NASA-TM-108657

Office of Space Science
& Applications

OSSA

Flight Project Data Book

1992 Edition

NASA

National Aeronautics and
Space Administration

(NASA-TM-108657) FLIGHT PROJECT
DATA BOOK (NASA) 147 p

N93-22870

Unclas

G3/12 0150642

Office of Space Science
& Applications

OSSA

Flight Project Data Book

1992 Edition

NASA

National Aeronautics and
Space Administration

TABLE OF CONTENTS

PAGE

Flight Projects Planned or In Development (Continued)

On-Going Flight Projects

INTRODUCTION

Office of Space Science and Applications

The Office of Space Science and Applications (OSSA) is responsible for the overall planning, directing, executing, and evaluating that part of the overall NASA program that has the goal of using the unique characteristics of the space environment to conduct a scientific study of the universe, to understand how the Earth works as an integrated system, to solve practical problems on Earth, and to provide the scientific and technological research foundation for expanding human presence beyond Earth orbit into the solar system. OSSA guides its program toward leadership through its pursuit of excellence across the full spectrum of disciplines.

OSSA pursues these goals through an integrated program of ground-based laboratory research and experimentation, suborbital flight of instruments on airplanes, balloons, and sounding rockets; flight of instruments and the conduct of research on the Shuttle/Spacelab system and on Space Station Freedom; and development and flight of automated Earth-orbiting and interplanetary spacecraft. The OSSA program is conducted with the participation and support of other Government agencies and facilities, universities throughout the United States, the aerospace contractor community, and all of NASA's nine Centers. In addition, OSSA operates with substantial international participation in many aspects of our Space Science and Applications Program.

OSSA Organizational Structure

OSSA consists of the Office of the Associate Administrator and nine divisions. Three of these divisions are responsible for centralized coordination activities, while six are responsible for their respective science disciplines. The Office of the Associate Administrator consists of the Associate Administrator (AA), the Deputy Associate Administrator (DAA), two Assistant Associate Administrators (AAA), and associated staff personnel. One AAA position is assigned principal responsibility for Science and Applications and the other is assigned principal responsibility for Institutions.

The NASA Resident Office is maintained on-site at the Jet Propulsion Laboratory (JPL) in Pasadena, California, and is responsible for on-site management of the JPL contract. JPL is operated by the California Institute of Technology (Caltech), under contract to NASA.

OSSA's Flight Systems Division serves as the primary interface between OSSA and the Offices of Space Systems Development and Space Flight. The Flight Systems Division coordinates OSSA interaction with the Space Shuttle, Spacelab, and Space Station Freedom programs.

The Administration and Resources Management Division coordinates OSSA's budget resources, financial operations, external relations, and institutional responsibilities, including OSSA's institutional management responsibilities for the Goddard Space Flight Center and the Jet Propulsion Laboratory.

The Astrophysics Division has as its objective the study of the origin and the evolution of the universe, the fundamental physical laws of nature, and the birth of stars, planets, and ultimately life. Research in these areas is based on contemporaneous observations across the entire electromagnetic spectrum.

The Solar System Exploration Division conducts research to determine the present nature of the solar system, its planets, moons, and primitive bodies (asteroids and comets). This Division also conducts research to identify and locate other planetary systems in various stages of formation, in order to understand how our solar system and its objects formed and evolved.

The Earth Science and Applications Division's primary responsibility is to understand planet Earth as an integrated system, including the interactive processes that control the environmental balance that maintains life, and those processes--both natural and human-induced--that alter that balance.

The Space Physics Division supports investigations concerning the Sun as a star, as an influence on Earth, and as the dominant source of energy, plasma, and energetic particles in the solar system; understanding the interactions between the solar wind and solar system bodies; understanding the nature of the heliosphere; and, the origin, acceleration, and propagation of solar and galactic cosmic rays.

The Life Sciences Division research extends from basic research to applied clinical practice. It focuses on the development of countermeasures and life support systems that will enable long-duration human exploration missions and knowledge of the origin, evolution, and distribution of life in the universe.

The Microgravity Science and Applications Division utilizes the unique characteristics of the spaceflight environment to conduct basic research in physics and chemistry, with special emphasis on fundamental phenomena, materials science, and biotechnology. This Division promotes understanding of the behavior of materials in a reduced gravity environment and, where possible, demonstrates the production of improved materials that have high technological utility.

As a result of actions arising from a review of NASA roles and missions conducted by the Deputy Administrator in 1991, OSSA is also responsible for the management of expendable launch vehicle and upper stage programs.

OSSA Strategic Planning

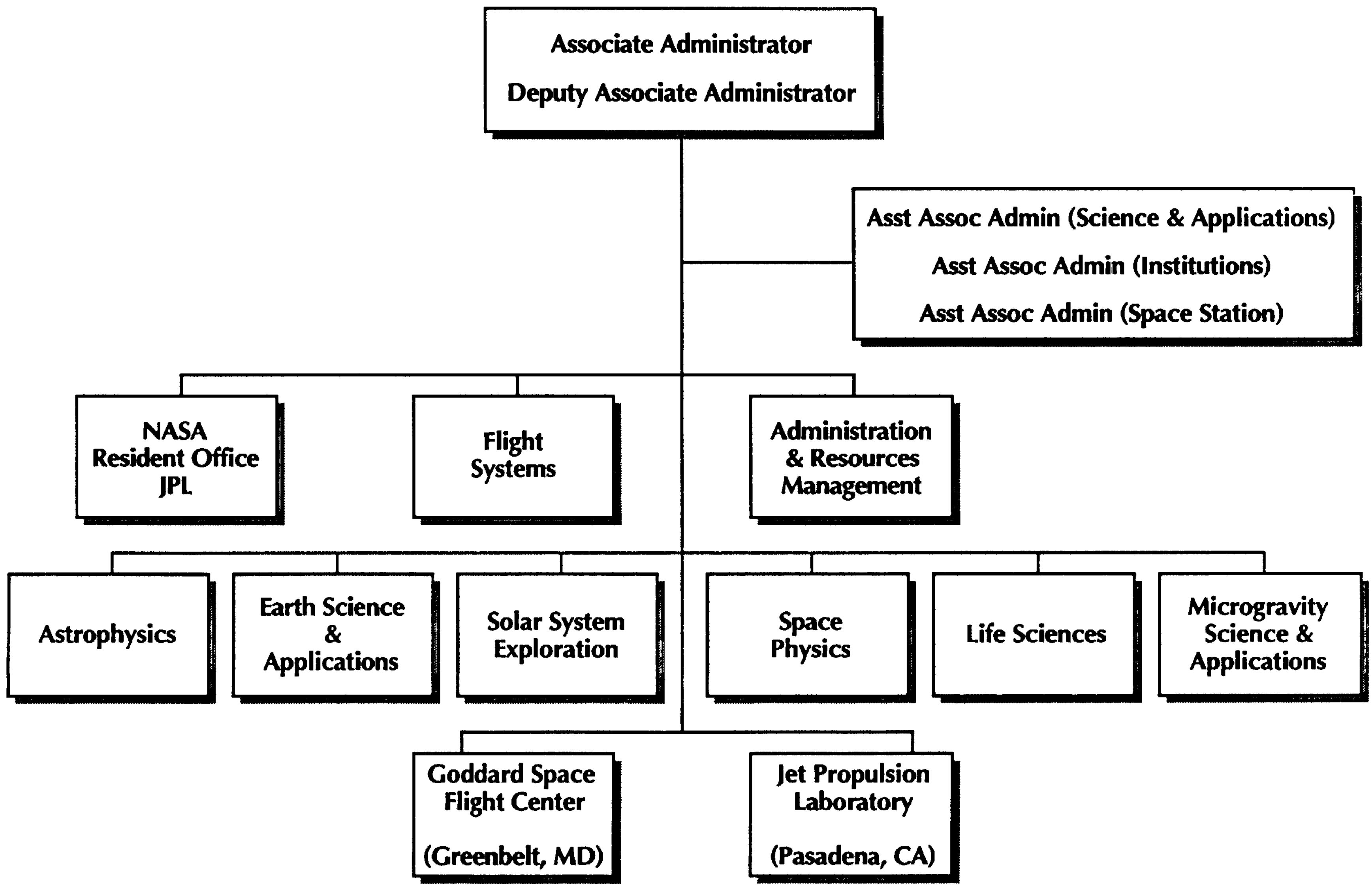
In 1988, OSSA began the process of formulating an annual strategic plan which incorporates the proposed program for the coming fiscal year and defines a flexible process for near-term decision making. The OSSA Strategic Plan is revised each year to reflect the approval of new programs, improved understanding of programmatic requirements and issues, and in recognition of significant changes in the circumstances in which OSSA initiatives are considered, whether they be internal or external to NASA. The Plan can be adjusted to accommodate varying programmatic and budgetary environments, retaining its resiliency in environments that provide for an expanded science and applications program, as well as those characterized by constrained growth. The outcome of this process continues to be a clear, coherent strategy that meets NASA's goals and assures realism in OSSA's long-range planning and advanced technology development. This process also provides sufficient flexibility to properly respond and adapt to both known and unexpected internal and external realities.

During 1991, the Space Science and Applications Advisory Committee (SSAAC) conducted a comprehensive review of the OSSA Strategic Plan. The goal of this effort was to identify whether fundamental, rather than incremental, changes in the Plan were necessary in light of the current programmatic and budgetary situation.

As a consequence of the profound changes in the budgetary environment in which NASA must expect to operate for the next several years, the 1992 Strategic Plan does reflect a fundamental restructuring with a major emphasis being placed on small and intermediate scale missions.

This edition of the Flight Projects Data Book reflects the recommendations made by SSAAC and should be used as a companion document to the 1992 OSSA Strategic Plan. This data book is not intended to be all inclusive, however, it does cover OSSA's programs currently in operation, those approved for development, and those planned future missions that are included in the 1992 OSSA Strategic Plan.

Office of Space Science and Applications



Flight Projects Planned or In Development

Advanced Communications Technology Satellite (ACTS)

Objective

The objectives of the Advanced Communications Technology Satellite (ACTS) include: 1) maintaining U.S. leadership in satellite communications; 2) providing advanced communications technology for NASA missions and other government agencies; 3) testing and verifying advanced technologies including high power, fast hopping spot-beam antennas, Ka Band (30/20 GHz) components, and on-board processing and switching; and 4) testing and demonstrating technologies through an experiment program with participation by telecommunications users, service and product providers.

Description

The ACTS spacecraft will be deployed from the Space Shuttle and then propelled into a geostationary orbit using a Transfer Orbit Stage (TOS). Following launch and checkout, a 2- to 4-year program is planned for user-funded experiments.

Launch Date:	April 1993
Payload:	Communications
Orbit:	Geostationary orbit, 0 degree inclination, 100 degrees West longitude
Design Life:	2 years (4 years of station keeping fuel)
Length:	9 m (30 ft)
Weight:	2,733 kg (6,026 lbs) (ACTS cargo element)
Diameter:	4.3 m (14 ft) (static payload envelope)
Launch Vehicle:	Space Shuttle, Transfer Orbit Stage

Instruments/Investigations/Principal Investigators

Communications Electronics Package (CEP) with Multi-Beam Antenna (MBA) - General Electric (GE)*
*The experiments are determined by ground terminal configuration.

Mission Events

Design and fabrication: 1984-1993
Experiment period: 1993-1995

Management

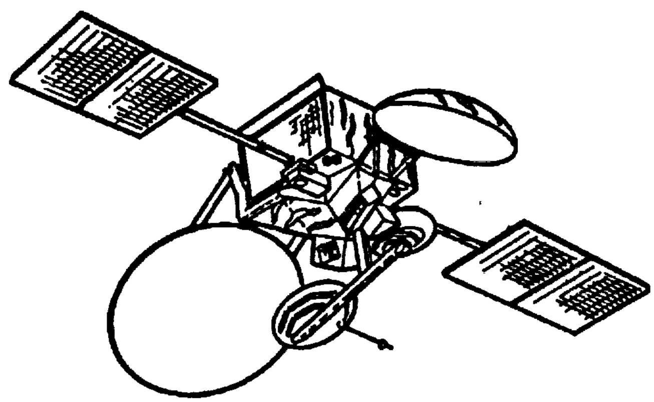
NASA Headquarters
J. Greaves, Program Manager
D. Olmstead, Experiments Manager
Lewis Research Center
R. Gedney, Project Manager
Major Contractors
General Electric, AstroSpace Division
COMSAT Laboratories
Harris Corporation

Advanced Communications Satellite (ACTS) (Continued)

Status

General Electric's AstroSpace Division's predecessor, RCA Astrospace, was awarded the prime contract for development of the ACTS system in August 1984. Current major contractors are GE AstroSpace, COMSAT Laboratories, and Harris Corporation.

Lewis Research Center is responsible for the overall system design and integration between the flight system (GE) and the ground based system (COMSAT). It will also directly manage the contracts for NASA's ground station and master control station development being conducted at COMSAT Laboratories, and for a prototype experimenter ground terminal being conducted by Harris.



Advanced Communications Technology Satellite

Advanced X-ray Astrophysics Facility (AXAF)

Objective

The objectives of the Advanced X-ray Astrophysics Facility (AXAF) are: 1) to obtain high resolution x-ray images and spectra in the 0.1 to 10 thousand electron volts (keV) wavelength range; 2) to investigate the existence of stellar black holes; 3) to study the contribution of hot gas to the mass of the universe; 4) to investigate the existence of dark matter in galaxies; 5) to study clusters and superclusters of galaxies; 6) to investigate the age and ultimate fate of the universe; 7) to study mechanisms by which particles are accelerated to high energies; 8) to confirm validity of basic physical theory in neutron stars; and 9) to investigate details of stellar evolution and supernovae.

Description

AXAF is the x-ray element of the Great Observatories program. It is a free-flying observatory with a goal for a 15-year operational lifetime. The AXAF telescope consists of a nested array of grazing incidence mirrors, a principal investigator-developed science payload unit consisting of up to four focal plane science instruments, and two sets of objective gratings. This telescope, with a geometric collecting area of 1,700 square centimeters and a 0.5 arcsecond angular resolution, will provide at least a 100-fold increase over its predecessor, the second High Energy Astronomy Observatory (HEAO-2, Einstein Observatory).

