and its effects on tolerance to space flight induced stresses, and (3) tests of procedures, devices and drugs to prevent and counteract deconditioning.

W79-70480**199-03-00**

Lyndon B Johnson Space Center, Houston, Tex

MEDICAL SELECTION CRITERIA

C F Sawin 713-483-2986

The NASA-JSC Space and Life Sciences Directorate will perform medical evaluations of applicants as Pilot Astronauts, Mission Specialist Astronauts and Payload Specialists. The JSC Space and Life Sciences Directorate in cooperation with the Director for Life Sciences, NASA Headquarters, will provide the selection official with medical recommendations regarding the applicants. Most of the personnel, facilities and equipment necessary to perform the medical evaluations of applicants for positions as Shuttle crewman exist at JSC, however, it is necessary to hire medical consultants. The JSC Space and Life Sciences Directorate inhouse capability, supplemented by the consultants, will be used to medically evaluate approximately 150 applicants for positions as astronauts from mid-August to late October 1977, and will be used to examine and medically certify Payload Specialists for space flight as required. The objective of the medical evaluation process - as it applies to space crew selection - is to identify those individuals who have the ability to adapt to and work in the space environment. The medical evaluation of astronaut applicants is designed to ensure the selection of astronauts with maximum career longevity and to identify those applicants who by current standards can be classified as having no unacceptable potential medical risk factors. The medical evaluation process also serves as a model against which subsequent astronaut selections can be more effectively conducted.

W79-70481**199-05-00**

Lyndon B Johnson Space Center, Houston, Tex

SPACE MOTION SICKNESS

J L Hornick 713-483-5457

OFFICE OF SPACE SCIENCE

The overall objective of this research program is to produce the information required to solve the problem of space motion sickness and neurosensory adaptation to the weightless environment. A broad based program of interrelated studies will be undertaken to delineate the etiology of the space motion sickness syndrome and to develop effective measures for its prediction, prevention, and treatment.

W79-70482

199-07-00

Ames Research Center, Moffett Field, Calif
BONE/MUSCLE ALTERATIONS
D R Young 415-965-5549

Losses in bone mineral, muscle mass, and muscle strength have been observed in crew members exposed to weightless space flight. The losses have not been of clinical concern, but the basis for the alterations have not been explained adequately and the consequences for passengers and crew members in future long duration space flight have not been assessed. The goals of this RTOP are to provide the ground-based program and implement the future flight experiment program required to clarify the mechanisms producing musculo-skeletal alterations during space flight, to determine remedial countermeasures for the prevention of alterations, and to provide operational guidelines for crew safety. Solution of the musculo-skeletal problem area will be based upon recognition of operant physiologic mechanisms as they are altered by space flight, the extent and manner in which those changes could impair tolerance for long duration space flight and the development of techniques for minimizing potential physiologic limitations. Animal models and human volunteers will be studied under hypodynamic and hypergravic conditions. Improved methods for the assessment of bone/muscle alterations will be established. Countermeasures will focus upon skeletal loading, pharmacologic intervention studies, and induced electrical events in bone. Flight experiment programs will be identified.

W79-70483

199-09-00

Lyndon B Johnson Space Center, Houston, Tex
BLOOD ALTERATIONS
S L Kimrey 713-483-4086

The most significant effect of the space environment observed relative to the blood and blood-forming tissues in man has been a consistent reduction in the circulating blood cell mass during the flight interval. The variations in the magnitude of the loss in individual crewmen and the complicated postflight recovery kinetics suggest a complex relationship between the red cell mass loss and the duration of the exposure to weightlessness. This 'anemia of space flight' was frequently accompanied by a reduction in plasma volume apparently occurring early in the mission and sustained throughout the flight. Other, more subtle effects have been observed with respect to the function and structure of red blood cells and of lymphocytes and in the concentration of some plasma proteins. The major emphasis of this research program will be to address questions relative to the regulation of blood volume during space flights and the causes of its apparent failure. The primary objectives will be to elucidate the mechanisms and the etiology of the alterations in the red cell mass and plasma volume and to determine the significance of these changes in limiting man's (both astronauts and non-astronauts) participation in space flight activities associated with the Shuttle Program.

W79-70484

199-11-00

Ames Research Center, Moffett Field, Calif
PREFLIGHT DETECTION OF DISEASE
A D Mandel 415-965-5061

During the Apollo and Skylab programs a number of in-flight infections occurred including upper respiratory infections, viral gastroenteritis and skin infections of microbial and fungal origin. In addition, there were several other in-flight disease events in which the clinical symptoms were high suggestive of upper respiratory infections. During one of the Skylab missions two crew members who were preflight carriers of STAPHYLOCOCCUS AUREUS, subsequently developed in-flight illness caused by these organisms. The objectives of this program are to develop measures for the rapid preflight detection of infectious disease, and

procedures which will minimize the probability of an in-flight infectious disease event. Current laboratory diagnostic procedures for the identification of infectious agents will be studied in order to develop modifications which will decrease the time interval between sampling and identification of the infectious agent. As an aid to preflight disease detection the application of instrumentation to the antigen-antibody reaction will be investigated. The pre-flight disease detection methods will be verified by clinical studies and a program will be developed to apply these findings to eliminate or minimize the probability of in-flight infections.

W79-70485

199-15-00

Lyndon B Johnson Space Center, Houston, Tex
THE MONITORING AND MAINTENANCE OF CREW HEALTH
C F Sawin 713-483-2986

This RTOP addresses the monitoring and maintenance of health of Shuttle crewman. Health is defined as the state of the organism when it functions optimally without evidence of disease or abnormality. Health therefore implies not only the absence of disease but a positive concept in which normality has quantitative and definable boundaries. The objectives for this RTOP are to (1) define health in relation to the space environment, (2) develop the procedures and equipment necessary to monitor health, (3) determine and develop appropriate countermeasures to maintain health and (4) develop flight experiments to support the aforementioned objectives. The end products will be (1) a set of criteria which describe health within the context of normal adaptive responses to weightlessness, (2) a set of procedures and hardware which will permit ground-based personnel to detect changes which violate the criteria established in (1), (3) procedures and/or equipment necessary to counteract changes caused by weightlessness of these changes are considered detrimental to crew health and (4) in-flight potential experiments. A four-year program which includes reviews, checkpoints, and parallel as well as sequential activities is defined. In-depth reviews of current efforts are planned to assure they support the basic problem addressed by this RTOP.

W79-70486

199-17-00

Ames Research Center, Moffett Field, Calif
HUMAN BEHAVIOR AND PERFORMANCE
R M Patton 415-965-6602

The objectives are to develop selection, training, performance monitoring and corrective procedures that are appropriate to personnel on space missions. Individual and group performance will be studied to determine what characteristics of the individual and the situation lead to effective performance and adjustment in simulations of space missions. Selection and training procedures will be developed to identify good candidates for space flight and to train them in minimum time. Corrective procedures will be developed to deal with possible cases of performance breakdown in space. The product of this work will be a selection/training/monitoring system suitable for application to space missions.