Launch Date:	1999 (under review)
Investigations:	Up to 4 focal plane instruments and 2 non-focal plane instruments
Orbit:	28.5 degree inclination; 600 km (324 nm) altitude, circular
Design Life:	15 years with servicing
Length:	14 m (46 ft)
Weight:	14,545 kg (31,999 lbs)
Diameter:	4 m (13 ft)
Launch Vehicle:	Space Shuttle
International Participation:	FRG, the Netherlands, United Kingdom

Instruments/Principal Investigators

AXAF CCD Imaging Spectrometer (ACIS) - G. Garmire (Pennsylvania State University)
High Resolution Camera (HRC) - S. Murray (Smithsonian Astrophysical Observatory)
Low Energy Transmission Grating Spectrometer (LETGS) - A. Brinkman (University of Utrecht - the Netherlands)
High Energy Transmission Grating Spectrometer (HETGS) - C. Canizares (Massachusetts Institute of Technology)
X-ray Spectrometer (XRS) - S. Holt (GSFC)
Bragg Crystal Spectrometer (BCS) - C. Canizares (Massachusetts Institute of Technology)

Mission Events

TRW Phase C/D contract initiation: January 1989
Initiation of science instrument development: January 1990
Completion of largest mirror pair: June 1991
Systems Requirement Review: Under review

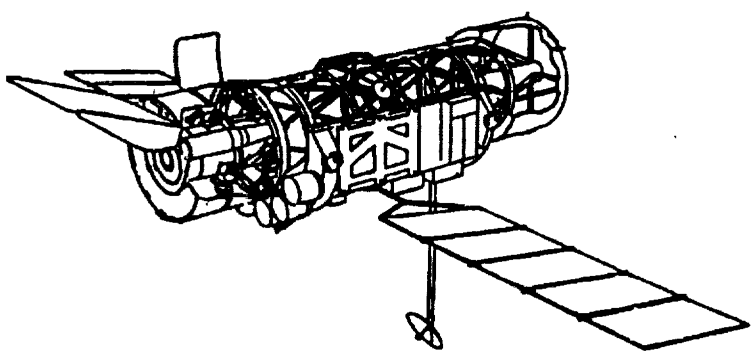
Advanced X-ray Astrophysics Facility (AXAF) (Continued)

Management

NASA Headquarters
P. Ulrich, Program Manager
A. Bunner, Program Scientist
Marshall Space Flight Center
F. Wojtalik, Project Manager
M. Weisskopf, Program Scientist
Major Contractors
TRW, Inc.
Hughes Danbury Optical Systems
Kodak
Boeing
Ball Aerospace

Status

The AXAF mission development program has been initiated. The largest mirror pair has been completed. Tests have demonstrated angular resolution to be better than the 0.5 arcsecond required. The program is being rebaselined in response to Congressional reductions in the fiscal year 1992 budget.



Advanced X-ray Astrophysics Facility

Astro-2

Objectives

The objectives of the Astro-2 mission are: 1) to study the far ultraviolet spectra of faint astronomical objects using imaging and spectroscopy; and 2) to study the polarization of ultraviolet light coming from hot stars and galaxies.

Description

The Astro payload consists of three ultraviolet telescopes capable of performing independent or simultaneous observations of selected celestial targets. They are the Wisconsin Ultraviolet Photo-Polarimeter (WUPPE), the Ultraviolet Imaging Telescope (UIT), and the Hopkins Ultraviolet Telescope (HUT). These three instruments flew as part of the payload on Astro-1 mission in December 1990. The instruments are mounted on a Spacelab double pallet; the Instrument Pointing System (IPS) aims the telescopes. Together, this complement of instruments obtains scientific measurements in the electromagnetic spectrum wavelength between 0.12 and 3,500 angstroms. Power, telemetry, and commands are provided by Spacelab electronic systems housed in the pressurized igloo, just forward of the pallets. Payload Specialists will use video terminals on the Orbiter aft flight deck to initiate observational sequences. Some data acquired during observations will be transmitted immediately to the Payload Operations Control Center (POCC) for evaluation. The science team on the ground will be in constant communication with the flight crew.

Launch Date:	September 1994
Payload:	Astro-2 (WUPPE, HUT, UIT)
Orbit:	28.5 degrees inclination; 352 km (189 nm) altitude
Duration:	Up to 10 days
Length:	7 m (23 ft)
Weight:	13,621 kg (30,034 lbs)
Launch Vehicle:	Space Shuttle

Instruments/Principal Investigators

Wisconsin Ultraviolet Photo Polarimeter (WUPPE) - A. Code (University of Wisconsin)
Ultraviolet Imaging Telescope (UIT) - T. Stecher (GSFC)
Hopkins Ultraviolet Telescope (HUT) - A. Davidson (Johns Hopkins University)

Mission Events

Instrument functional assessments: Ongoing
Payload integration/flight certification: Ongoing
Delivery to KSC: TBD

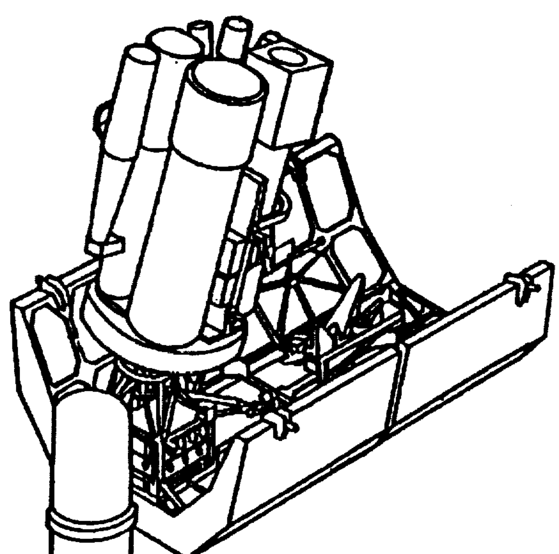
Astro-2 (Continued)

Management

NASA Headquarters
W. Huddleston, Program Manager
R. Stachnik, Program Scientist
Marshall Space Flight Center
R. Jayroe, Mission Manager
C. Meegan, Mission Scientist
Johnson Space Center
E. Jung, Payload Integration Manager
Kennedy Space Center
TBD, Launch Site Support Manager
Major Contractors
University of Wisconsin
Johns Hopkins University
Teledyne Brown

Status

Preliminary activities, such as Investigator Working Group (IWG) meetings, have been initiated for the implementation of Astro-2 mission. The three telescopes and support hardware are currently undergoing functional evaluation and refurbishment.



Astro-2

Astro-D Mission
Spectroscopic X-ray Observatory (SXO)

Objectives

The Astro-D Mission will perform spectroscopic x-ray astronomy in the wavelength band from less than 1 thousand electron volts (keV) to 12 keV, with particular emphasis on the iron K band.

Description

Astro-D is a cooperative mission with Japan's Institute of Space and Astronautical Science (ISAS) in which the Goddard Space Flight Center (GSFC) will provide four conical, grazing incidence, thin foil mirrors and the Massachusetts Institute of Technology (MIT) will provide two Charge Coupled Device (CCD)-based detectors. Japan will provide the balance of the science payload, the spacecraft and the launch vehicle. In return for its scientific instrument contribution, NASA will be allocated approximately 25 percent of the science data.

Launch Date:	February 1993
Payload:	4 x-ray instruments
Orbit:	Inclination TBD; 500 km (270 nm) altitude
Design Life:	2 years
Length:	4 m (13 ft) (deployed)
Weight:	220 kg (484 lbs) (entire satellite)
Diameter:	1.4 m (5 ft)
Launch Vehicle:	M3S-II (Japan)
International Participation:	Japan

Instruments/Investigations/Principal Investigators

X-ray Telescopes - Institute of Space and Astronautical Science - Japan
Gas Scintillation Imaging System (GSIS) - Institute of Space and Astronautical Science - Japan
Conical Grazing Incidence Mirrors (CGIM's) - P. Serlemitsos (GSFC)
CCD-based Detectors - G. Ricker (Massachusetts Institute of Technology)

Mission Events

Delivery of Flight Hardware (CCD-based Detectors and CGIM's) to Japan: Fall 1991
Fabrication of Flight Mirrors and Detector Complete: December 1991
Space Flight Readiness Review: January 1993

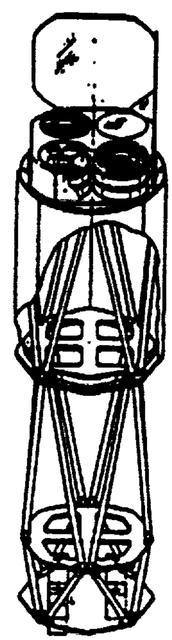
Management

NASA Headquarters
J. Lintott, Program Manager
A. Bunner, Program Scientist
Goddard Space Flight Center
G. Ousley, Program Manager
S. Holt, Program Scientist
Major Contractor
Massachusetts Institute of Technology

Astro-D Mission
Spectroscopic X-ray Observatory (SXO) (Continued)

Status

Astro-D is an approved mission, both in Japan and in the U.S. Flight CCD detectors and mirror assemblies have been shipped to Japan in preparation for a February 1993 launch.



Astro-D Mission: Spectroscopic X-ray Observatory (SXO)

Astro-SPAS Program

Objective

The Astro-SPAS program will provide flight opportunities for selected scientific payloads that can contain a one-meter class telescope or equivalent equipment. The instruments will address specific scientific objectives in astrophysics and Earth sciences.

ORFEUS

The Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer Shuttle Pallet Satellite (ORFEUS-SPAS) will explore the universe in the far (900-1,200 angstroms) and extreme (400-900 angstroms) ultraviolet wavelengths and obtain high resolution spectroscopy of the physical conditions in coronae and hot atmospheres of stars and energetic astronomical objects. A second instrument on ORFEUS-SPAS, the Interstellar Medium Absorption Profile Spectrograph (IMAPS), will also explore the narrow interstellar spectral lines to determine the state of the interstellar medium.

CRISTA

The Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere (CRISTA) will explore the variability of the atmosphere and will provide measurements that will complement those provided by the Upper Atmosphere Research Satellite (UARS) and the Atmospheric Laboratory for Applications and Science (ATLAS) missions.

Description

Astro-SPAS is a joint scientific program between NASA and DARA, the German Space Agency. The program employs a reusable carrier, the Shuttle Pallet Satellite (SPAS), developed by Messerschmitt-Boelkow-Blohm (MBB) in the Federal Republic of Germany (FRG) for short-duration missions. Science instruments will be provided by the U.S. and FRG. After being transported to low Earth orbit by the Space Shuttle, Astro-SPAS will be deployed from the cargo bay using the Remote Manipulator System (RMS). For the next 4 to 6 days, Astro-SPAS will execute a pre-programmed series of mission operations. The carrier is a semi-autonomous system powered by batteries with data being stored on tape. The on-board star tracker and cold gas thrusters can achieve 5 to 10 arcseconds pointing accuracy for up to 250 targets. At the end of the mission, the Astro-SPAS carrier will be retrieved by the RMS and placed in the Shuttle cargo bay and returned to Earth for reuse on other missions. Two missions have been selected for the Astro-SPAS Program; brief descriptions of the selected missions follow:

The **Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer (ORFEUS)** consists of a combination of spectrometers/telescopes capable of sensing and measuring ultraviolet radiation. The primary telescope, provided by DARA, houses the Echelle spectrometer and the Rowland spectrometer. The Rowland spectrometer is a NASA-provided instrument being developed by the University of California-Berkeley. The Interstellar Medium Absorption Profile Spectrograph (IMAPS) is mounted on the Astro-SPAS carrier and utilizes the same star acquisition and tracking systems as the primary telescope. IMAPS is a NASA-provided instrument being developed by Princeton University. The Surface Effects Sample Monitor (SESAM) is a passive experiment designed to assess the effects of atomic oxygen on optical materials. ORFEUS operates at a distance of approximately 25 miles from the carrier.

Astro-SPAS Program (Continued)

Description (Continued)

The **Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere (CRISTA)** consists of a German telescope/cryostat assembly sensitive in the 4 to 70 micrometer spectral range, and containing U.S. experiments including the Infrared Measurements of the Atmosphere (IRMA, 50 to 60 micrometers) and Airglow Measurements of Infrared Measurements Emissions (AMIE, 1 to 2 micrometers). The payload operates at a distance of approximately 4 kilometers from the Shuttle following deployment from the cargo bay using the RMS. CRISTA contains onboard batteries, cryogenic and nitrogen cold-gas maneuvering subsystems. CRISTA will be retrieved at the end of the mission and returned to Earth with the Shuttle. CRISTA, along with its co-manifested NASA payload (ATLAS-2), will constitute a joint science mission with a single set of science objectives managed by a single management structure.

	ORFEUS	CRISTA
Launch Date:	April 1993	June 1994
Investigations:	2 telescopes and 2 spectrographs	1 instrument/ 3 investigation regions
Orbit:	28.5 degree inclination; 296 km (160 nm) altitude Deployed from/retrieved by Space Shuttle	57 degree inclination; 250 km (135 nm) altitude Deployed from/retrieved by Space Shuttle
Duration:	6-7 days	7-10 days
Length:	1.7 m (6 ft)	TBD
Weight:	3,500 kg (7,718 lbs)	6,400 kg (14,080 lbs) (planned)
Diameter:	TBD	457 cm (15 ft)
Launch Vehicle:	Space Shuttle	Space Shuttle
International Participation:	FRG	FRG

Instruments/Principal Investigators

ORFEUS Rowland Spectrometer - S. Bowyer (University of California-Berkeley)
ORFEUS Echelle Spectrometer - G. Krämer (Astronomical Institute of Tubingen - FRG)
Interstellar Medium Absorption Profile Spectrograph (IMAPS) - E. Jenkins (Princeton University)
Surface Effects Sample Monitor (SESAM) - (German Aerospace Research Establishment - FRG)

Mission Events

Instrument development: Ongoing
Mission implementation: Ongoing
ORFEUS instrument fabrication complete: Spring 1992
ORFEUS delivery to Kennedy Space Center: August 1992
CRISTA delivery to Kennedy Space Center: Early 1993

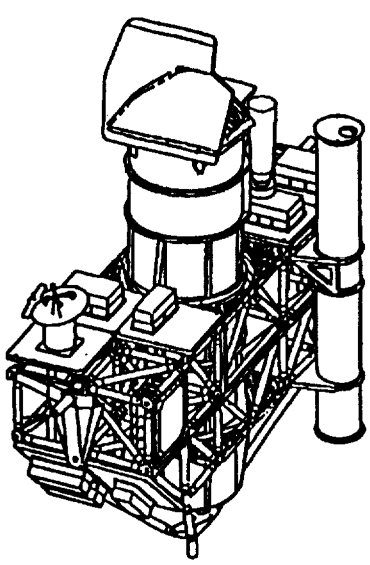
Astro-SPAS Program (Continued)

Management

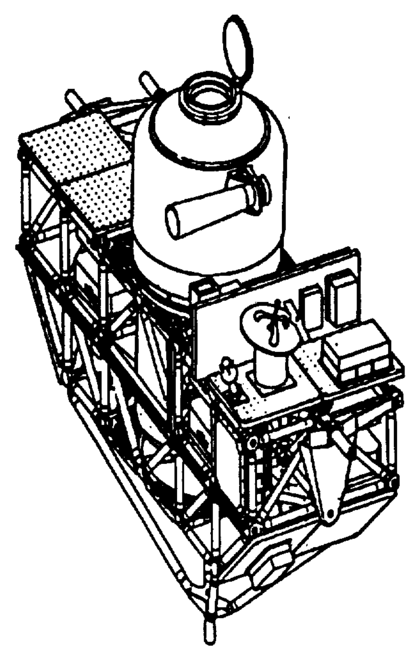
NASA Headquarters
E. Reeves, Astro-SPAS Program Manager (Acting)
W. Huddleston, ORFEUS Program Manager
R. Stachnik, ORFEUS Program Scientist
E. Montoya, CRISTA Program Manager
D. Butler, CRISTA Program Scientist
Federal Republic of Germany
G. Hartmann, Astro-SPAS Program Manager, DARA
G. Krämer, ORFEUS Project Scientist, University of Tubingen
D. Offermann, CRISTA Project Scientist, University of Wuppertal
Major Contractors
University of California-Berkeley
Princeton University Observatory
Messerschmitt-Boelkow-Blohm

Status

ORFEUS and ASTRO-SPAS hardware are currently in fabrication and testing in the U.S. and FRG. Instrument delivery is planned for 1992.