W79-70487

199-19-00

Lyndon B Johnson Space Center, Houston, Tex
DEFINITION OF PHYSIOLOGICAL DESIGN REQUIREMENTS

J M Waligera 713-483-5457

Physiological Design Requirements are quantifiable limits within which are assured some predictable level of physiological performance. Such limits have been defined and used for each of our manned spacecraft programs but they have not been fixed. They have evolved from program to program and in all cases they have been referenced to assumed conditions as to the subject population, length of exposure and a basic null hypothesis as to effects of zero-g. In the orbiter program and in manned programs that will follow from it, some of these assumed conditions will no longer apply. Defining and maintaining applicable Physiological Design Requirements will require research in several specific areas. (1) In the shuttle era we will be dealing not with well conditioned relatively young pilots but with a broad population of men and women ranging in age to 65 years. An

effort is required to define the response of this population. The vast majority of data collected on physiological response to environmental stress has utilized young male college students and military recruits. (2) The physiologic responses to spaceflight as demonstrated in Skylab and bed rest studies may have indirect effects on physiological response to environmental stresses.

W79-70483**199-21-00**

Ames Research Center, Moffett Field Calif
SUPPORTING BIOMEDICAL RESEARCH
 J Vernikos-Basellis 415-065-5752

The objectives are to determine the process, time course and biomedical consequences of prolonged stays in weightlessness simulated by hypokinesia, confinement, or other means. This research program will result in the identification of prolonged space flight problems, the selection and planning of flight experiments to confirm the existence and explain the mechanisms causing these problems and recommendations for preventative or correction measure to ensure the safety and tolerance of man in prolonged missions. The program will include both animal and human studies. Skylab data and data from Kosmos flight experiments will be compared to those obtained from animals and humans in chronic stress situations and in weightlessness simulation (bed rest, inactivity) to determine the physiological cost of man's adaptation to prolonged space flight and the time course of such adaptation. Particular emphasis will be placed on mechanisms regulating hormone changes that accompany such general adaptation, on changes in gravity sensing tissue receptors, on nutritional and energy requirements and metabolism during prolonged missions. Man's degree of adaptation will be measured by his ability to respond to unexpected demands such as infection, drugs and toxic materials, sleep deprivation, pain, heat, cold and to other emergencies such as tissue repair.

W79-70489**199-23-00**

Lyndon B Johnson Space Center, Houston Tex
SUPPORTING BIOMEDICAL RESEARCH
 W H Shumate 713-483-4461

The objective is to conduct biomedical research to insure man's well-being and his capability to function properly during extended space flight and upon subsequent reentry into the one-g environment. This research program, together with planned flight experiments will identify potential problems, attempt to understand the causative mechanisms and provide solutions and/or appropriate countermeasures. This RTOP will collate those JSC research tasks which either do not specifically lend themselves to any of the problem-oriented RTOPs or conversely contribute and/or support many of these RTOPs.

W79-70490**199-25-00**

Lyndon B Johnson Space Center, Houston, Tex
CLINICAL USES OF SPACE AND CLINICAL APPLICATION OF SPACE TECHNOLOGY
 Tracey Sauerland 713-483-5457

Progress in the field of clinical medicine is based on discoveries and developments produced either through research or serendipity. Utilizing research, scientists learn of the basic mechanisms which cause normal human function and the alterations in these mechanisms which produce disease. Often the environment in which the organism exists is altered and the effects of this manipulation either initiates disease states, hastens their progress, or improves them. With the coming of the shuttle era and the age of the space colony, opportunities for studying the effects of O-G on disease states become feasible. Since the technology to sustain human life in space is now at a high developmental level, one can begin to more critically study the effects of the O-G state on the human organism and upon 'model' organisms (single cell preparations, lower animal species) which mimic the responses of man at a more basic level. Previous spaceflight has provided tantalizing clues to the physiological and metabolic changes which occur in man in altered gravity states. Now, using this information as a foundation, one can create and explore new hypotheses of man's response to this environment. In order to test these scientific hypotheses the development of new hardware to record and process our findings must continue. Much of this hardware will prove to be invaluable to the medical profession.

W79-70491**199-27-00**

Lyndon B Johnson Space Center, Houston Tex
CLINICAL MEDICAL CREWS SUPPORT
 S A Jr Bergman 713-483-4731

The objective of this RTOP is to assure that adequate clinical support systems (hardware and software) are available for shuttle passengers and crew. The approach may be separated into two major thrusts. One concerns the development of diagnostic systems, and the other concerns the development of therapeutic capability. The approach will be broad based and tie together several related efforts. It will involve a wide range of activities from systems engineering and component production to evaluation and selection of equipment and medications.

W79-70492**199-41-00**

National Aeronautics and Space Administration, Washington, D C
SPACE BIOLOGY
 Thora Halstead 202-755-3734

The primary goal of this program is to understand the past and present effects of gravity on biological systems, and to use this information and gravity as a tool to understand how living systems operate both on Earth and in space. Specific objectives are to (1) identify and investigate the role of gravity in plant and animal cellular processes, embryonic development, morphology and physiology; (2) identify the mechanisms of gravity sensing and gravity information transmission within both plants and animals; (3) identify the independent and complimentary effects of gravity and other animal stimuli (e.g. light) on the development and metabolism of plants; (4) use gravity as a tool to probe biological systems; and (5) extend the limits of knowledge about plant growth and metabolism for space application, through investigation of plants under various controlled conditions. To accomplish these objectives, ground based experiments will be carried out on both plants and animals. Studies will include those necessary to (1) identify gravity sensitive biological systems, (2) formulate scientific concepts and design experiments to elucidate how organisms are effected by and respond to gravity, (3) provide baseline data in support of future biological space flight experiments, and (4) provide information about plant growth and metabolism under various controlled conditions for application in space.

W79-70493**199-43-01**

Lyndon B Johnson Space Center, Houston, Tex
ECOLOGICAL/ENVIRONMENTAL EFFECTS
 D S Sacntwey 713-483-3419

The objective of this program is to investigate and define the extent of the impact on human health and the biosphere that may be caused by increased ultraviolet radiation resulting from stratospheric ozone layer reduction by space transportation systems (STS) operations and other potential NASA activities. It has been calculated that emissions from the space shuttle booster rockets will reduce the stratospheric ozone layer and allow an increase in biologically damaging ultraviolet radiation (UV-B, 290-320 nm) to penetrate to the earth's surface. Factors other than shuttle operations may also contribute to an increased UV-B via reduction of the ozone layer: high altitude aircraft emissions, halocarbon refrigerants and aerosol propellants, nuclear weapons detonations, nitrogen fertilizer usage, heavy lift launch vehicle emissions, etc. Because of the multiple causes for potential ozone reduction and the various government agencies concerned, the research program represented here constitutes only a part of a more comprehensive, longterm, interagency program that is needed to provide definition data on the potential biological impacts from all sources. Although such a longterm interagency program has not yet been established, the NASA program presented here lays very valuable groundwork for such an interagency program, when and if it should be established.

W79-70494**199-45-01**

Lyndon B Johnson Space Center, Houston, Tex
RADIATION EFFECTS AND PROTECTION
 C. M Barnes 713-483-3419

This research program is designed to investigate and quantitate the effects of the exposure to the space radiation.

OFFICE OF SPACE SCIENCE

environment both natural and man-made, with the primary objective of assuring the safety of man in flight. Radiation protection for personnel in space flight is dependent upon (1) knowledge of the radiation environment (2) determination of acceptable levels of exposure, and (3) providing the methods and technology to assess the levels of exposure actually experienced. This RTOP addresses these areas. The basic effort of the radiation effects research program must be the determination of the biological effects of those components or factors of the space radiation environment that are unique and for which no prior ground-based experience is applicable. There will be emphasis therefore on investigating the response to high energy heavy, multi-charged (HZE) particles including the basic mechanism of damage to living tissues. This area presents potentially the greatest hazard to long-duration manned spaceflight and the level of hazard must be adequately characterized before extended activity at geosynchronous activities can occur. In general, this effort will consist of exposure of experimental animals to various radiation regimens simulating space radiation exposure. The effects observed will be compared with existing knowledge of animal and human responses to radiation and extrapolated to provide an estimation of human response to these potential radiation situations.

W79-70495

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

ADVANCED TELEOPERATOR TECHNOLOGY DEVELOPMENT

A. K. Bejczy 213-354-4568

(506-19-35)

The objectives are to develop technical information about Remotely Manned Systems (RMS) or teleoperators so that Shuttle-based orbital missions requiring the use of such systems can be planned and implemented with the required reliability, performance, and economy. Specific objectives are to identify requirements, develop conceptual designs and breadboards, and determine the complementary roles of man and machine in the operation of Remotely Manned Systems and teleoperators including time delay requirements with emphasis on supervisory control. The approach is through experimental studies identifying the scientific and operational mission requirements and developing the resultant necessary RMS or teleoperator functions. From the implied capability requirements for man and machine the necessary technology developments for teleoperator systems and subsystems are derived. Required developments are defined and implemented experimentally using breadboard set-ups. The experimental studies will give insight into the functions to be performed by man or machine or both for remote explorations and operations. Function allocations will be made between man and machine for various communication time delay requirements so that optimum system performance can be achieved and critical technology/development requirements can be identified. New concepts of teleoperator systems and subsystems will be developed and breadboarded when appropriate and related feasibility studies will be conducted. Man-machine system performance evaluations will be conducted using also modern psychophysiological methods. Emphasis is given to the concept of shuttle-based flight experiments to give the work focus. The tasks are aimed at developing technology advancing teleoperators toward semi-autonomous operations. The major FY-79 objectives are (1) development of force-reflecting hand controller, (2) extension of voice command for display control, (3) conducting sensor-aided control experiments for tracking and handling extended objects, and (4) introducing psychophysiological methods for human performance evaluation in teleoperation.

W79-70496

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

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W79-70497

Lyndon B. Johnson Space Center, Houston, Tex.

MAN-MACHINE ENGINEERING REQUIREMENTS FOR DATA FUNCTIONAL INTERFACES

J. L. Lewis 713-483-4966

The objectives are to move toward quantification of man-machine engineering data both on the ground and in flight, to continue to pursue state-of-the-art technology and to advance that technology for the purpose of creating more effective man-machine interfaces for manned spacecraft and to improve techniques of man-machine engineering design so that innovative steps may be taken toward creating better crew interfaces in future vehicles. The approach is to implement a series of continuing tasks to identify and implement workable instrumentation packages for acquiring quantitative man-machine engineering data in one-g simulated zero-g and actual zero-g, to continue efforts currently defined that lead toward definitive design requirements inputs to and data inputs from the Design Performance Lab and to pursue feasibility studies of promising new crew interface items.

W79-70498

Ames Research Center, Moffett Field, Calif.

ADVANCED EXTRAVEHICULAR SYSTEMS

P. D. Quattrone 415-965-5733

The objective of this RTOP is to advance the technology base for advanced extravehicular systems required to support long-term manned space missions. The advanced extravehicular systems must provide for extended EVA capability. This RTOP program will emphasize improved hardware performance, increased hardware and system life, and reduced EVA equipment and payloads design, manufacturing, maintenance, and operations costs. The technology areas associated with protection of an EVA astronaut will be pursued under this RTOP. This includes development of efficient 8 psig suit components that provide for greater mobility, development of advanced liquid-cooled/vent garments to provide improved thermal comfort and control, development of regenerative portable life support subsystems to eliminate and reduce the expendable requirements associated with CO₂ and thermal control, development of portable life support components, and development of scratch-resistant coatings to protect space suit helmet visors.

W79-70499

Ames Research Center, Moffett Field, Calif.

199-53-00

199-71-00

199-73-00

ADVANCED LIFE SUPPORT SYSTEMS

P D Quattrone 415-965-5733

The objective of this program is to advance the technology base for regenerative life support systems required to support long-term manned space missions. The regenerative life support processes must provide a more complete system closure (reduction of expendables). The subsystem functions to be investigated and developed include the following: air revitalization, atmospheric supply and composition control, water reclamation, waste management, and advanced food technology. Specific life support subsystem technology areas will be investigated (feasibility and/or development) and subsystem concept designs will be generated. This RTOP will be directed toward advancing the technology and/or hardware development status for advanced life support subsystems and will result in achieving a technology base (research and hardware development) for subsystems that have the characteristics of low maintenance, high reliability, and long life.

W79-70500**199-91-00**

Ames Research Center, Moffett Field, Calif

JOINT US/USSR BIOLOGICAL SATELLITE PROJECT (COSMOS 90)

Kenneth A Souza 415-965-5735

The objectives are (1) to determine the gravitational force preference of *Drosophila melanogaster*, (2) to determine the effects of spaceflight on behavior and circadian rhythm of Wistar rats, embryonic development of Japanese quail and Wistar rats and the development of high plants, and (3) to measure the radiation environment inside and outside the spaceflight, evaluate shielding techniques, and to conduct radiobiological experiments. A variety of biological specimens and radiation dosimeters will be subjected to approximately three weeks of weightlessness and cosmic radiation aboard a Soviet unmanned biological satellite during the first quarter of 1980 (final selection of U.S. experiments is pending). U.S. experiments selected for flight will be designed and developed by P.I.'s and NASA personnel while implementation of the experiments will be the cooperative effort of Soviet and U.S. personnel.