Orbiting and Retrievable Far and Extreme Ultraviolet Spectometer



Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere

Astromag

Objective

Astromag will: 1) investigate the origin and evolution of matter in the galaxy by directly sampling galactic material and comparing it with the solar system abundances; 2) study the origin, acceleration, and propagation of cosmic rays and the effect of this galactic relativistic particle plasma on the dynamics of the galaxy; 3) search for anti-nuclei of either galactic or extragalactic origin; and 4) look for signatures of exotic processes such as dark matter annihilation or the decay of primordial black holes.

Description

Astromag, a large superconducting magnet spectrometer to be flown in space, will accommodate two scientific instruments, one on either end of a double-coil magnet system. Although originally designed as a Space Station Freedom attached payload, a scaled down Astromag facility on a spacecraft in a high inclination orbit would also accomplish the primary science objectives of Astromag. In this free-flyer version, the spacecraft would be a momentum-biased stabilized satellite weighing 5,250 kilograms, including the science instruments, and would provide 1,250 Watts orbital average power. A fundamental component of the satellite is the large stainless steel dewar containing 2,250 liters of superfluid helium (He II) which provides cooling for two superconducting magnet coils with near-zero net magnetic dipole moment. The magnets operate in persistent mode and generate a magnetic field with 11 Megajoules of stored energy at a peak field strength of 7 Tesla.

Launch Date:	TBD
Payload:	Relativistic Particle Detectors
Orbit:	At least 57 degrees inclination
Design Life:	2 years minimum
Length:	4.0 m (13 ft)
Weight:	5,700 kg (12,566 lbs)
Diameter:	3.7 m (12 ft)
Launch Vehicle:	Expendable Launch Vehicle
International Participation:	Italy, FRG, Denmark

Instruments/Investigations/Principal Investigators

A Program to Measure Cosmic Ray Antiprotons and Positrons, and Search for Primordial Antimatter (WiZard) - R. Golden (New Mexico State University)
Large Isotope Spectrometer for Astromag (LISA) - J. Ormes (GSFC)

Mission Events

Phase A study for Space Station Facility completed: May 1988
Selected as Attached Payload for Space Station Freedom: June 1989
Phase B study agreement with Italian Space Agency: October 1989
Deferred as Attached Payload: December 1990
Free-Flyer feasibility study completed: May 1991

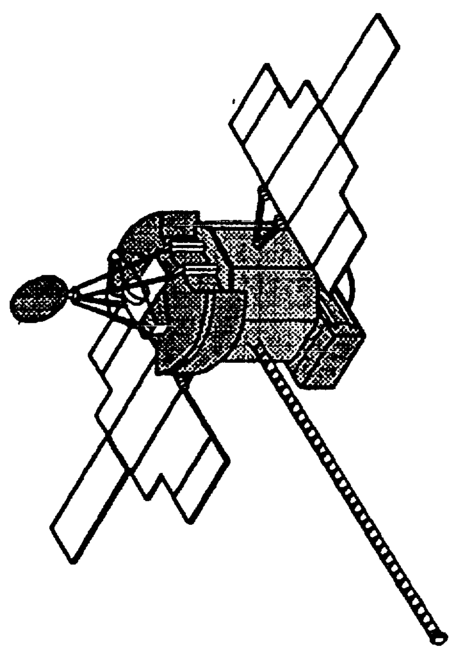
Astromag (Continued)

Management

NASA Headquarters
R. Howard, Program Manager
V. Jones, Program Scientist
Goddard Space Flight Center
G. Anikis, Project Manager
J. Ormes, Project Scientist

Status

The instruments and principle investigator teams were selected in June 1989 through the Space Station Freedom Attached Payloads Announcement of Opportunity issued in July 1988. Astromag has been proposed as a fiscal year 1997 New Start candidate. Design studies on the dewar, magnet and spacecraft are continuing.



Astromag

Atmospheric Laboratory for Applications and Science (ATLAS) Series

Objective

The Atmospheric Laboratory for Applications and Science (ATLAS) will: 1) measure long-term changes in the total energy radiated by the Sun; 2) determine the variability in the solar spectrum; and 3) measure the global distribution of key molecular species in the middle atmosphere. Such measurements are needed because even small changes in the Sun's total irradiance or its spectral distribution can have a significant impact on the Earth's climate and environment. Additional objectives are to differentiate man-made from natural perturbations in the Earth's atmosphere and to provide absolute calibrations for solar monitoring instruments on free-flying spacecraft.

Description

The first of the ATLAS missions will use two Spacelab pallets and an igloo to accommodate a core payload of six solar and atmospheric monitoring instruments plus reflights of several Spacelab investigations. Subsequent missions scheduled at approximately 1-year intervals will have a single pallet. The Space Shuttle's orientation will either be inertially fixed so that selected instruments are pointed at the Sun, or the nadir for observations of the Earth's atmosphere. The orbit must have solar occultations so that absorptions in the solar spectrum caused by trace molecules in the atmosphere can be detected by the Atmospheric Trace Molecules Spectroscopy (ATMOS) instrument, an infrared spectrometer with a mirror system to track the Sun. Command, control and data handling support for the experiments are provided by Spacelab's avionics located in the igloo. The crew will work in the aft flight deck, which has the displays and controls needed to conduct the ATLAS investigations.

Launch Date:	ATLAS-1: April 1992 ATLAS-2: May 1993 ATLAS-3: June 1994 ATLAS-4: 4th Quarter FY 1995 ATLAS-5: 4th Quarter FY 1997
Investigations:	13 instruments and SSBUV for ATLAS-1
Orbit:	57 degree inclination; 300 km (162 nm) altitude
Duration:	8-10 days
Length:	9.2 m (30 ft)
Weight:	ATLAS-1: 9,090 kg (19,998 lbs) ATLAS-2: 6,400 kg (14,080 lbs) (planned) ATLAS-3: 6,400 kg (14,080 lbs) (planned)
Diameter:	Approx. 4.6 m (15 ft)
Launch Vehicle:	Space Shuttle
International Participation:	FRG, Belgium, France, Japan

Instruments/Investigations/Principal Investigators (ATLAS-1)

Active Cavity Radiometer (ACR) - R. Wilson (Jet Propulsion Laboratory)

Solar Constant Radiometer (SOLCON) - D. Crommelynck (Royal Meteorological Institute of Belgium)

Solar UV Spectral Irradiance Monitor (SUSIM) - G. Brueckner (Naval Research Laboratory)

Solar Spectrum (SOLSPEC) - G. Thuiller (Aeronomy Department, National Center for Scientific Research - France)

Atmospheric Trace Molecule Spectroscopy (ATMOS) - M. Gunson (Jet Propulsion Laboratory)

Atmospheric Laboratory for Applications and Science (ATLAS)
(Continued)

Instruments/Investigations/Principal Investigators (ATLAS-1) (Continued)

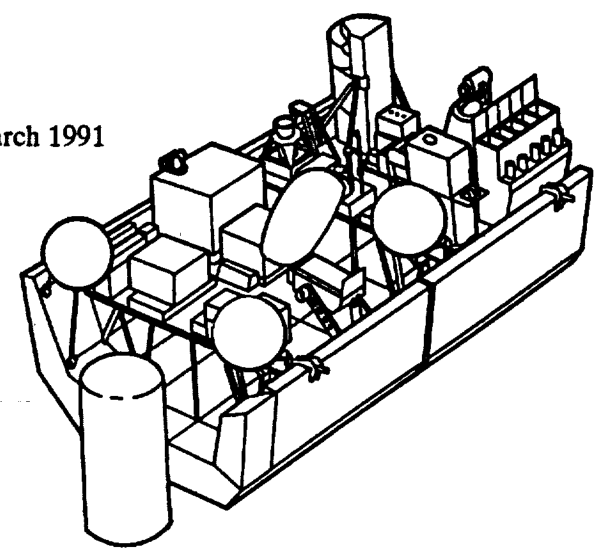
Imaging Spectrometric Observatory (ISO) - M. Torr (MSFC)
Millimeter-Wave Atmospheric Sounder (MAS) - G. Hartmann (Max Planck Institute for Aeronomy - FRG)
Space Experiments with Particle Accelerators (SEPAC) - J. Burch (Southwest Research Institute)
Atmospheric Emission Photometric Imaging (AEPI) - S. Mende (Lockheed Palo Alto Research Laboratory)
Shuttle Solar Backscatter Ultraviolet Experiment (SSBUV)*- E. Hilbenrath (GSFC)
Far Ultraviolet Astronomy (FAUST) - C. Bowyer (University of California-Berkeley)
Atmospheric Lyman Alpha Emissions (ALAE) - J. Bertaux (French Space Agency - CNES)
Grille Spectrometer (Grille) - M. Ackerman (Belgian Institute for Space Aeronomy - Belgium), J. Besson (National Office of Aerospace Studies and Research - France)
Energetic Neutral Atom Precipitation (ENAP) - B. Tinsley (University of Texas-Dallas)
Far Ultraviolet Space Telescope (FAUST) - C. Bowyer (University of California-Berkeley)
* *co-manifest*

Mission Events

Preliminary experiment design: Completed
Mission concept, feasibility studies: Completed
Mission definition studies: Completed
Mission implementation: Ongoing
Instrument delivery to Kennedy Space Center: March 1991

Management

NASA Headquarters
E. Montoya, Program Manager
J. Kaye, Program Scientist
Marshall Space Flight Center
A. O'Neil, Mission Manager
M. Torr, Mission Scientist
Major Contractor
Teledyne Brown



Atmospheric Laboratory for Applications and Science

Status

ATLAS-1 instruments were delivered to Kennedy Space Center in March 1991 for integration onto the pallets for launch. The Level-IV Mission Sequence Test (MST) was completed May 1991. The pallets have been moved to the Level-III/II test stands for a Level-III/II MST scheduled for December 1991. The mission is planned for launch in April 1992.

Cassini

Objectives

The Cassini Program, building on the discoveries made by the Pioneer and Voyager missions, will provide unprecedented information on the origin and evolution of our solar system and will help tell how the necessary building blocks for the chemical evolution of life are formed elsewhere in the universe.

The Cassini mission will conduct a detailed exploration of the Saturnian system including: 1) the study of Saturn's atmosphere, rings and magnetosphere; 2) remote and in situ study of Titan; 3) the study of Saturn's icy moons; and 4) an asteroid and Jupiter flyby to expand our knowledge of these bodies.

Description

This free-flying mission will spend 4 years in orbit around the planet Saturn conducting a detailed exploration of the Saturnian system. At the conclusion of this mission, we will have a better understanding of the origin and evolution of the solar system including elemental and isotopic abundances; the internal structure of Saturn, Titan and icy satellites; the surface morphology of Titan, icy satellites, and asteroids; and the structure, dynamics, and evolution of Saturn's rings and magnetosphere. Our understanding will also increase regarding the chemical evolution in the solar system by studying the surface state and atmospheric chemistry of Titan and the composition of dark material on the icy satellites. Cassini will also study processes in cosmic plasma physics including the interaction of flowing plasma with icy solid bodies, plasma impact processing of surfaces and atmospheres, and interaction of energetic plasma, gas and dust.

After launch in 1997, the Cassini spacecraft will use a combination of Venus, Earth and Jupiter gravity assists to gain energy. Cassini will fly past an asteroid and the planet Jupiter, making detailed observations at each close approach. The spacecraft will arrive at Saturn and will be inserted into a loose elliptical orbit. The European Space Agency's (ESA) Titan probe, called "Huygens," will be dropped into the atmosphere of Saturn's moon, Titan, during the first orbit. The Cassini orbiter will then make approximately 40 revolutions to study Saturn, its rings, satellites and magnetosphere.

Launch Date:	October 1997
Payload:	12 instruments on orbiter, 6 instruments on probe
Orbit:	Interplanetary-Venus/Earth/Jupiter Gravity Assist, Saturn orbit
Design Life:	13 years
Weight:	2,050 kg (4,510 lbs)
Launch Vehicle:	Titan IV/Centaur
International Participation:	European Space Agency, FRG, Italy, 59 Foreign Co-Investigators

Cassini (Continued)

Instruments/Investigations/Principal Investigations

Infrared Composite Spectrometer (CIRS) - V. Kunde (GSFC)
Cosmic Dust Analyzer (CDA) - E. Grün (Max Planck Institute for Nuclear Physics - FRG)
Radio and Plasma Wave System (RPWS) - D. Gurnett (University of Iowa)
Cassini Plasma Spectrometer (CPS) - D. Young (Southwest Research Institute)
Ultraviolet Imaging Spectrograph (UVIS) - L. Esposito (University of Colorado)
Magnetospheric Imaging Instrument (MIMI)- S. Krimigis (Johns Hopkins University)
Dual Technique Magnetometer (DTMAG) - D. Southwood (Imperial College of Science and Technology - UK)
Titan Radar Mapper (RADAR) - C. Elachi (Jet Propulsion Laboratory)
Imaging Science Subsystem (ISS) - C. Porco (University of Arizona)
Radio Science Subsystem (RSS) - A. Kliore (Jet Propulsion Laboratory)
Ion and Neutral Mass Spectrometer (INMS) - TBD
Visual and Infrared Mapping Spectrometer (VIMS) - R. Brown (Jet Propulsion Laboratory)

Mission Events

Venus Flyby: December 1996
Earth Flyby: July 1998
Asteroid Flyby: November 1998
Jupiter Flyby: April 2000
Saturn Arrival: May 2004
Probe Deployment: August 2004
Nominal End-of-Mission: May 2008

Management

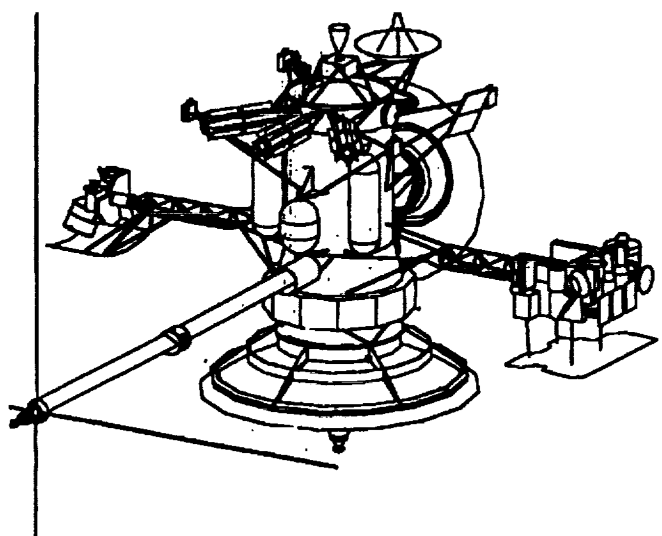
NASA Headquarters
H. Wright, Program Manager
H. Brinton, Program Scientist
Jet Propulsion Laboratory
R. Spehalski, Project Manager
D. Matson, Project Scientist
European Space Agency (ESA)
H. Hassan, Huygens Project Manager
J-P. LeBreton, Huygens Project Scientist
Major Contractors
Martin Marietta Aerospace
General Dynamics Corporation

Cassini (Continued)

Status

The CRAF/Cassini Program was approved as a new start in NASA's fiscal year 1990 budget. On January 29, 1992, NASA announced the planned cancellation of the CRAF Mission.

ESA has competitively selected Aerospatiale for design and development of the Huygens Probe segment of Cassini. Separate but coordinated Announcements of Opportunity for Cassini science investigations were released by NASA (Saturn Orbiter) and ESA (Huygens Probe) in October 1989. Selection of investigations has been announced by both parties, and the Cassini Project Science Group has been formed. NASA's selection for the Saturn Orbiter is tentative, with confirmation scheduled to occur in 1992.



Cassini

Centrifuge Facility Program

Objective

The Life Sciences Division Centrifuge Facility Program provides a suite of equipment to conduct basic research on Space Station Freedom (SSF) to determine the influence of gravity on biological systems and to develop countermeasures to enable long-duration human activity in space. The major objectives of the Centrifuge Facility are to provide: 1) a gravity control capability to separate the effects of microgravity from those of other environmental factors; 2) a capability to study gravity threshold levels; 3) a testbed for determining the impact of artificial gravity on biological specimens within the spacecraft environment; and 4) a supply of gravity conditioned specimens that are adapted to the spacecraft environment.

Description

The Centrifuge Facility is comprised of the following flight hardware: 1) Centrifuge, supporting a number of habitats, will be 2.5 meters in diameter, and is designed to produce gravity levels between .01 and 2 g's; 2) Modular Habitats will, in conjunction with the Habitat Holding Units and the Centrifuge, provide life support for rats, mice, squirrel monkeys and plants, and potentially avian and aquatic species; 3) Two Habitat Holding Units, one SSF rack each, provide the holding locations and support systems for the habitats located in the microgravity environment; 4) Life Sciences Glovebox one SSF rack in size, will provide a bio-isolated work area where specimens can be manipulated and transferred into and out of habitats; and 5) Specimen Chamber Service Unit one SSF rack in size, will provide for refurbishment of habitats at regular intervals.

Launch Date:	December 1999
Orbit:	28.5 degree inclination
Duration:	Extended
Length:	TBD
Weight:	1909 kg (4,200 lbs)
Diameter:	2.5 m (8 ft) centrifuge
Launch Vehicle:	Space Shuttle
International Participation:	Anticipated

Mission Events

Phase B Start: October 1989
Phase C/D RFP Release: Spring 1992
Phase C/D Start: January 1993
Centrifuge Launch: December 1999
Habitat Holding Unit #1 Launch: 1999
Habitat Holding Unit #2 Launch: 2000

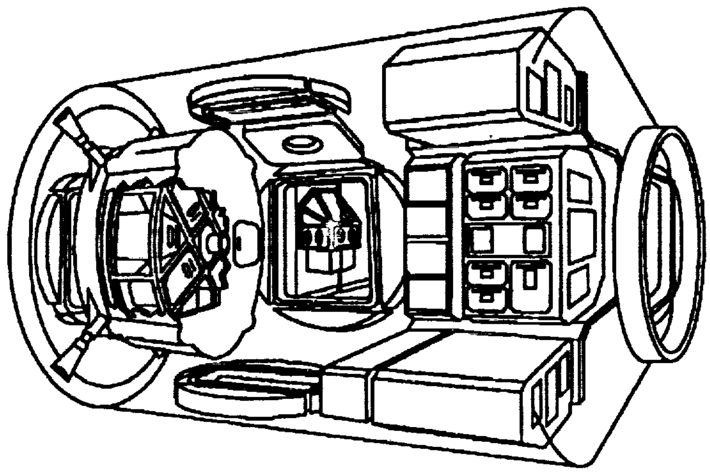
Management

NASA Headquarters
L. Chambers, Program Manager
J. Keefe, Program Scientist
Ames Research Center
J. Sperans, Project Manager
A. Hargens, Project Scientist
Major Contractors
TBD

Centrifuge Facility Program (Continued)

Status

Phase B Studies were completed in 1991. Preparations are underway to release a Phase C/D Request for Proposal (RFP) in spring 1992.



Centrifuge Facility

Collaborative Solar-Terrestrial Research (COSTR) Program: Cluster Mission

Objective

The Cluster Mission will perform three-dimensional studies of the microphysical properties of different plasma states in the Earth's magnetosphere.

Description

The Cluster Mission consists of four identically instrumented, spin-stabilized spacecraft built and launched by the European Space Agency (ESA). Program management for the ESA-provided components of the Cluster Mission will be conducted by the European Space Research and Technology Center (ESTEC). These spacecraft will be launched into a 4 x 22 Earth radii elliptical polar orbit with a full range of shared ESA/NASA plasma physics fields and particles instrumentation.

Launch Date:	December 1995
Payload:	11 instruments
Orbit:	4 x 22 Earth radii elliptical, polar orbit
Design Life:	2 years
Length:	4 m (13 ft)
Weight:	4,000 kg (8,800 lbs)
Diameter:	2.9 m (10 ft)
Launch Vehicle:	Ariane-V
International Participation:	European Space Agency

Instruments/Investigations/Principal Investigators

Active Spacecraft Potential Control (ASPOC) - W. Riedler (Institute for Interstellar Space Research - FRG)

Cluster Ion Spectrometry (CIS) - H. Reme (Center for the Study of Space Radiation, University of Toulouse - France)

Digital Wave Processor (DWP) - L. Woolliscroft (University of Sheffield - UK)

Electric Fields and Waves (EFW) - G. Gustafsson (Swedish Institute of Space Physics - Sweden)

Electron Drift Instrument (EDI) - G. Paschmann (Max Planck Institute for Physics and Astrophysics - FRG)

Fluxgate Magnetometer (FGM) - A. Balogh (Imperial College of Science and Technology - UK)

Plasma Electron and Current Analyzer (PEACE) - A. Johnstone (Mullard Space Science Laboratory - UK)

Research with Adaptive Particle Imaging Detectors (RAPID) - B. Wilken (Max Planck Institute for Aeronomy - FRG)

Spatio-Temporal Analysis of Field Fluctuations (STAFF) - N. Cornilleau (Center for Research of Terrestrial and Planetary Environmental Physics/National Center for the Study of Telecommunications - France)

Waves of High Frequency and Sounder for Probing of Density by Relaxation (WHISPER) - P. Decreau (Laboratory for Environmental Physics and Chemistry - France)

Wide Band Data (WBD) - D. Gurnett (University of Iowa)

Collaborative Solar-Terrestrial Research (COSTR) Program: Cluster Mission (Continued)

Mission Events

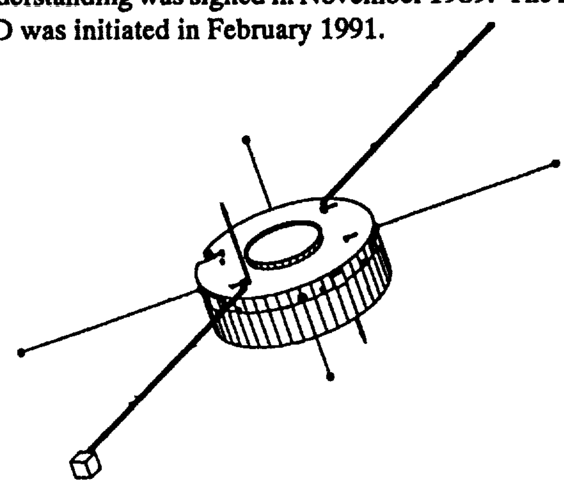
Announcement of Opportunity released: March 1987
Investigations confirmed: December 1989
Instrument development initiated: 1989
Spacecraft development initiated: 1990
Instrument Critical Design Review: 2nd Quarter 1991
Spacecraft Critical Design Review: 4th Quarter 1992
Instrument delivery: 1st Quarter 1993

Management

NASA Headquarters
M. Calabrese, Program Manager
E. Whipple, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
European Space Research and Technology Center (ESTEC)
D. Dale, Program Manager
R. Reinhard, Program Scientist
J. Credland, Project Manager
R. Schmidt, Project Scientist
Major Contractor
Dornier

Status

Investigation development has been initiated. Spacecraft contract was awarded to Dornier in October 1989. Memorandum of Understanding was signed in November 1989. The Program Plan was signed in December 1989. Phase C/D was initiated in February 1991.



Collaborative Solar-Terrestrial Research Program: Cluster Mission

Collaborative Solar-Terrestrial Research (COSTR) Program: Geotail Mission

Objective

The Geotail Mission will characterize the energy stored in the Earth's geotail and mid-magnetosphere region including measurements in the tail plasma sheet and measurements of plasma entry and transport in the magnetosphere boundary layer for the Global Geospace Science (GGS) program.

Description

Geotail is a spin-stabilized spacecraft provided by Japan's Institute of Space and Astronautical Science (ISAS) with a full range of shared ISAS/NASA plasma physics field and particles instrumentation. Geotail will be launched by a Delta II into a night side double lunar swingby orbit to 8 x 250 Earth radii and later reduced to an 8 x 32 Earth radii equatorial orbit.

Launch Date:	July 1992
Payload:	6 investigations and 1 instrument
Orbit:	7.5 degree inclination; double lunar swingby to a 8 x 220 Earth radii, reduced to an 8 x 30 Earth radii equatorial orbit
Design Life:	3 years
Length:	1.6 m (5 ft)
Weight:	970 kg (2,134 lbs)
Diameter:	2.2 m (7 ft)
Launch Vehicle:	Delta II
International Participation:	Japan

Instruments/Investigations/Principal Investigators

Comprehensive Particles Investigation (CPI) - L. Frank (University of Iowa)
Electric Field Detector (EFD) - K. Tsuruda (Institute of Space and Astronautical Science - Japan)
Energetic Particle and Ion Composition (EPIC) - D. Williams (Applied Physics Laboratory)
High Energy Particle Experiment (HEP) - M. Doke (Waseda University - Japan)
Low Energy Particle Experiment (LEP) - T. Mukai (Institute of Space and Astronautical Science - Japan)
Magnetic Field Experiment (MGF) - S. Kokobun (University of Tokyo - Japan)
Plasma Waves Investigation (PWI) - H. Matsumoto (Kyoto University - Japan)

Mission Events

Announcement of Opportunity released: October 1979
Confirmation of investigations: September 1987
Engineering unit integration test: Completed
U.S. instrument flight models delivered: 1989
Detailed system design: Completed
Spacecraft Critical Design Review: April 1990
Spacecraft delivery: May 1992

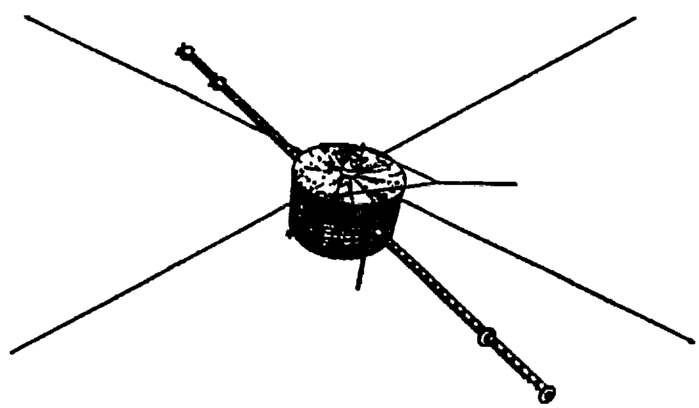
Collaborative Solar-Terrestrial Research (COSTR) Program: Geotail Mission (Continued)

Management

NASA Headquarters
M. Calabrese, Program Manager
E. Whipple, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
Institute of Space and Astronautical Science (ISAS)
A. Nishida, Program Manager, Program Scientist
K. Uesugi, Project Manager
T. Mukai, Project Scientist
Major Contractor
NEC

Status

Spacecraft integration is underway at ISAS. Program is on schedule for launch in July 1992.



Collaborative Solar-Terrestrial Research Program: Geotail Mission

Collaborative Solar-Terrestrial Research (COSTR) Program: Solar and Heliospheric Observatory Mission (SOHO)

Objective

The Solar and Heliospheric Observatory Mission (SOHO) will perform remote measurements of the Sun and in situ measurements of the solar wind abundance to characterize the structure of the solar interior and the dynamics of coronal plasma.

Description

SOHO is a three-axis stabilized European Space Agency (ESA) spacecraft with shared ESA and NASA solar physics and plasma physics field and particles instrumentation. Program management for the ESA-provided components of the SOHO mission will be conducted by the European Space Research and Technology Center (ESTEC). SOHO will be launched by NASA into a halo orbit at the Sun-Earth L_1 Lagrangian point.

Launch Date:	July 1995
Payload:	6 instruments and 6 investigations
Orbit:	Halo at L_1 Lagrangian point
Design Life:	2 years
Length:	3.6 m (12 ft)
Weight:	1,850 kg (4,070 lbs)
Diameter:	3.6 m (12 ft)
Launch Vehicle:	Atlas IIAS
International Participation:	European Space Agency

Instruments/Investigations/Principal Investigators

Charge, Element and Isotope Analysis (CELIAS) - D. Hovestadt (Max Planck Institute for Physics and Astrophysics - FRG)

Coronal Diagnostic Spectrometer (CDS) - B. Patchett (Rutherton Appleton Laboratory - UK)

Energetic Particle Analyzer (ERNE) - J. Torsti (University of Turku - Finland)

Extreme Ultraviolet Imaging Telescope (EIT) - J. Delaboudiniere (Laboratory for Stellar and Planetary Physics - France)

Global Oscillations at Low Frequencies (GOLF) - A. Gabriel (Laboratory for Stellar and Planetary Physics - France)

Large Angle and Spectrometric Coronagraph (LASCO) - G. Brueckner (Naval Research Laboratory)

Michelson Doppler Imager (MDI) - P. Scherrer (Stanford University)

Solar Ultraviolet Measurements of Emitted Radiation (SUMER) - K. Wilhelm (Max Planck Institute for Aeronomy - FRG)

Solar Wind Anisotropies (SWAN) - J. Bertaux (Aeronomy Department, National Center for Scientific Research - France)

Suprathermal and Energetic Particle Analyzer (COSTEP) - H. Kunow (University of Kiel - FRG)

Ultraviolet Coronagraph Spectrometer (UVCS) - J. Kohl (Smithsonian Astrophysical Observatory)

Variability of Solar Irradiance (VIRGO) - C. Frohlich (Physical-Meteorological Observatory, Davos (PMOD) - Switzerland)

Collaborative Solar-Terrestrial Research (COSTR) Program: Solar and Heliospheric Observatory Mission (SOHO) (Continued)

Mission Events

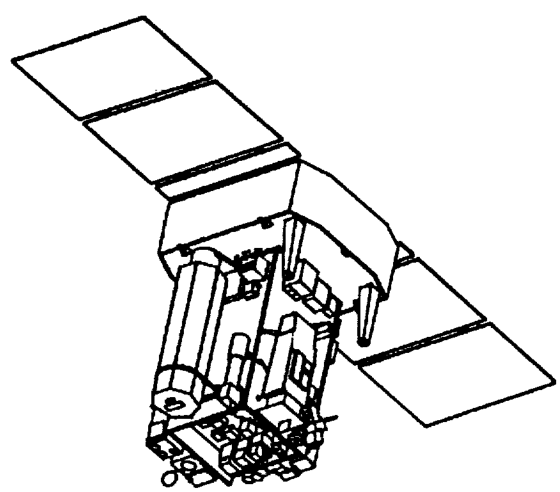
Announcement of Opportunity released: March 1987
Investigations confirmed: December 1989
Initiate instrument development: 1990
Initiate spacecraft development: 1990
Proto-flight model delivery: June 1993

Management

NASA Headquarters
M. Calabrese, Program Manager
W. Wagner, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
European Space Research and Technology Center (ESTEC)
D. Dale, Program Manager
R. Reinhard, Program Scientist
P. Logalbo, Project Manager
V. Domingo, Project Scientist
Major Contractor
Matra

Status

Structural models were delivered in fall 1991 and U.S. instrument engineering models are in development for delivery in summer 1992.