OFFICE OF SPACE TRACKING AND DATA SYSTEMS**Supporting Research and Technology****W79-70501****310-10-23**

Goddard Space Flight Center, Greenbelt, Md

SOFTWARE AND DISTRIBUTED COMPUTING TECHNOLOGY FOR FLIGHT DYNAMICS PROBLEMS

F E McGarry 301-982-5048

(310-10-22 310-10-26)

The primary objective of this RTOP is to develop methodologies for system development for flight dynamics computations. These methodologies are intended to significantly reduce the costs of such computations and simultaneously improve the reliability of the computational systems. The costs associated with flight dynamics computations encompass a wide range of expenditures from requirements analysis to software and/or hardware system installation and maintenance for orbit/attitude determination and control, and mission analysis computations. Under this research project, all aspects of system development will be investigated, including techniques and tools to analyze requirements and system designs, methodologies and practices of software engineering, the feasibility of distributed computing concept using minicomputers and microprocessors for software development, the validity of programmer workbench concept and optimization of software/hardware configuration. The approach will be to establish a system development laboratory in which the stated areas of systems development can be investigated under suitable conditions. This laboratory will support the research effort in the areas of data management and data analysis, high-level language compiler evaluation, software development tools, applicability of minis and micros for flight dynamics

computations and multiprocessor simulation. From this research, a set of methodologies will be generated to direct system developers toward the reduction of overall system costs in the flight dynamics area.

W79-70502**310-10-25**

Goddard Space Flight Center, Greenbelt, Md

INTELLIGENT TERMINAL SYSTEMS FOR FLIGHT DYNAMICS IN THE 1980'S

Donald T Ketterer 301-982-5063

The goal of this RTOP is to determine the capabilities of intelligent terminals and their effective application to the Flight Dynamics functions. The first year of the effort will be directed towards studying the present day and new advances in terminal technology, and examining their ability to meet the needs of the analysis, operational and software development functions of the Flight Dynamics system. The second year of the effort will be to select and install an intelligent terminal system for hands-on testing of its capabilities. The final year of the effort will be to simulate selected functional operations in the Flight Dynamics area to test and evaluate the intelligent terminal concept.

W79-70503**310-10-26**

Goddard Space Flight Center, Greenbelt, Md

ATTITUDE-ORBIT ANALYSIS

W H Wooden, II 301-981-5666

The objectives of this RTOP are to increase the efficiency and to decrease the resources needed to meet the requirements for spacecraft missions by (1) the application of new data types and their onboard processing to attitude/orbit estimation in order to minimize the use of tracking and telemetry data for attitude and orbit determination and control, (2) the provision of generalized and flexible computing systems utilizing on-board and small ground computers to increase the speed of information flow to the user and to reduce the demand upon the central computer facility, and (3) the utilization of standardized sensor combinations, telemetry interfaces and computational algorithms suitable to meet the demands of changing computer environments to effect a reduction in the attitude and orbit determination software development cost. The approach involves the development of computational software to permit the analysis and evaluation of the coupled attitude-orbit-landmark registration process. Such studies were started with simple attitude models. Extension to the use of wheel speed data and later to the use of gyro and star camera data will be made. The generation of efficient reliable algorithms suitable for minicomputer and onboard implementation of autonomous attitude and orbit determination and control will be continued. Simulations of on-board processors with their fixed point arithmetical computations will enable the evaluation of developed algorithms to be done.

W79-70504**310-10-42**

Goddard Space Flight Center, Greenbelt, Md

PRECISION TIME AND FREQUENCY SOURCES

Victor S Reinhardt 301-982-5946

(644-03-15)

The RTOP is to develop improved frequency and time standards with a frequency stability of 10 to the minus 15 power at 10,000s and with a frequency accuracy of 1×10^{-10} to the minus 14 power to aid in the transfer of existing hydrogen maser technology to provide a contractor source of operational hydrogen masers, and to develop improved frequency and time distribution systems for meeting critical NASA applications such as optical and microwave range and range rate tracking, very long baseline interferometry, and G-STDN. In order to complete Task A (Operational Hydrogen Maser Standards) it will be necessary to finish instrumentation for Frequency Standard and Test Facility, evaluate performance of NX and NR Hydrogen Masers, construct NRX masers with hybrid cavity and teflon film storage bulb. Task B (Calibration Standards) involves conducting an accuracy evaluation of Concertina Maser of Zero Wall Shift Maser, and of Mercury Ion Frequency Standard.

W79-70505**310-10-43**

Goddard Space Flight Center, Greenbelt, Md

ADVANCED LASER RANGING SYSTEMS DEVELOPMENT

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

T S Johnson 301-982-5538
(506-18-26)

The objective is the development field test, evaluation and intercomparison of advanced prototype laser ranging systems to meet the requirements for economy, reliability and accuracy for these systems in the operational laser tracking network. The development of low cost high reliability short pulse laser transmitters for use in new low cost systems as well as retrofit to existing systems will be emphasized. The combination of this laser type with low signal level detection, improved operating techniques, smaller aperture telescopes, and simpler range timing subsystems will be tested, evaluated and the results used to produce systems offering high reliability and low operating costs as well as high accuracy when deployed in the operational tracking network.

W79-70506

310-10-60

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

RADIO METRIC ANALYSIS, DEMONSTRATION AND INSTRUMENTATION DEVELOPMENT

D W Curkendall 213-354-4199
(310-10-61, 310-20-62)

It is the objective of this RTOP to develop the advanced radio metric systems employed by the DSN for spacecraft navigation and radio science. Current navigation strategies rely upon two-way Doppler when tracking spacecraft at high (greater than 10 deg) geocentric declination and upon two-way ranging for low declination spacecraft. The system is capable of determining the angular position of the spacecraft to approximately 25 to 10 microradians depending on the geocentric declination. It is a major goal of this RTOP to replace these systems with a single unified technique capable of 05 microradian accuracy independent of spacecraft declination. A second goal is to provide the advanced systems development necessary for supporting the development of the Radio Science Subsystem. The technical approach is to organize within this single RTOP: (1) the anticipated navigation and radio science requirements analysis; (2) the radio metric conceptual technique exploration; (3) the conceptual technique demonstration; (4) the instrumentation development for data acquisition, processing and calibration; and (5) the end-to-end navigation system demonstrations. The major navigation thrust involves developing and demonstrating the Very Long Baseline Interferometry (VLBI) concepts as they apply to spacecraft navigation. With present, relatively narrowband spacecraft signals, the scheme having the highest potential accuracy is differential spacecraft-radio source VLBI, a technique for navigating the spacecraft relative to a quasar. This scheme, which is most effective at high spacecraft declinations, will be demonstrated in 1979 during the Voyager encounter at Jupiter with proposed modifications to the spacecraft.