Collaborative Solar-Terrestrial Research Program: Solar and Heliospheric Observatory Mission

Cosmos Program

Objectives

The objectives of the Cosmos program include: 1) investigating the areas of rodent and primate physiology, general biology, radiation biology and dosimetry; 2) identifying the physiological, developmental, biochemical, and behavioral changes associated with microgravity; and 3) identifying and evaluating potential hazards during long-duration space flight.

Description

The unmanned Russian Biological Satellite (Biosat) missions involve extensive international participation including significant U.S. scientific investigations. Since the Biosat program began over 15 years ago, the U.S. has participated on seven missions, and flown experiments involving plants, insects, rodents, fish and rhesus monkeys.

Launch Date:	November 1992
Payload:	2 rhesus monkeys and radiation dosimetry experiment
Orbit:	89.3 degree inclination; 294 km (159 nm) apogee, 216 km (117 nm) perigee
Duration:	14 - 19.5 days
Length:	488 cm (16 ft)
Weight:	900 kg (2,000 lbs)
Diameter:	244 cm (8 ft)
Launch Vehicle:	VOSTOK (former Soviet Union)
International Participation:	Czechoslovakia, FRG, Poland

Investigations/Principal Investigators

Relationship of Bone Strength to Mineral Density and Metabolic Changes Before and After Spaceflight - S. Arnaud (ARC); P. Buckendahl (University of California-Santa Cruz); C. Cann (University of California-San Francisco); M. Hughes-Fulford (Metabolic Research); A. LeBlanc and V. Schneider (University of Texas Medical School); and T. Wronski (University of Florida College of Veterinary Medicine)

Adaptation to Microgravity of Oculomotor Reflexes (AMOR): Semicircular Canal Ocular Reflexes - B. Cohen (Mt. Sinai School of Medicine)

Studies of Vestibular Nuclei Responses in Normal, Hyper- and Hypogravity - M. Correia (University of Texas Medical Branch)

Functional Neuromuscular Adaptation to Spaceflight - V. Edgerton (University of California-Los Angeles)

Biological Rhythm and Temperature Regulation and Rhesus Monkey Metabolism During Spaceflight - C. Fuller (University of California-Davis)

Rhesus Monkey Immunology Experiment - G. Sonnenfeld (University of Louisville)

Adaptation to Microgravity of Oculomotor Reflexes (AMOR): Otolith-Ocular Reflexes - D. Tomko (ARC)

Cosmos Program (Continued)

Mission Events

Cosmos Hardware Meeting in former Soviet Union: February 1991
Soviet/U.S. Technical Interchange Meeting at ARC: July 1991
Soviet Scientists' meeting in U.S.: November 1991
Hardware testing in U.S.: March 1992
U.S. Scientists' meeting in Russia: March 1992
Delivery of hardware to Russia: July 1992

Management

NASA Headquarters
L. Chambers, Program Manager
F. Sulzman, Program Scientist
Ames Research Center
J. Connolly, Project Manager
R. Ballard, Project Scientist

Status

NASA has flown seven Cosmos missions since 1975. Final results for the experiments conducted on Cosmos 2044 (1989 mission) were presented in August 1991 at the Cosmos Biosatellite Symposium, St. Petersburg, Russia. The final report on Cosmos 2044 was submitted in October 1991. Preparations for the 1992 mission are in process and on schedule.

Diffuse X-ray Spectrometer (DXS)

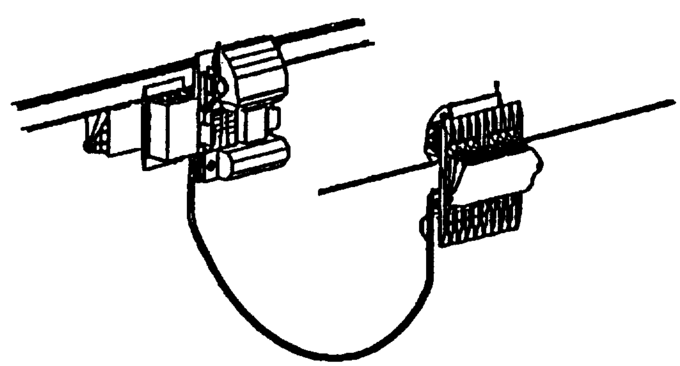
Objective
The objectives of the Diffuse X-ray Spectrometer (DXS) include: 1) measuring the spectral distribution of diffuse x-rays in the "Local" Interstellar Medium to help determine its elemental composition and dynamic state; and 2) testing the theory that the observed diffuse soft x-ray background originates in a hot plasma which is a remnant from a star that exploded eons ago.

Description
The two DXS instruments used for the mission will be identical in configuration. Each consists of six major elements: a rotating detector, an electronic interface box, a control electronics assembly, a power control subsystem, a gas tank, and a gas system manifold box. The detector will sort out x-rays according to wavelength and direction as they enter the opening and reflect off a curved surface made of x-ray reflecting lead stearate crystals. The wavelength range covered by each of the instruments is 42 angstroms to 84 angstroms. The DXS spectrometers will each be mounted on a Shuttle Payload of Opportunity Carrier (SPOC) plate facing each other from opposite sides of the orbiter bay. Sky coverage is arranged through use of a motor driven shaft which rotates each detector 154 degrees backwards and forwards. The field of view of each detector above the orbiter bay is +/- 75 degrees by +/- 15 degrees. DXS will be operated from the Goddard Space Flight Center's (GSFC) Payload Operations Control Center. The DXS will require 50,000 seconds of observing time during a 6-7 day mission. Since it can operate only during orbital night, observations will be made during 60 passes averaging 14 minutes per pass.

Launch Date:	January 1993
Payload:	2 instruments
Orbit:	28.5 degree inclination; 296 km (160 nm) altitude
Duration:	6-7 days
Length:	1.52 m (5 ft)
Weight:	680 kg (1,500 lbs)
Diameter:	1.27 m (4 ft)
Launch Vehicle:	Space Shuttle

Principal Investigator
W. Sanders (University of Wisconsin)

Management
NASA Headquarters
W. Huddleston, Program Manager
L. Kaluzienski, Program Scientist
Goddard Space Flight Center
C. Dunker, Mission Manager
F. Marshall, Mission Scientist
Major Contractor
University of Wisconsin



Diffuse X-ray Spectrometer

Diffuse X-ray Spectrometer (DXS) (Continued)

Mission Events

Instrument functional testing: Ongoing
DXS delivery to KSC: July 1992
Instrument integration: TBD

Status

DXS is currently under final test and integration phases in preparation for a January 1993 launch. Delivery of the instrument to Kennedy Space Center is expected to occur by July 1992.

Discovery Program

Objectives

The objectives of the Discovery Program are: 1) to increase the flight rate to fill the data gaps between larger missions; 2) complement current and planned Flagship and Intermediate/Moderate Profile Missions; 3) increase university and industry participation in the Solar System Exploration Division program; 4) provide opportunities for conducting collaborative ventures with other agencies, domestic and foreign; 5) allow for rapid responses to new emerging science opportunities; 6) give increased opportunities to young researchers; and 7) give young scientists and engineers the opportunity to be involved in program management from start to finish.

Description

The Discovery Program is a proposed new initiative for low-cost planetary missions. Mission costs are to be minimized by emphasizing focused science return achieved with mature instrument and spacecraft technology, and the spacecraft, science payload, and mission designs are to be kept as simple as possible. Only flight-proven launch vehicles will be used, and none shall be larger than a Delta II. Projects will identify back-up mission opportunities within 12 months of the primary launch date.

The primary science goal of the first Discovery mission, the Near Earth Asteroid Rendezvous (NEAR) mission, is to characterize the physical and geological properties of Near Earth Objects (NEOs), and, if possible, infer their chemical and mineralogical make-up. Measurement objectives include determination of bulk properties such as size, volume, mass, gravity field, and spin state; surface properties, such as geochemical composition, morphology, and texture; internal properties, such as mass distribution and magnetic field; and environmental characteristics, such as gas, dust, and interactions with the solar wind. On average, there will be about one target opportunity each year. The duration of a typical rendezvous mission(to Anteros) would be 3 years; up to 2 years in transit and 1 year in close proximity. Flybys would achieve only a fraction of the measurement objectives, but flybys enroute to rendezvous are important and would provide observations of diverse objects.

Other potential Discovery Program missions include the following: 1) Multiple Comet Flybys to examine the diversity of cometary objects and evolutionary states; 2) Earth-orbiting Planetary Telescope, a visible/Ultraviolet telescope in orbit to examine the interaction and evolution of planetary atmospheres and magnetospheres, with an initial focus on the Jovian system; 3) Earth-orbiting Cometary Composition Telescope to examine variations in cometary compositions and temporal variations in out-gassed volatiles and dust; 4) Venus Atmospheric Probe to examine abundances and vertical profiles of gases and particles in the lower Venusian atmosphere; 5) Mars Aeronomy Orbiter to examine chemistry, dynamics, and composition of the upper atmosphere, ionosphere, and magnetosphere of Mars; and 6) Phobos/Deimos Probe to examine the composition of these Martian moons in order to relate them to NEOs and cometary nuclei.

Candidate Instruments for NEAR

CCD Imager (CI)
Gamma-Ray Spectrometer (GRS)
Radiometer
Infrared Spectral Mapper (ISM)
X-ray Spectrometer
Laser Altimeter (LA)
Magnetometer (MAG)
Dust Collection Device (DCD)

Discovery Program (Continued)

Management

NASA Headquarters
C. Pilcher, Chief, Advanced Studies Branch
J. Rahe, Program Scientist
Center Assignment
TBD

Status

Reactivation of studies awaits center assignment. The Discovery Program is included in the OSSA Strategic Plan for a proposed fiscal year 1996 New Start.

Earth Observing System (EOS)

Objective

The Earth Observing System (EOS) will be a science and observation program that will provide long-term (15-year) data sets for Earth system science in order to gain an understanding of the interactions between Earth's land, atmosphere, oceans, and life. Areas of study will include the global hydrological cycle, global biogeochemical cycle, and global climate processes with a focus on greenhouse gases and the role of clouds. EOS will provide for the interdisciplinary evaluation of EOS data. This includes the funding of interdisciplinary science team grants, Principal Investigator research grants, and post-graduate fellowships. To process the data from EOS, the program will include development of a comprehensive Earth Observing System Data and Information System (EOSDIS), designed to maximize the Earth science research community's access to, and processing of, the necessary measurements through an open data policy. Each EOS spacecraft will consist of an integrated platform and instrument payload complement. In addition, instruments may be flown on spacecraft provided by the European Space Agency (ESA) and Japan.

Description

The EOS program consists of four primary components:

The EOS science program began in FY 1991, building on and complementing Earth science research efforts of NASA, other U.S. research agencies and their international counterparts. Existing satellite data are being used to determine the requirements for the instruments, spacecraft, and Data System. The science program will focus on defining the state of the Earth system, understanding its basic processes, and developing and applying predictive models of those processes. EOSDIS will provide computing and network facilities to support these EOS research activities, including data interpretation and modeling; processing, distribution and archiving of EOS data; and command and control of the spacecraft and instruments. Through the Version 0 (prototype) system and subsequent activities, EOSDIS will also provide access to current and upcoming Earth science data sets, and is eventually expected to serve as the NASA Earth Science and Applications data system. EOSDIS will be developed in an evolutionary manner, with extensive input from and testing by the research community and will be on-line and tested prior to the launch of the first EOS spacecraft. After the first launch, the system will continue to evolve in response to scientific research needs.

The EOS instruments will make long-term measurements of the Earth's land, biosphere, atmosphere and oceans. The EOS instruments, and their supporting science teams, were selected through an Announcement of Opportunity in February 1989. This diverse set of instruments includes spectrometers, sounders, radiometers, altimeters and lasers. The EOS spacecraft will provide for flight of these instruments in both sun-synchronous, polar orbits (for global coverage) and inclined orbits (for particular aspects of global change). The program will include intermediate and small spacecraft each flying a suite of instruments.

Earth Observing System (EOS) (Continued)

Description (Continued)

	EOS-AM	EOS-PM	EOS-COLOR
Launch Date:	June 1998	2000	1998
Payload:	5 Instruments	6 Instruments	Data Purchase
Orbit:	705 km (381 nm)	705 km (381 nm)	TBD
Design Life:	5 years	5 years	5 years
Length/Diameter:	TBD	TBD	TBD
Weight:	5,448 kg (12,000 lbs)	5,584 kg (12,300 lbs)	236 kg (520 lbs)
Launch Vehicle:	Atlas IIAS-Class	Atlas IIAS-Class	Pegasus-Class
International Participation:	Japan, Canada	ESA, EUMETSAT	None

	EOS-AERO	EOS-ALT	EOS-CHEM
Launch Date:	2000	2002	2002
Payload:	1 Instrument	3 Instruments	4 Instruments
Orbit:	57 degree inclination	TBD	Polar
Design Life:	3 years	5 years	5 years
Length/Diameter:	TBD	TBD	TBD
Weight:	250 kg (550 lbs)	2,724 (6,000 lbs)	5,448 (12,000 lbs)
Launch Vehicle:	Pegasus-Class	Delta II-Class	Atlas IIAS-Class
International Participation:	None	None	United Kingdom

Candidate Instruments/Investigations/Principal Investigators

Altimeter (ALT) - L. Lueng Fu (Jet Propulsion Laboratory)
Atmospheric Infrared Sounder/Advanced Microwave Sounding Units/Microwave Humidity Sounder (AIRS/AMSU-A/MHS) - M. Chahine (Jet Propulsion Laboratory)
Active Cavity Radiometer Irradiance Monitor (ACRIM) - R. Willson (Jet Propulsion Laboratory)[A]
Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) - H. Tsu (Geological Survey of Japan)
Clouds and the Earth's Radiant Energy System (CERES) - B. Barkstrom (LaRC)
Earth Observing Scanner Polarimeter (EOSP) - L. Travis (Goddard Institute for Space Studies)
Global Positioning System (GPS) Geoscience Instrument (GGI) - W. Melbourne (Jet Propulsion Laboratory)
Geoscience Laser Ranging System (GLRS) - R. Schutz (University of Texas-Austin)[B]
High-Resolution Dynamics Limb Sounder (HiRDLS) - J. Gille (National Center for Atmospheric Research), - J. Barnett (Oxford University - UK)
High-Resolution Imaging Spectrometer (HIRIS) - A. Goetz (University of Colorado)
Laser Atmospheric Wind Sounder (LAWS) - W. Baker (NOAA)[A]
Multi-Angle Imaging Spectro-Radiometer (MISR) - D. Diner (Jet Propulsion Laboratory)
Microwave Limb Sounder (MLS) - J. Waters (Jet Propulsion Laboratory)[A,B]
Moderate-Resolution Imaging Spectrometer (MODIS-N) - V. Salomonson (GSFC)
Measurements of Pollution in the Troposphere (MOPITT) - J. Drummond (University of Toronto - Canada)
Multifrequency Imaging Microwave Radiometer (MIMR) - TBD (European Space Agency)
Spectroscopy of the Atmosphere Using Far Infrared Emission (SAFIRE) - J. Russell III (LaRC)[A,B]
Sea Wide-Field Viewing Sensor (SeaWiFS) - TBD

Earth Observing System (EOS) (Continued)

Candidate Instruments/Investigations/Principal Investigators (Continued)

Solar Stellar Irradiance Comparison Experiment (SOLSTICE) - G. Rottman (University of Colorado)[A]
Stratospheric Aerosol and Gas Experiment (SAGE III) - M. McCormick (LaRC)
Stick Scatterometer (STIKSCAT) - M. Freilich (Jet Propulsion Laboratory)
Tropospheric Emission Spectrometer (TES) - R. Beer (Jet Propulsion Laboratory)

[A] Flight of Opportunity [B] Descoped

Mission Events

Phase A: June 1983 - October 1988
Instrument Announcement of Opportunity: January 1988 - March 1989
Phase B: October 1988 - September 1990
EOSDIS Core System RFP Release: July 1991
EOS Restructuring: August-December 1991
Award EOSDIS Phase C/D contract: Late 1992
EOS-AM1 Observatory Preliminary Design Review: 3rd Quarter 1993
Follow-on Spacecraft Selection: 1st Quarter 1994
EOSDIS Version 0 (Prototype) Demonstration: 3rd Quarter 1994
EOS-AM1 Observatory Critical Design Review: 2nd Quarter 1995
EOSDIS Version 1 On-line: 4th Quarter 1996
EOS-AM1 Launch Readiness: Mid-1998

Management

NASA Headquarters
R. Roberts, Program Director
A.Tuyahov, Deputy Program Director
R. Felice, EOS Program Integration and Assessment Manager
TBD, Program Scientist
D. Butler, EOSDIS Program Manager
Goddard Space Flight Center
J. Madden, Project Manager
J. Dozier, Project Scientist
C. Scolese, EOS Observatory Project Manager
M. Donohoe, EOS Instruments Project Manager
T. Taylor, EOSDIS Project Manager
Major Contractor
General Electric for EOS-AM1 Spacecraft

Status

EOS was approved for a new start as part of NASA's fiscal year 1991 budget. Instruments for flight on the first EOS-A series spacecraft were confirmed in January 1991, as were the 29 Interdisciplinary Investigations. Progress continued during 1991 on the EOS spacecraft and on the instrument procurement process. During the summer, a changing fiscal environment led NASA to begin restructuring the EOS program. Many of the critical issues involved in the program were discussed by the EOS Engineering Review Committee, which met twice and submitted its report in September 1991.

Earth Observing System (EOS) (Continued)

Status (Continued)

Between August and December 1991, NASA initiated a restructuring of the program. The restructuring was undertaken 1) to make the program more flexible to reduced levels of funding expected from the Congress; 2) to take advantage of new launch opportunities for the EOS spacecraft (including the Atlas IIAS); and 3) to provide the EOS program with greater robustness in the face of external changes. The restructured program was approved by the NASA Administrator in December 1991. The new program substantially alters the implementation plan for the program, including deselection of several science and instrument teams. Instruments planned for flight on the first spacecraft (EOS-AM1) are being developed to support a June 1998 launch readiness. Others are in various stages of the procurement process. The restructured program will use intermediate and small spacecraft to accommodate the selected instruments. Spacecraft configurations for flights following EOS-AM1 will be solicited through a competitive process beginning in 1992.

The restructured program includes flights to investigate the key aspects of global climate change:

EOS-AM1:	Clouds, aerosols, radiative balance and characterization of terrestrial surface (CERES, MODIS-N, MISR, ASTER, MOPITT)
EOS-PM1:	Clouds, precipitation, and radiative balance; terrestrial snow and sea ice; sea surface temperature and ocean productivity (CERES, MODIS-N, AIRS, AMSU-A, MHS, MIMR)
EOS-COLOR:	Oceanic biomass and productivity (continues measurements of ocean color by SeaWiFS)
EOS-AERO:	Atmospheric aerosols (SAGE III)
EOS-ALT:	Altimetry flight to study ocean circulation and ice sheet mass balance (ALT, GGI, GLRS-A)
EOS-CHEM:	Atmospheric chemical species and their transformations and ocean surface stress (HiRDLS, TES, SAGE III, STIKSCAT)

Progress continued on the EOS Data and Information System (EOSDIS), though it was also reconfigured to support the flight of a smaller complement of instruments in the period before 2000. Development of the EOSDIS Version 0 (prototype) system continued in support of a 1994 date for on-line capability. The Request for Proposal for the EOSDIS Core System was released in July 1991. A Source Evaluation Board is currently reviewing these responses; a selection is expected in mid-1992 and a final contract by November 1992. This schedule supports on-line capability for the Core System by 1996.

Earth Probes

Objective

The Earth Probes program is composed of a series of small- and moderate-sized missions that will address highly focused problems in Earth science. This Explorer-class program will provide a start/continuation of long-term global change data sets prior to the launch of the Earth Observing System (EOS). Each free flyer/instrument has a specific purpose, providing critical measurements of particular phenomenon but requiring a unique orbit or configuration not available from EOS or other Earth Science missions.

Description

The Total Ozone Mapping Spectrometer (TOMS) measures total ozone concentrations. Information gathered on atmospheric composition will continue the long-term data set being gathered by the TOMS instrument on Nimbus-7 (1978-present). A second TOMS instrument, on a Soviet Meteor-3 spacecraft, was launched on August 15, 1991. These data will allow time series evaluations to establish trends, with the goal of studying the question of global and regional changes in the ozone. Ancillary data products will reveal lower stratosphere/tropopause dynamics and allow detection of sulfur dioxide clouds resulting from major volcanic eruptions. TOMS serves as a precursor to NOAA instrumentation in the EOS timeframe.

	Earth Probe 93 (EP 93)	ADEOS
Launch Date:	December 1993	February 1995
Payload:	1 instrument	1 instrument
Orbit:	900 km (486 nm), polar	796 km (430 nm), polar
Design Life:	3 years	3 years
Satellite Bus:	EP93	ADEOS (Japan)
Weight:	30 kg (66 lbs)	30 kg (66 lbs)
Dimensions:	15 x 30 x 27 cm (6 x 12 x 11 inches)	15 x 30 x 27 cm (6 x 12 x 11 inches)
Launch Vehicle:	Pegasus	H-II (Japan)
International Participation:	None	Japan

NASA Scatterometer (NSCAT) will measure ocean surface wind velocity and provide data on air-sea interactions. NSCAT measurements will allow, for the first time, calculation of large-scale fluxes of momentum, heat, and moisture between the atmosphere and ocean; thereby, contributing essential information to studies on air-sea coupling and interannual variability of the Earth's climate. This instrument has been selected for flight on the Japanese Advanced Earth Observing Satellite (ADEOS) in 1995.

Launch Date:	February 1995
Payload:	1 instrument
Orbit:	98.6 degrees inclination; 796 km (430 nm) altitude, nominally circular, (sun-synchronous)
Design Life:	3 years
Satellite Bus:	ADEOS (Japan)
Weight:	237 kg (523 lbs) (excluding antenna deployment hardware)
Dimensions:	50 x 47 x 55 cm (20 x 19 x 22 inches)
Launch Vehicle:	H-II (Japan)
International Participation:	Japan

Earth Probes (Continued)

Description (Continued)

<u>Tropical Rainfall Measuring Mission (TRMM)</u> will measure diurnal variation of precipitation and evaporation in the tropics, providing an increased understanding of how substantial rainfall affects global climate patterns. The goal of this mission is to obtain a minimum of 3 years of climatologically significant observations of rainfall in the tropics, and, in tandem with cloud models, to provide accurate estimates of the vertical distributions of latent heating in the atmosphere. TRMM is a joint venture with the National Space Development Agency of Japan (NASDA).

Launch Date:	1996-1997
Payload:	5 instruments
Orbit:	35 degree inclination; 350 km (189 nm) altitude, circular
Design Life:	3 years
Weight:	3,200 kg (7,040 lbs)
Dimensions	TBD
Launch Vehicle:	H-II (Japan)
International Participation:	Japan

Instruments/Investigations/Principal Investigators

<u>TRMM</u>

Visual Infrared Scanner (VIRS) - TBD
TRMM Microwave Imager (TMI) - TBD
Precipitation Radar (PR) - (NASDA/Communication Research Laboratory)
Clouds and Earth's Radiant Energy System (CERES) - (LaRC)
Lightning Imaging Sensor (LIS) - (MSFC)

Management

NASA Headquarters
L. Jones, Earth Probes Program, NSCAT, TOMS, and TRMM Program Manager
G. Esenwein, TOMS Instruments/Meteor-3 Program Manager
R. Watson, TOMS Program Scientist
W. Patzert, NSCAT Program Scientist
J. Theon, TRMM Program Scientist
R. Kakar, ADEOS Program Scientist
Goddard Space Flight Center
C. Cote, TOMS/Meteor-3 Project Manager
D. Margolies, TOMS Project Manager (EP 93/ADEOS)
J. Hrastar, TRMM Project Manager
A. Krueger, TOMS Instrument Scientist
J. Herman, TOMS Data Scientist
J. Simpson, TRMM Project Scientist
Jet Propulsion Laboratory
F. Naderi, NSCAT Project Manager
T. Liu, NSCAT Project Scientist

Earth Probes (Continued)

Status

TOMS/EP 93

New Start for Earth Probes approved in fiscal year 1991 budget. Instrument under contract in fiscal year 1991. Launch vehicle contract for SELV awarded for Pegasus. Spacecraft contract award was completed in August 1991. The instrument Preliminary Design Review was conducted in August 1991, with Critical Design Review planned for July 1992. Spacecraft Preliminary Design Review was conducted October 1991, and Critical Design Review is planned for March 1992. Delivery of the first flight instrument is expected in early 1993 to support a December 1993 launch.

TOMS/ADEOS

Confirmed for flight aboard Japanese ADEOS in 1990. New Start for Earth Probes approved in fiscal year 1991 budget. TOMS/ADEOS is a common instrument buy with Earth Probe 1993 mission. Preliminary ADEOS interfaces have been defined with the National Space Development Agency of Japan (NASDA). The ADEOS spacecraft Preliminary Design Review was conducted in September 1991. Engineering model delivery expected in November 1992 with flight model delivery in fall 1993. Launch on Japanese H-II scheduled for February 1995.

NSCAT/ADEOS

Confirmed for flight aboard Japanese ADEOS in 1990. New Start for Earth Probes approved in fiscal year 1991 budget. Instrument completed design phase and is currently in flight hardware manufacture. Engineering model delivery is expected in November 1992 and flight model delivery is expected in late 1993. Launch on Japanese H-II is planned for February 1995.

TRMM

Phase A studies completed in May 1988, with Phase B study initiated in September 1989. TRMM new start approved as part of Congressional augmentation to fiscal year 1991 budget. Phase B completed early 1991 and development (Phase C/D) began April 1991. The spacecraft is being built by Goddard Space Flight Center with procured sensors (RFP packages in progress). Letter Agreement signed with NASDA in February 1991. Preliminary Design Review for the spacecraft scheduled for mid-1992, with Critical Design Review in late 1993. Spacecraft integration and testing is scheduled to begin in 1995 to support a mid-1996 to mid-1997 launch readiness. Launch date subject to negotiations with NASDA in 1992.

Explorer Program

Objective

The Explorer Program currently consists of a series of Delta-class missions to address highly focused problems in the disciplines of space physics and astronomy. Explorer missions provide: 1) frequent and rapid access to space; 2) a modestly scaled option for scientific research; 3) hands-on experience for university researchers and students; and 4) opportunities for international collaboration. The Explorer Program will increase flight opportunities by selecting small missions and then constraining cost growth. First, missions that would previously have fallen into the Delta-class Explorer will be redirected to the intermediate missions category where they will be initiated as new starts. Second, two new categories of Explorer will be added to complement the Small Explorer (SMEX) effort: Middle-class Explorers (MIDEX) and University-class Explorers (UNIX).

Description

The X-ray Timing Explorer (XTE) has commenced its design and development phase. It is designed to study temporal variability in compact x-ray emitting objects. It will include a large area Proportional Counter Array (PCA), an All-Sky Monitor (ASM), and High-Energy X-ray Experiment (HEXTE). XTE will be launched on a Delta II expendable launch vehicle (ELV). XTE will have a 6 arcminute pointing accuracy with a 10 degrees per minute slew rate. XTE will be able to observe cosmic x-ray sources and perform spectral-temporal correlations and burst searches to the sub-millisecond level. The PCA will have a collection area of 6,250 square centimeters, covering the energy range from 2 to 60 thousand electron Volts (keV), and an energy resolution of 15 percent at 6 keV. XTE's All-Sky Monitor will provide a full-time monitor for x-ray novae and flares while it compiles an all-sky encyclopedic record of variable x-ray sources.

The Advanced Composition Explorer (ACE) mission will observe particles of solar, interplanetary, interstellar, and galactic origins, spanning the energy range from that of the solar wind (approximately 1 keV/nucleon) to galactic cosmic ray energies (several hundred MeV/nucleon). Studies will also be made of the abundance of essentially all isotopes from hydrogen to zinc, with exploratory isotope studies extending to zirconium. ACE will also monitor the solar wind and provide real-time data to scientists. The ACE study payload includes six high-resolution spectrometers designed to provide a collecting power factor of 10 to 1,000 times greater than previous or planned experiments. The flux dynamic range of these instruments will enable measurements under all solar wind flow conditions and during both large and small solar particle events. Magnetic field, solar wind electrons, and solar flare electrons will also be measured.

The Far Ultraviolet Spectroscopic Explorer (FUSE) mission will conduct high resolution spectroscopy of faint sources at wavelengths from 800 to 1,200 angstroms and moderate resolution spectroscopy down to 100 angstroms. This small region in the far ultraviolet can only be observed with innovative optics. FUSE will measure the amount of cold, warm, and hot plasma in objects ranging from planets to quasars. The instrument elements include a grazing incidence telescope, spectrographs, detectors and supporting subsystems. Science characteristics will include: simultaneous measurement of temperatures ranging from a few thousands to millions of degrees Kelvin; grazing incidence optics (approximately 10 degrees); low and high-dispersion spectroscopy in two key wavelength regimes (100 to 912 angstroms and 912 to 1,200 angstroms); and spectral resolving power near 30,000 and sensitivity of approximately 100 square centimeters for the wavelength range above 912 angstroms. The 64 centimeter aperture telescope has stigmatic imaging, and approximately 1 arcsecond angular resolution.