W79-70507

310-10-61

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

VLBI DEVELOPMENT AND ANALYSIS

J L Faselow 213-354-6323
(310-10-60, 310-20-65, 310-30-68)

DSN tracking system uncertainties limit spacecraft navigation capability. The current limit is about 100 km at Mars and 1000 km at Saturn. A tenfold increase in required radio metric accuracy is anticipated for future outer planet missions. Very long Baseline Interferometry (VLBI) has been identified as one of the technologies to meet these anticipated requirements. In fact, a result of previous work in related RTOPs, a first generation VLBI system is already being implemented in the DSN in support of Voyager. Particular emphasis for this first implementation will be on monitoring of the time and frequency systems of the DSN. However, more demanding uses of VLBI are anticipated for Galileo and possible future mission sets. Consequently, understanding the fundamental practical limits of VLBI is necessary. The objective of this RTOP is to obtain an understanding of the capabilities and limitations of VLBI and, where practical, to reduce the effects of error sources in the application of this technique. To this end, data reduction software is being developed, systems analysis and engineering performed, and demonstration VLBI data are being analyzed. Analytical studies and simulations of the troposphere contribution are being made. Since water

vapor in the atmosphere has been shown to be the primary remaining significant error source, this RTOP is developing the use of water vapor radiometers to measure the line-of-sight water vapor. Temporal variations in the instrumental delays are also known to be significant error sources in VLBI. Measurement and modeling of the antenna mechanical variations, measurement and modeling of the delay in the antenna structure, and calibration of the RF electrical delay in the receiving system are work units designed to understand and reduce these instrumental effects. Finally, an understanding of the effects of the natural radio sources themselves is required.

W79-70508

310-10-62

Jet Propulsion Lab, Calif Inst of Tech, Pasadena

FREQUENCY AND TIMING RESEARCH

R L Sydnor 213-354-2763
(310-10-60, 310-30-68)

In the mid-1960s, the rubidium oscillator was implemented to replace the crystal oscillator standard and an improvement of nearly two orders of magnitude in frequency stability was realized. This was one of the first enabling technologies for precision planetary navigation. Today, outer planet missions require a frequency standard five orders of magnitude more stable than the crystal baseline system. Currently, second generation hydrogen-masers are being implemented to meet this requirement. In the future, navigation and experiments in gravitational physics will demand an additional stability improvement of three orders of magnitude. The goal of this RTOP is to conduct research and engineering and to carry out technology demonstrations of frequency and timing systems which meet the future requirements for navigation and spacecraft radio science. To meet the goal of this RTOP, four primary objectives are established. The first objective is to evaluate the next generation hydrogen maser design. The approach will be to conduct extensive tests and do design and performance analysis on a Smithsonian Astrophysical Observatory VLG-11 maser and a GSFC Advanced Systems maser in order to recommend a direction for future development. The second objective is to develop a state-of-the-art monitor system, unattended operations and remote control will be emphasized. Stable distribution of the frequency and time information is as essential as the stability of the oscillator. The third objective is to provide the technology for distribution within a station, within a complex, and throughout the network. Microwave fiber optics and bent pipe satellite systems will be investigated. The final and most demanding objective is to conduct research leading to a field worthy new generation frequency and time standard which will be two to three orders of magnitude improved in stability. Investigations will be closely coordinated with GSFC, the National Bureau of Standards and with the academic community.

W79-70509

310-20-27

Goddard Space Flight Center, Greenbelt, Md

NETWORK TIMING AND SYNCHRONIZATION TECHNOLOGY

A R Chi 301-982-2502

The objectives of this research are to study and develop techniques for time synchronization, to coordinate time determination methods and dissemination formats to meet NASA needs and network requirements and to conduct theoretical investigations and experimental tests for network applications. The approach is to develop a satellite time transfer system with which to test a new operational concept of transferring precise time from the ground via a satellite to the users in another satellite or on the ground. The time transfer technique selected for this program will be that developed earlier under a joint program between NASA and the Federal Aviation Administration. It is the two-way satellite time transfer technique with which the propagation path delay can be measured and removed so that the signal received at the user's station is on-time relative to the ground station reference clock. In operation, the system is planned to include an automatic time transfer feature which can be activated by command in a remote site.

W79-70510

310-20-31

Goddard Space Flight Center, Greenbelt, Md

ANTENNA SYSTEMS DEVELOPMENT

Thomas Keating 301-982-4873

The first objective is to develop a set of analytical programs to permit cost effective analysis of a broad range of antenna types based on frequency, size type of reflector (parabola cassegrain, shaped solid mesh, etc) and use (space ground telemetry autotrack etc) The approach is to minimize computer costs while assuring applicable accuracy Further, analysis of near-field measurement data will permit field test data to be directly usable for fair-field performance The second objective is to develop a microprocessor that will be a building block in the development of 'unattended antenna systems for NASA's unique requirements The microprocessor controller will provide the pointing necessary for antenna and laser systems This controller will replace unique analog equipment and custom-designed logic circuitry which is presently used in the servo tracking system There is sufficient similarity between laser and antenna control systems that will permit the development of one controller for both applications The provision of a microprocessor will also provide a ready interface to equipment being developed under the GSTDN System Optimization RTOP (812-310-20-47)

W79-70511**310-20-33**

Goddard Space Flight Center, Greenbelt, Md

NETWORK SYSTEMS TECHNOLOGY DEVELOPMENT

J J Schwartz 301-982-2313

The objective of this RTOP is to investigate the applicability of new technology of the network systems Selected technology will be investigated by means of feasibility studies prototype development and demonstration, and by cost and reliability impact studies A major goal will be to carry out feasibility studies on technology applicable to a second generation Tracking and Data Relay Satellite System (TDRSS) The initial approach will be to investigate the effect of non-Gaussian channel characteristics on communications link performance and develop coding and signal designs which can optimize link performance A second goal will be to investigate wideband data matrix switches and transmission lines using fiber and integrated optics technology The feasibility of introducing this technology into the next generation switching systems in the Space Tracking and Data Network (STDN) will be investigated

W79-70512**310-20-47**

Goddard Space Flight Center, Greenbelt, Md

GSTDN SYSTEM OPTIMIZATION

Hall Theiss 301-982-2526

Significant changes in the role of the ground network (GSTDN) are anticipated in the post TDRSS era Support requirements will be confined primarily to missions with geosynchronous and highly elliptical orbits Such support usually consists of handling relatively low (less than 50 Kb/s) data rates In addition to radical changes in GSTDN support requirements, profound changes have occurred and are occurring in the electronics industry The appearance of low cost, highly reliable, modular equipment makes feasible a new approach to achieving effective and economic site maintenance and operation Full utilization of this new technology is of extreme importance to T&DA in the light of ever increasing site manning costs Projected figures for the 1980 network indicate that these costs will exceed \$1M per position per year This RTOP will investigate two candidate areas with the goal of achieving optimum efficiency and economy in the 1982-90 time period

W79-70513**310-20-64**

Jet Propulsion Lab Calif Inst of Tech Pasadena

X-BAND UPLINK DEVELOPMENT

R M Dickinson 213-354-4273

(310-10-60, 310-30-68 310-30-69, 310-40-70)

The goal of this RTOP is to develop and demonstrate the transmitter technologies required to meet future flight project communication requirements The near term objective is to provide the technology for reliable high-power X-band transmissions A 400 KW X-band uplink is being developed to enable high-power emergency commanding to a deep space probe using X-band and to allow Earth-based radar to more effectively complement

spacecraft science and planetary ephemeris computation for navigation A dual S-X-band uplink also enables new gravitational physics and relativity experiments, improves transmission media calibrations for solar physics and provides better spacecraft navigation data An additional objective is to enable new transmitter frequency options to abate interference problems associated with the increased spectrum utilization at S-band A specific objective is to develop demonstrate and transfer to implementation a reliable X-band uplink capability of at least 20 KW by 1981 A future objective is to provide a reliable transmitter at X-band of at least 100 KW by 1985 and 400 KW by 1990 The initial approach is to redesign the high-speed RF protective circuitry needed for reliable X-band transmitters Remote testing and performance evaluation is being emphasized Catastrophic events such as waveguide and body arcing are being modeled to improve hardware specification development, single point failures are being removed through hardware redesign As new systems are developed, the planetary radar test bed will be used to gain operational experience and to determine equipment performance and reliability The activities in this RTOP are being coordinated with the spacecraft transponder development to achieve a balanced cost-effective design

W79-70514**310-20-65**

Jet Propulsion Lab Calif Inst of Tech Pasadena

ANTENNA SYSTEMS DEVELOPMENT

R Levy 213-354-3872

(310-10-61 310-20-66 310-30-68 310-30-73)

This RTOP develops the technology for increasing the communication capabilities of the DSN antennas as part of optimizing the overall flight-ground communications link for planned NASA missions to the outer planets Communications capability is measured by the antenna figure-of-merit usable operational frequencies and environmental limits of operation The technology developed provides communication options for spacecraft planning in both the telemetry and radio metric data Megabit data rates and higher frequencies require improved reflector surfaces and antenna pointing techniques Missions with low signal levels such as VLBI require accurate blind pointing Increasing costs of construction accompanied by increased requirements for functional performance requires development of low cost construction technology and superior new approaches to microwave design Advances in ground antenna performance are developed by microwave, structural, mechanical and pointing system technologies Emphasis in the microwave area is in multiple frequency techniques at S-, X- and K-band and in effective alternatives to the present reflex feeds Advanced analytical techniques are used to extend the scope of structural design optimization for development of antenna configurations with improved performance and lower cost A 4 to 5 dB improvement in antenna figure-of-merit is a goal to be achieved by a succession of improvements in antenna and microwave elements New surveillance systems with the capability of efficiently monitoring large numbers of spacecraft are designed to reduce requirements for additional ground antennas Orbiting antennas used in a bent pipe mode are considered as alternatives to meet requirements that exceed ground-based antenna capability and also to relieve the dependence on existing facilities

W79-70515**310-20-66**

Jet Propulsion Lab Calif Inst of Tech, Pasadena

RADIO SYSTEMS DEVELOPMENT

W H Higa 213-354-4240

(310-10-61, 310-20-64 310-30-69)

The objective of this RTOP is to improve the spacecraft-to-ground radio system elements of the communications link in order to meet the future navigation and high data rate telecommunications requirements of the planetary exploration program Future missions to the outer planets will require sensitive and stable higher frequency receivers and wideband radio communications for high rate video telemetry navigation, and radio science data They will require calibration and models of the propagation medium and of the DSN ground radio parameters for efficient link design The natural microwave environment due to the atmosphere places a limit on the sensitivity obtainable by Earth-based microwave receiver systems, therefore the environ-

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ment needs to be monitored so that accurate statistical models of meteorological effects on communications are available for mission design purposes. A reflected-wave X-band maser structure was developed to achieve a 3.5 Kelvin noise temperature across an instantaneous bandwidth from 8400-8500 MHz. The system is being tested and optimized in the laboratory. Tests to evaluate performance with interfering signals are planned. Field performance will be demonstrated following laboratory evaluation. After field testing this design will be implemented at the 64-m stations to enhance the Saturn encounter of Voyager. Parametric upconverters will be developed and demonstrated at S- and X-band to provide maser-like noise temperatures with wide instantaneous bandwidth (300-500 MHz) and large tuning ranges. An additional objective is to develop a compact system with multiple upconverters and two masers in one cryogenic refrigerator.

W79-70616

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MULTIMEGABIT TELEMETRY DEVELOPMENT
J. R. Lesh 213-354-2766

(310-10-60 310-20-66 310-30-69 310-40-73)

The objective of this RTOP is to develop the technology necessary for expanding the telemetry data reception and processing capability of the DSN to the 30 Mbps region while maintaining or enhancing other DSN system requirements such as low rate telemetry and precision spacecraft radio metric measurements. To accomplish this objective a developmental program was initiated which will lead to a feasibility model of a telemetry demodulator-detector assembly capable of processing telemetry signals in the region from 100 Kbps to 30 Mbps. The necessary test equipment and other support equipment required for this development will also be developed or purchased. Simultaneous with this development a commercial off-the-shelf telemetry modulator-demodulator covering approximately this data rate range will be purchased and evaluated. These two activities will lead to a thorough understanding of the needs of the DSN concerning multimegabit telemetry and the ability of the commercial sector to satisfy these needs. This knowledge will enable an intelligent make or buy decision with regards to further development. If a buy decision is reached, a contract will be let for the development of a prototype demodulator-detector system which can operate within the context of the DSN. Otherwise the inhouse development will continue through a prototype model. Additionally a systems design will be initiated for the development of a complete multimegabit telemetry reception system. Also, the technology created by this high rate development will be applied to the low rate telemetry problem to guide the development of a universal telemetry system which will replace the existing aging equipment. The technology developed in the RTOP has direct application to the VOIR mission and to the Orbiting Deep Space Relay Station and will remove the data rate limitations on all future flight projects.

W79-70617

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STATION AND NETWORK MONITOR AND CONTROL TECHNOLOGY DEVELOPMENT
C. F. Foster 213-354-5070

(310-10-61 310-20-64 310-40-73)

The goal of this RTOP is to develop and demonstrate techniques for unattended tracking station operations. The objective is to develop the technology leading to a factor of two improvement in productivity, the ratio of end-user station hours to operations and operations support man-years. The approach is to conduct demonstrations and to collect data which are analyzed to determine how unattended station operations can increase network productivity and decrease network life-cycle costs. The near term objective is to develop DSS 13 into a tracking station capable of conducting all of the 26 meter network function in a remote-controlled unattended configuration. Information obtained from the development itself and from subsequent use of the station will form a data base to be used in RTOP 310-40-73 to predict life-cycle costs of automation and to study the feasibility of implementing an automated network. A number of demonstrations will be conducted to study the applicability of unattended operations to the various types of

activities supported by the DSN. In particular during the DSS 12 downtime for S-X conversion DSS 13 will be used in an unattended mode to supplement flight project tracking and to accumulate data about the reliability and capability of unattended spacecraft tracking. Because substantial progress has already been made in the automation of command and telemetry processing, the near term emphasis is on the RF and electro-mechanical subsystems.