Explorer Program (Continued)

Description (Continued)

	XTE	ACE	FUSE
Launch Date:	April 1996	August 1997	2000 (under review)
Payload:	3 Instruments	6 major Science Instruments, 3 monitoring instruments	High Resolution Spectrograph
Orbit:	28.5 degree inclination; 500 km (270 nm), circular	Libration Point (L_1), 250 Earth radii toward the Sun	high Earth orbit
Design Life:	2 years	1-3 years	5 years
Length:	5.8 m (19 ft)	2.5 m (8.2 ft)	TBD
Weight:	2,950 kg (6,505 lbs)	650 kg (1,433 lbs)	1,300 kg (2,867 lbs)
Diameter:	1.8 x 1.8 m (6 x 6 ft)	2 m (6.5 ft)	2.1 m (6.9 ft)
Launch Vehicle:	Delta II	Delta II	Delta II
International Participation:	None	Switzerland, FRG	Canada, United Kingdom

Instruments/Investigations/Principal Investigators

XTE

High-Energy X-ray Timing Experiment (HEXTE) - R. Rothchild (University of California-San Diego)
All-Sky Monitor (ASM) - H. Bradt (Massachusetts Institute of Technology)
Proportional Counter Array (PCA) - J. Swank (GSFC)

ACE

Principal Investigator - E. Stone (California Institute of Technology)
Solar Wind Ion Mass Spectrometer (SWIMS) - G. Gloeckler (University of Maryland)
Solar Wind Ion Composition Spectrometer (SWICS) - G. Gloeckler (University of Maryland)
Ultra-low Energy Isotope Spectrometer (ULEIS) - G. Mason (University of Maryland)
Solar Energetic Particle Ionic Charge Analyzer (SEPICA) - E. Mobius (University of New Hampshire)
Solar Isotope Spectrometer (SIS) - R. Mewaldt (California Institute of Technology)
Cosmic Ray Isotope Spectrometer (CRIS) - R. Mewaldt (California Institute of Technology)
Electron, Proton, and Alpha-particle Monitor (EPAM) - T. Krimingus (Applied Physics Laboratory)
Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM) - D. McComas (Los Alamos National Laboratory)

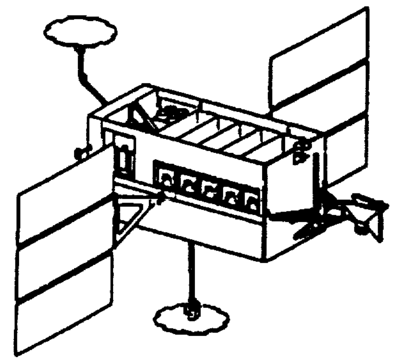
FUSE

High Resolution Spectrograph (HRS) - W. Moos (Johns Hopkins University)

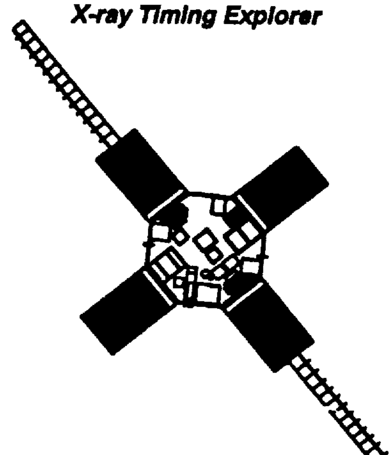
Explorer Program (Continued)

Mission Events

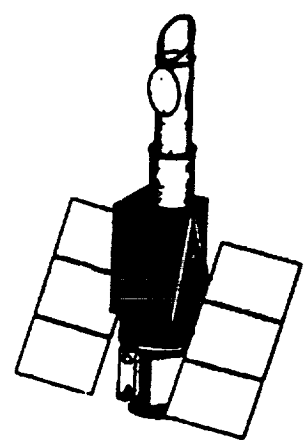
Explorer Program rebaselined to ELV's: Spring 1991
XTE Instrument Phase C/D start: October 1989
XTE Spacecraft System Concept Review: December 1991
XTE Preliminary Design Review: December 1992
XTE Launch: April 1996
ACE Phase B Study start: May 1991
ACE Phase C/D start - July 1993
ACE launch: August 1997
FUSE Phase A completed: July 1989
FUSE Spectrograph impartial review: July 1990
FUSE Phase C/D start: Fiscal Year 1994
FUSE Launch: 2000 (under review)



X-ray Timing Explorer



Advanced Composition Explorer



Far Ultraviolet Spectroscopic Explorer

Management

NASA Headquarters
J. Lintott, XTE Program Manager
L. Kaluzienski, XTE Program Scientist
G. Newton, ACE Program Manager (Acting)
V. Jones, ACE Program Scientist
G. Newton, FUSE Program Manager (Acting)
R. Stachnik, FUSE Program Scientist

Goddard Space Flight Center
D. Schulz, XTE Project Manager
J. Swank, XTE Project Scientist
E. Thomas, ACE Project Manager
J. Ormes, ACE Project Scientist
G. Anikis, FUSE Project Manager
G. Sonneborn, FUSE Project Scientist

Major Contractors
University of California-San Diego (XTE)
Massachusetts Institute of Technology (XTE)
California Institute of Technology (ACE)
Johns Hopkins University/Applied Physics Laboratory (ACE)
Johns Hopkins University (FUSE)
Ball Aerospace Corporation (FUSE)
University of Colorado (FUSE)
University of California-Berkeley (FUSE)

Status

The Explorer missions were rebaselined as dedicated spacecraft with expendable launch vehicles in spring 1991. XTE entered Phase C/D during October 1989 and its instruments are currently under development. ACE began Phase B study in May 1991. FUSE completed Phase A study in 1989 and is currently undergoing a Phase B study. The instrument program will be managed by Johns Hopkins University under contract with GSFC.

Extreme Ultraviolet Explorer (EUVE)

Objective

The objectives of the Extreme Ultraviolet Explorer are: 1) to produce a highly sensitive survey of the sky in the 70 to 760 angstroms range; 2) to survey a portion of the sky with extremely high sensitivity; 3) to perform follow-up spectroscopic observations on bright extreme ultraviolet point sources; 4) to study stellar evolution and the local stellar population; 5) to perform spectral emission physics; 6) to investigate energy transport in stellar atmospheres; and 7) to study ionization and opacity of the interstellar medium.

Description

The Extreme Ultraviolet Explorer (EUVE) consists of four grazing incidence, EUV-sensitive telescopes and a variety of optical filters housed on an Explorer Platform. Three of the telescopes are co-aligned scanning telescopes, and one is a deep survey and spectroscopic telescope which is aligned perpendicular to the others. Approximately 95 percent of the sky will be mapped in 0.1 degree increments for the all-sky survey. The deep survey will scan a region 2 degrees wide by 180 degrees long along the ecliptic, again in 0.1 degree increments. After a 6-month survey, EUVE will carry out spectroscopic observations of bright sources. The primary responsibility for this science payload resides with the University of California at Berkeley.

Launch Date:	May 1992
Payload:	4 telescopes
Orbit:	28.5 degree inclination; 528 km (979 nm) altitude, circular
Design Life:	19 months
Length:	4.5 m (15 ft)
Weight:	3,280 kg (7,233 lbs) (observatory)
Diameter:	3 m (10 ft)
Launch Vehicle:	Delta II

Principal Investigators

Science Principal Investigator - S. Bowyer (University of California-Berkeley)
Instrument Principal Investigator - R. Malina (University of California-Berkeley)

Mission Events

Mission Preliminary Design Review: June 1988
Mission Critical Design Review: June 1989
Instrument Delivery to GSFC: February 1990
Observatory Integration and Testing complete: January 1992

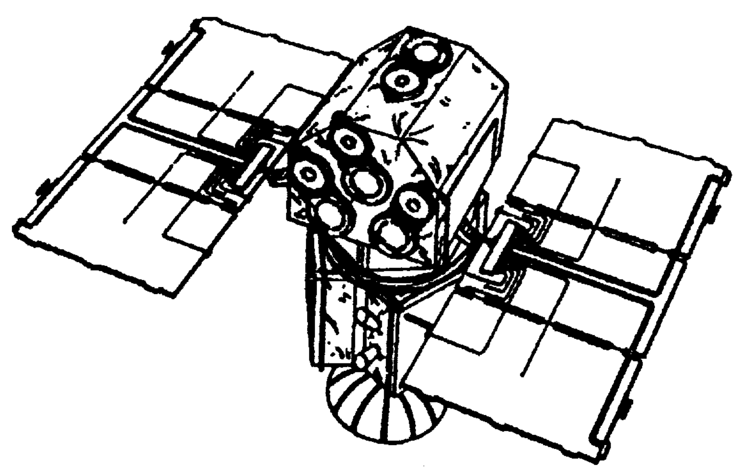
Extreme Ultraviolet Explorer (EUVE) (Continued)

Management

NASA Headquarters
J. Lintott, Program Manager
R. Stachnik, Program Scientist
Goddard Space Flight Center
F. Volpe, Project Manager
Y. Kondo, Project Scientist
Major Contractors
University of California-Berkeley
Fairchild Space Company
General Electric Company
McDonnell Douglas Astronautics Company

Status

Integration and testing of the EUVE observatory is being completed following mating of the payload module and the Explorer Platform spacecraft bus. EUVE is scheduled to be launched from Cape Canaveral Air Force Station, Florida in May 1992.



Extreme Ultraviolet Explorer

Geostationary Operational Environmental Satellites (GOES I-M)

Objective

The Geostationary Operational Environmental Satellites (GOES) will: 1) provide continuous environmental observations of cloud cover, atmospheric temperatures and moisture profiles; 2) provide severe storm warnings; 3) conduct search and rescue operations; 4) conduct remote platform investigations; and 5) conduct space environment monitoring.

Description

Under a 1973 Basic Agreement between NASA and the National Oceanic and Atmospheric Administration (NOAA), NOAA establishes the observational requirements for both the polar and geostationary weather satellites. Acting as NOAA's agent, NASA procures the spacecraft and instruments required to meet NOAA's objectives, and provides for their launch. NASA also conducts an on-orbit checkout before transferring the satellites to NOAA for routine operations. The requirement to replace spacecraft on an as-needed basis is determined by NOAA.

Launch Dates:	1993-2004
Payload:	Weather Satellite
Orbit:	Geostationary
Design Life:	5 years
Length:	2.6 m (9 ft)
Weight:	980 kg (2,160 lbs)
Diameter:	2.6 m (9 ft)
Launch Vehicle:	Atlas-I

Instruments/Investigations/Principal Investigators

GOES 1-7

Visible Infrared Spin-Scan Radiometer (VISSR) Atmospheric Sounder (VAS) - (Hughes/Santa Barbara Research Corporation)

Space Environment Monitor (SEM) - (Ball Aerospace/Panametrics)

Search and Rescue Transponder - (Ford Aerospace)

GOES I-M

GOES Imager - (International Telephone and Telegraph)

GOES Sounder - (International Telephone and Telegraph)

Space Environment Monitor (SEM) - (Schonstedt and Panametrics)

Search and Rescue Transponder - (Space Systems/Loral)

Data Collection System - (Space Systems/Loral)

Spacecraft - (Space Systems/Loral)

Geostationary Operational Environmental Satellites (GOES I-M) (Continued)

Mission Events
GOES-6 launched April 1983; failed January 1989
GOES-7 launched February 1987; Operational
Spacecraft Preliminary Design Review: March 1987
Spacecraft Critical Design Review: February 1988
Instrument Deliveries: March 1993
Ship Spacecraft: October 1993
GOES-I Launch: December 1993
GOES-J Launch: December 1994
GOES-K Launch: Late 1998
GOES-L Launch: Late 1999
GOES-M Launch: Late 2003

Management
NASA Headquarters
J. Greaves, Program Manager
Goddard Space Flight Center
R. Obenschain, Project Manager
Major Contractors
Space Systems/Loral
International Telephone and Telegraph

Status
GOES is an operational satellite system and a reimbursable program funded by NOAA. Instrument and spacecraft testing for GOES-I are underway in support of a late 1993 launch. After significant review of program progress, NOAA decided to continue development of the GOES instruments until they were able to meet performance specifications. Based on these requirements, NASA submitted a revised program plan in October 1991 to support the launch of GOES-I in late 1993.

Global Geospace Science (GGS) Program: Polar Mission

Objective
The objectives of the Polar Mission of the Global Geoscience (GGS) Program are: 1) to characterize the energy input to the ionosphere; 2) to determine the role of the ionosphere in substorm phenomena and in the overall magnetosphere energy balance; 3) to measure complete plasma, energetic particles, and fields in the high latitude polar regions, energy input through the dayside cusp; 4) to provide global multispectral auroral images of the footprint of the magnetospheric energy disposition into the ionosphere and upper atmosphere; and 5) to determine characteristics of ionospheric plasma outflow.

Description
The Polar Mission features a spin-stabilized NASA spacecraft characterizing polar ionospheric region energy input with a full range of plasma physics fields and particles in situ and remote sensing instrumentation.

Launch Date:	May 1994
Payload:	11 auroral imaging and plasma physics instruments
Orbit:	1.8 x 9 Earth radii polar orbit
Design Life:	3 years
Length:	2.0 m (7 ft)
Weight:	1,200 kg (2,640 lbs)
Diameter:	2.8 m (9 ft)
Launch Vehicle:	Delta II
International Participation:	Approximately 25 percent of instruments supplied through international Co-Investigators

Instruments/Investigations/Principal Investigators
Charge and Mass Magnetospheric Ion Composition Experiment (CAMMICE) - T. Fritz (Los Alamos National Laboratory)
Comprehensive Energetic Particle Pitch Angle Distribution (CEPADD) - B. Blake (Aerospace Corporation)
Electric Fields Instrument (EFI) - F. Mozer (University of California-Berkeley)
Fast Plasma Analyzer (HYDRA) - J. Scudder (GSFC)
Magnetic Fields Experiment (MFE) - C. Russell (University of California-Los Angeles)
Plasma Wave Instrument (PWI) - D. Gurnett (University of Iowa)
Polar Ionospheric X-ray Imaging Experiment (PIXIE) - W. Imhoff (Lockheed Palo Alto Research Laboratory)
Thermal Ion Dynamics Experiment (TIDE) - C. Chappell (MSFC)
Toroidal Ion Mass Spectrograph (TIMAS) - E. Shelley (Lockheed Palo Alto Research Laboratory)
Ultraviolet Imager (UVI) - M. Torr (MSFC)
Visible Imaging System (VIS) - L. Frank (University of Iowa)

Mission Events
Announcement of Opportunity release: October 1979
Confirmation of investigations: December 1988
Instrument Critical Design Review: April 1990
Spacecraft Critical Design Review: May 1991
Deliver instruments: Late 1992
Spacecraft assembly: February 1993

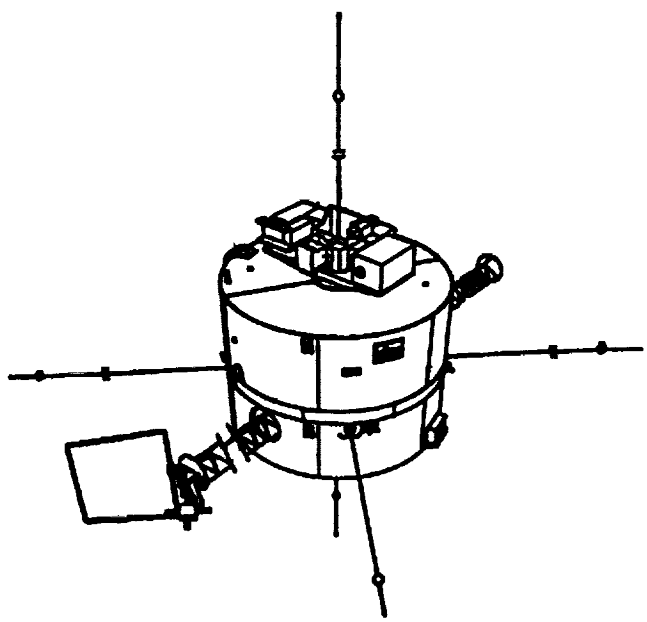
Global Geospace Science (GGS) Program: Polar Mission (Continued)

Management

NASA Headquarters
M. Calabrese, Program Manager
E. Whipple, Program Scientist
Goddard Space Flight Center
J. Hraster, Project Manager
M. Acuna, Project Scientist
Major Contractor
General Electric's AstroSpace Division

Status

Spacecraft components in fabrication for assembly and integration with instruments in 1992.