W79-70618

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

RFI SYSTEMS TECHNOLOGY

B. K. Levitt 213-354-3848

(310-20-64 310-40-72)

The goal of this RTOP is to develop the technology to alleviate the Radio Frequency Interference (RFI) problem confronting the DSN. A twofold approach is being pursued to accomplish this goal. An extremely sensitive wideband digital RF surveillance station is being developed to monitor the RF environment at the Goldstone DSN complex. Secondly several promising techniques for desensitizing the DSN to RFI, including cryogenic maser filters, auxiliary antenna RFI cancellation and suppressed carrier and spread spectrum modulation will be studied for future implementation. The RF surveillance station being developed will initially contain a 20 MHz 65,000 line spectrum analyzer based on digital Fast Fourier Transform (FFT) techniques. The entire system will be composed of an 18 dB, 25 degree beamwidth circular horn antenna, a 150 Kelvin 300 MHz S-band receiver, a FFT spectrum analyzer and a MODCOMP digital computer for controlling system operations and reducing observed data to a manageable and user-oriented format. The RF monitoring system will be housed in a trailer and will undergo six months of testing at Goldstone to demonstrate its operational capability. This will allow the data reduction algorithms to be adapted to the characteristics of the observed RF environment at the DSN complex. These characteristics are not adequately known at this time. One objective of this test phase is the establishment of a data base of observed RFI signatures including spectral characteristics, receive level, duration, direction, frequency of occurrence, and source identity. Although initial observations will be made at the Goldstone Operational Support Radar (GOSR) hillsite, the portable nature of the RFI trailer will allow measurements to be taken beside individual stations, or even at overseas DSN complexes, if the need arises. In the next development phase during FY-79 and FY-80 the RFI surveillance system will be upgraded to provide an 80 MHz 260,000 line capability at S- and X-band.

W79-70619

Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

NETWORK SIGNAL PROCESSING CONCEPTS

R. R. Green 213-354-3015

(310-10-64 310-40-72)

The goal of the RTOP is to provide a focus for the Advanced Systems work in signal processing. The four phases through which signals pass as they flow through DSN systems will be considered. First is the real-time data acquisition phase which is followed by a data communication phase. The communication link delivers the information to the equipment which mechanizes the data processing or signal analysis phase. The final phase is to integrate the information into a data base or provide for its archival storage. As resources become available over the life of this RTOP, techniques will be developed in each of these phases which have wide applicability to DSN systems. Where possible the work will be demonstrated in Advanced Systems prototype hardware. This year's work is being concentrated in reconstructing the planetary radar system real-time data acquisition equipment. This will be done in such a way that the equipment can be transferred to operations for maintenance and operation under an in-place transfer agreement. Aging equipment will be replaced. Considerable publication of the data acquisition techniques developed for the radar test bed will take place. Results obtained in coding theory will be applied in two areas. Since the signal handling ability of the network is degraded by interfering signals, coding techniques are being developed to minimize the impact of those signals. For example, spread-spectrum communication

310-30-69

310-30-70

systems are relatively immune to narrow-band interference and the converse is also true. By properly understanding the characteristics of interfering signals, a spectrum shape which minimizes the data path sensitivity to that signal can be designed. Work will also be done in developing signal processing techniques for handling the megabit per second downlink telemetry stream expected for the missions of the 1980s. In future years, research will be conducted into distributed multi-processor architecture, large scale integrated circuit techniques, computer-aided design systems and digital computer applications.

W79-70620 310-40-26
Goddard Space Flight Center, Greenbelt, Md
EVOLUTION OF OPERATIONS SUPPORT COMPUTING SYSTEMS

R L Larsen 301-982-2777

RTOP 310-40-26 consists of two tasks which support the evolution of Operations Support Computing (OSC) systems into the 1980's. OSC systems provide orbit computations for spaceflight missions and the STDN. The first task is a systems study of the orbit determination and computation function as it relates to the end-to-end of data from its capture onboard a spacecraft to its delivery to an investigator. This task is in concert with the NASA End-to-End Data Systems (NEEDS) study. The second task is the completion of a study on the performance of intercomputer communication systems for local computer networks. This year, simulation models which have developed by the University of Maryland under this RTOP will be used to evaluate communication alternatives for the future OSC system.

W79-70621 310-40-36
Goddard Space Flight Center, Greenbelt, Md
AUTOMATIC DATA HANDLING
J C Rodgers 301-982-4189

Support requirements demanded by NASA's future space programs specifically include a higher level of automation for Goddard Space Flight Center (GSFC) facilities resulting in increased data and information exchanges between the various GSFC facilities. This RTOP shall study methods of handling data and information and shall result in the design and development of improved methods of communications and interactions between the operational M&DOD computer systems. The Integrated Telecommunications Distribution System being designed and proven under this RTOP, will interconnect existing M&DOD computer systems and will provide resource sharing of data sets, programs, and peripherals, permit any computer on the telecommunications network to communicate with any other computer on the network, and provide a standard telecommunications method. Improved process entry systems usable by multiple computer systems are also to be studied.

W79-70622 310-40-37
Goddard Space Flight Center, Greenbelt, Md
NATURAL HUMAN-TO-MACHINE INTERFACE
R desJardins 301-982-4878
(310-40-40)

The objective of this RTOP is to develop one or two prototype natural human-to-machine interfaces for space payload and ground systems control. Natural in this context means English-language-like. The intention is to apply recent advances in low-cost computer systems hardware and artificial intelligence software techniques to restricted operational language interpretation and display problems. A two-pronged approach is proposed. On the information side of the problem, knowledge engineering techniques will be employed to represent operational scenarios in an appropriate representation to be selected (e.g. production systems). The scenarios will be coupled to the human via restricted-context natural language interpreters, and to the machine via an interactive command language (the GSFC Systems Test and Operation Language, STOL). On the physical side of the problem, a speech understanding and synthesis approach will be taken in parallel with a traditional text-oriented approach, in the expectation that the text-oriented approach (with a high probability of success) will complement and support the voice-oriented approach (with only a medium probability of success).

W79-70623 310-40-39
Goddard Space Flight Center, Greenbelt, Md
IMAGE PROCESSING FACILITY PERFORMANCE EVALUATION METHODS
B Peavey 301-982-4995

This RTOP supports the development of system performance evaluation methods for the Image Processing Facility. Implementation feasibility of system performance measurement methods (e.g. modulation transfer function) on the previously developed Image Display and Recording System (IDARS) is studied in terms of software and hardware resource requirements. In addition, adoption of the existing precision microdensitometer to making very accurate film recordings is investigated and implemented.

W79-70624 310-40-40
Goddard Space Flight Center, Greenbelt, Md
POCCNET, PAYLOAD OPERATIONS CONTROL CENTER COMPUTATIONAL SYSTEM OF THE 1980S
R desJardins 301-982-4878

The goal of this RTOP is to develop a control center computational system organization (hardware/software) for GSFC for the 1980s, christened Poccnet (Payload Operations Control Center Network) embodying the following features: (1) robust, fail-soft hardware/software design, (2) high visibility of systems implementation status and operational state, (3) virtualization of computational system functions (subsystem functional independence), (4) flexibility and ease of reconfiguration, (5) simplified integration and test of applications systems, (6) reduced development time and cost, (7) special attention to human interfaces and to software engineering and (8) common Software Modules and supporting services for the Multimission Modular Spacecraft (MMS) and other standard envelopes of requirements. The effort is divided into four elements spread over five years (1975-79): (1) identify probable computational requirements on GSFC POCs in the 1980s, (2) identify applicable advanced technologies and develop specifications, (3) identify applicable software engineering methodologies and (4) design Poccnet subsystems in both the systems and applications areas.

W79-70625 310-40-42
Goddard Space Flight Center, Greenbelt, Md
IMPACT OF SPACECRAFT TIMING SYSTEMS ON DATA PROCESSING
G A Smith 301-982-5470

Timing accuracy requirements for satellite experiment data have increased significantly over the past decade. Methods of improving or maintaining time accuracy at lower cost and higher efficiency have become essential. The total timing for each spacecraft from onboard time reference and electronics to ground time verification or time tagging, correction, and correlation will be studied to identify limitations, areas where improvement is possible, and tradeoffs within the total system where savings in processing time or costs can occur. Because of similarities in spacecraft systems, a study of a few classes of timing accuracy designs and processes will be sufficient to identify most significant improvement possibilities. Cost savings by reduction of programming effort, computer time usage, and analyst's effort and improvement in the accuracy of a timing system will result. One system of particular interest is the Space Shuttle (SS). Currently this primary transport vehicle for spaceborne experiments in the 1980's is designed to provide GMT resolution and accuracy in the millisecond range. Evaluation of SS user requirements and recommendations for optimum time accuracy procedures is a goal of this study. The study is to be divided into seven tasks, each oriented toward a specific area for improvement. Presentations will be given and reports written for each task. A final report will be assembled summarizing the results of the study.

W79-70626 310-40-43
Goddard Space Flight Center, Greenbelt, Md
MICROWAVE IMAGE DATA PROCESSING TECHNIQUES AND SYSTEM DEVELOPMENT
B Peavey 301-982-4995

This RTOP supports the development, evaluation, and implementation of digital techniques for generic processing of

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microwave (active) image data. In addition it performs an assessment of a given set of processing and analysis algorithms, and type of system architecture with respect to potential thruput and performance accuracy of synthetic aperture radar (SAR) data. Microwave imaging instruments such as those to be flown on Seasat and Spacelab produce signals that are time and phase histories of scanned areas on the ground or water. Images of these areas are constructed by properly synthesizing or correlating these signal histories with respect to platform position and direction of reflected beam pulses or echoes at given instants of time. Digital methods to synthesize such image data have already been formulated. The objective of this RTOP is to evaluate these methods by implementing them on an already existing system such as the Master Data Processor (MDP) and determine the feasibility of achieving a ground resolution of 30 meters or better. Also to be investigated is the extent to which such methods or techniques can be standardized or made applicable to various microwave imaging systems in terms of program control data format, platform and signal parameters and performance accuracy.

W79-70627

310-40-72

Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena

NETWORK CONTROL AND DATA PROCESSING DEVELOPMENT

R. C. Tausworthe 213-354-2773
(310-30-69, 310-40-70)

The objective of this RTOP is to develop the techniques necessary for the efficient and cost-effective application of computational resources to the jobs of the DSN. Software design methods devised in this RTOP will improve management control of systems development by facilitating the top-down hierarchical expansion from functional requirements through detailed software design and implementation tasks. The DSN Advanced Systems segment of the DSN Programming System work utilizes pathfinder projects to develop and tune a Software Methodology appropriate to DSN needs. This methodology in turn contributes to standard practices, standard languages, etc., for DSN implementation to improve the overall productivity of the DSN and the service to end user flight projects. In the past years this RTOP has included the work unit RFI Identification Processing Research. This work unit was transferred to RTOP 69, RFI Systems Technology Development which consolidates all RFI work units into one RTOP.

W79-70628

310-40-73

Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena

NETWORK PRODUCTIVITY RESEARCH

J. R. Lesh 213-354-2766
(310-30-68, 310-20-65)

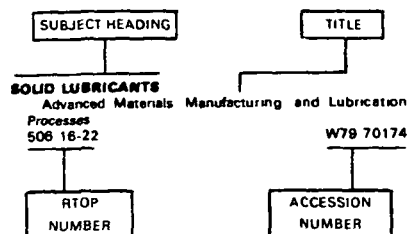
The objective of this RTOP is to increase the effectiveness of DSN use of NASA resources for tracking and data acquisition support of flight projects and other end-users. The steadily rising cost of providing flight project support is rapidly consuming the resources available to meet needed new flight project support requirements. The remedy is either to secure more funding or to increase network productivity and cost-effectiveness. Network productivity is the ratio of end-user station hours to operations and operations support work-years; network cost-effectiveness is defined as end-user station hours per dollar of DSN funding. The approach used in this RTOP to achieve the latter of the two alternatives will be to develop the tools necessary to perform meaningful life-cycle cost analyses or similar cost-benefit analyses so that the full impact of new technology, or alternate approaches of providing DSN service, can be evaluated prior to the expenditure of large amounts of implementation funds. Specifically, this RTOP will construct analytic models for the fundamental components of life-cycle costs, and will formulate models of the maintenance and operation of DSN subsystems. Also, this RTOP will provide the analyses of the cost-effectiveness and productivity of the unattended operations demonstration conducted under RTOP 310-30-68. Two work units formerly in this RTOP have been moved to other RTOPs. The Bent Pipe Feasibility and Assessment Study (310-40-73-03-00) for future years has been integrated into RTOP 310-20-67 and Mark IV DSN Planning (310-40-73-04-00) has been moved to RTOP 310-10-60.

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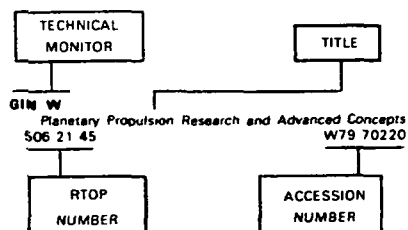
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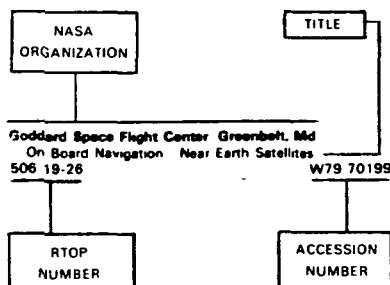
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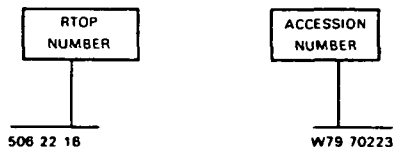
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