Global Geospace Science Program: Polar Mission

Global Geospace Science (GGS) Program: Wind Mission

Objective

The Wind Mission will determine solar wind input properties including plasma waves, energetic particles, electric, and electric and magnetic fields for magnetospheric and ionospheric studies in the Global Geospace Science (GGS) Program.

Description

The Wind Mission features a spin-stabilized NASA spacecraft located at dayside double lunar swingby and Sun-Earth (L_1) Lagrangian point orbits to characterize solar wind input with a full range of plasma physics fields and particles instrumentation.

Launch Date:	August 1993
Payload:	Plasma Physics Instrumentation
Orbit:	Lunar swingby, 250 Earth radii apogee followed by 3 x 10^5 km radius halo orbit at the L_1 libration
Design Life:	3 years
Length:	2.0 m (7 ft)
Weight:	1,200 kg (2,640 lbs)
Diameter:	2.8 m (9 ft)
Launch Vehicle:	Delta II
International Participation:	Approximately 25 percent of instruments supplied through international Co-Investigators

Instruments/Investigations/Principal Investigators

Energetic Particles Acceleration Composition Transport (EPACT) - T. Von Rosenvinge (GSFC)
Energetic Particles and 3-D Plasma Analyzer (3-D PLASMA) - R. Lin (University of California-Berkeley)
Magnetic Fields Investigation (MFI) - R. Lepping (GSFC)
Radio/Plasma Wave Experiment (WAVES) - J. Bougeret (Meudon Observatory - France)
Solar Wind and Suprathermal Ion Composition Studies (SMS) - G. Gloekler (University of Maryland)
Solar Wind Experiment (SWE) - K. Ogilvie (GSFC)
Soviet Gamma Ray Spectrometer (KONUS) - E. Mazets (Ioffe Institute - Russia)
Transient Gamma Ray Spectrometer (TGRS) - B. Teegarden (GSFC)

Mission Events

Announcement of Opportunity released: October 1979
Confirmation of investigations: December 1988
Instrument Critical Design Review: April 1990
Spacecraft Critical Design Review: May 1991
Deliver Instruments: March 1992
Structural assembly: July 1992

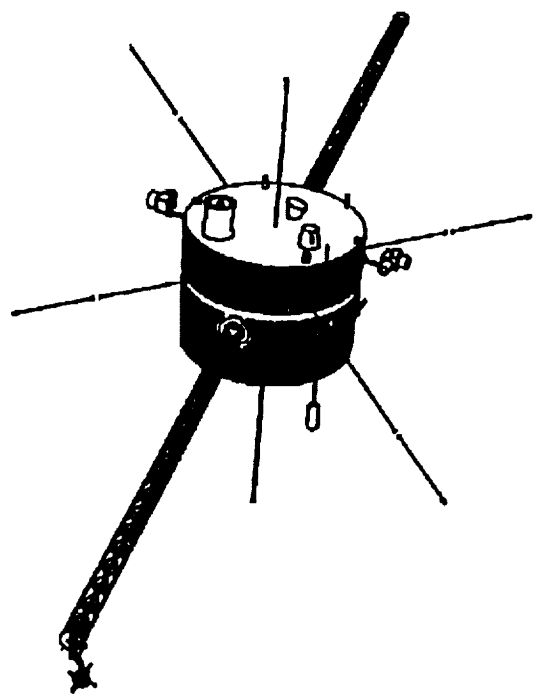
Global Geospace Science (GGS) Program: Wind Mission (Continued)

Management

NASA Headquarters
M. Calabrese, Program Manager
E. Whipple, Program Scientist
Goddard Space Flight Center
J. Hraster, Project Manager
M. Acuna, Project Scientist
Major Contractor
General Electric's AstroSpace Division

Status

Spacecraft components in fabrication for assembly and integration with instruments in 1992.



Global Geospace Science Program: Wind Mission

Grand Tour Cluster (GTC)

Objectives

The objectives of the Grand Tour Cluster (GTC) mission are: 1) to determine the nature and 3-dimensional (3D) structure of the key magnetospheric plasma boundary regions; 2) measure the physically relevant properties of magnetic reconnection in each of the regimes where it is thought to occur; 3) identify and characterize the processes which accelerate plasma particles to high energies in different locations and magnetic geometries; 4) characterize the small-scale spatial and temporal properties of plasma waves and turbulence, and their role in plasma transport; and 5) study the stability and dynamics of plasma structures on both microscale and mesoscale. GTC will, for the first time, measure 3D fields and particle distributions and their temporal variations and 3D spatial gradients, with high resolution, while dwelling in the key magnetospheric boundary regions from the subsolar magnetopause to the distant tail. It will uniquely separate spatial and temporal variations over scale lengths appropriate to the processes being studied — down to the kinetic regime beyond the approximations of magneto-hydrodynamics (MHD).

Description

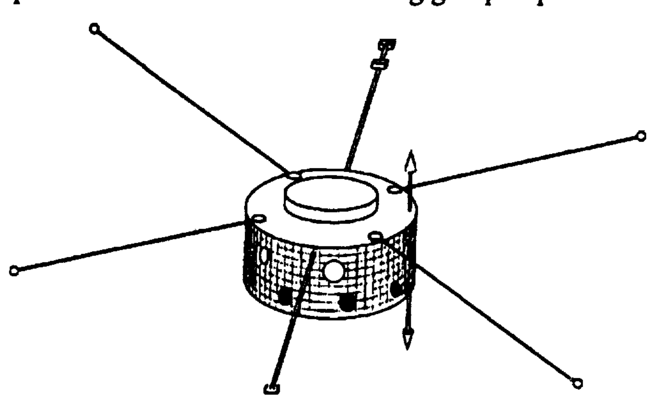
GTC consists of four identical spinning spacecraft, flying in a tetrahedral configuration. Each spacecraft will contain an identical set of 3-dimensional instruments with high angular and temporal resolution (plasma electron and ion composition, energetic electron and ion composition, magnometer, electric fields and waves). Interspacecraft Very High Frequency (VHF) ranging will determine spacecraft spacing to 1 percent, and allow trigger mode burst high rate data recording on all spacecraft for maximum resolution of boundaries or events. The weight of each spacecraft will be 663 kilograms (1,459 pounds) dry and 1,120 kilograms (2,464 pounds) wet.

<u>Orbit and Duration of Each Phase</u>

Phase 1:	1.2 x 12 Re ($\leq$ 10 degree inclination)	1.5 Years
Phase 2:	1.2 x 30 Re ($\leq$ 10 degree inclination)	0.5 Years
Phase 3:	8 x 235 Re (Double Lunar Swingby)	1.0 Years
Phase 4:	10 x 10 Re (90 degree inclination)	0.5 Years

Status

Pre-phase A study completed. Science definition working group in place and operational.



Grand Tour Cluster Mission

Gravity Probe B (GP-B)

Objective

Gravity Probe B will test predictions of Einstein's general theory of relativity. Mission objectives will include: 1) measurement of Einstein-Schiff frame-dragging effect to precision between 0.1 and 1 percent; 2) measurement of geodetic effect (Fermi-Walker transport) to precision between 1 part in 1,000 and 1 part in 100,000; 3) recheck to 1 percent of Einstein starlight deflection effect; 4) check of parameters in nonmetric theories of gravitation by use of gyro as precision clock and as part of the Geodesy co-experiment; and 5) to determine from precision orbit tracking data Earth harmonics to order 60 x 60, producing a two order of magnitude improvement in Earth model up to order 30 x 30 and significant improvements for higher orders.

Description

Gravity Probe B will provide novel, high precision tests of Einstein's general theory of relativity as well as a geodesy co-experiment. This free-flyer, launched on Delta II, will follow a Shuttle engineering test (Shuttle Test of Relativity Experiment – STORE) of the science instrument. It will be a symmetric spacecraft that will roll about the line of sight to the guide star with a 10 minute period. The gyro spin axis will be compared to the guide star by observations with the reference telescope and the gyro spin axis will be measured to 0.1 milliarcsecond by means of superconducting readout of the gyro's magnetic "London moment." The optically contacted reference telescope will also have 0.1 milliarcsecond precision and be cooled with the superfluid helium at 1.8 degrees Kelvin (K) held in a 1,580 liter dewar which is planned to have a 2-year lifetime. The four electrically suspended and also cryogenically cooled spherical gyroscopes (38 millimeter diameter) will spin at 170 Hertz and operate at a pressure of 10^{-11} torr. A drag-compensation system will reduce the mean gyro acceleration to below 10^{-10}g. In order to achieve the desired objectives, extensive in-flight verification tests will need to be performed.

Launch Date:	1999 (under review)
Payload:	GP-B
Orbit:	926 km (500 nm), polar, circular
Design Life:	2 years
Length:	3.5 m (11 ft)
Weight:	2,500 kg (5,572 lbs)
Diameter:	1 m (3 ft)
Launch Vehicle:	Delta II

Principal Investigator

C. Everitt (Stanford University)

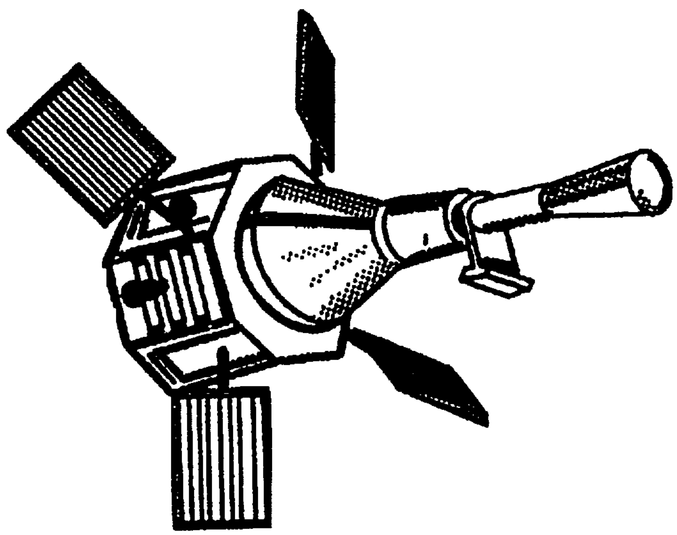
Management

NASA Headquarters
D. Gilman, Program Manager
R. Stachnik, Program Scientist
Marshall Space Flight Center
R. Ise, Project Manager
R. Decker, Project Scientist
Major Contractors
Stanford University
Lockheed
Fairchild Space

Gravity Probe B (GP-B) (Continued)

Status

Gravity Probe-B is currently funded through the development of the Shuttle Test of Relativity Experiment (STORE) and its related technology, ground test, and systems studies program. One working prototype of the instrument probe has been developed and tested, and the qualification model is expected to be delivered in mid-1992. Design work is ongoing for STORE, and the Critical Design Review of the STORE instrument is planned for the first half of 1992. On January 29, 1992, NASA announced the planned cancellation of STORE.



Gravity Probe B

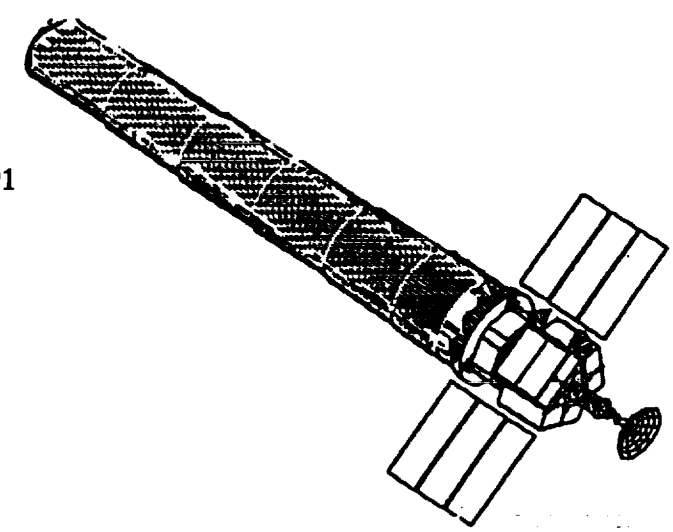
High Energy Solar Physics (HESP)

Objective
The High Energy Solar Physics (HESP) mission will: 1) study solar flares with the goal of providing an understanding of the impulsive release of energy, efficient acceleration of particles to high energies, and the rapid transport of energy in fundamental cosmic processes; 2) conduct the first gamma-ray and neutron imaging of solar flares; and 3) perform simultaneous imaging spectroscopy in x-rays, gamma rays, and neutrons.

Description
A strawman concept for the HESP spacecraft calls for it to rotate about the Sun-Earth line at 15 revolutions per minute to allow modulation collimator imaging of high energy solar sources. Three subsystem modules might surround the main telescope-detector. A pair of grids, one attached to the tip of a 5-meter fixed boom, the other immediately in front of the detector, could provide Fourier components of the images of flares. Mechanical coolers would be used for hyperpure (n-type) Germanium detectors.

Launch Date:	Under review
Payload:	Imaging system in front of spectral detector
Orbit:	600 km (324 nm), polar, sun-synchronous
Design Life:	> 3 years
Length:	6 m (20 ft)
Weight:	2300 kg (5,060 lbs)
Diameter:	2 m (7 ft)
Launch Vehicle:	Delta 7920
International Participation:	TBD

Candidate Instruments
High Spatial Resolution Imager
High Spectral Resolution Detector
Context Experiment


High Energy Solar Physics Mission

Mission Events
Initiation of Phase A study: November 1991

Management
NASA Headquarters
L. Demas, Program Manager
W. Wagner, Program Scientist
Goddard Space Flight Center
J. Hartman, Study Manager
B. Dennis, Study Scientist
Major Contractors
TBD

Status
New start candidate for Fiscal Year 1995.

Inner Magnetosphere Imager (IMI)

Objective

The scientific objectives of the Inner Magnetosphere Imager (IMI) mission are: 1) to understand the global shape of the inner magnetosphere from simultaneously obtained images of the Earth's magnetosphere and its components (ring current, inner plasmasheet, plasmasphere, aurora, and geocorona); 2) to observe how magnetospheric current systems, field configurations, and conductivities derived from images respond on a global scale to internal and external influences; 3) to visualize and identify the connections of various magnetospheric components to each other, especially as connections act to change the components during substorms and solar wind variations; and 4) to relate global images of the magnetosphere to local observations in order to learn how local processes combine to form the whole; to provide a global framework within which to place local observations, and, to provide a "ground-truth" for the global observations.

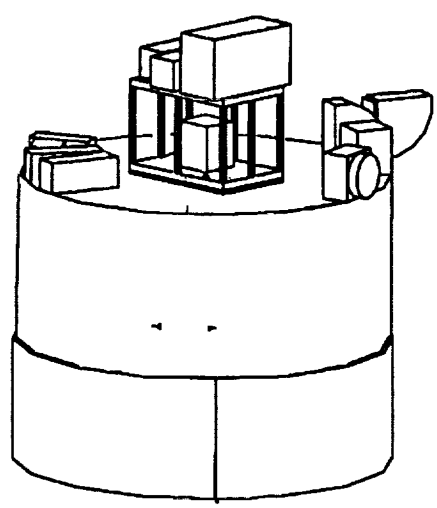
Description

IMI will obtain images of component regions of the inner magnetosphere; namely the ring current and inner plasmasheet using Energetic Neural Atoms (ENA); the plasmasphere using Extreme Ultraviolet (EUV); the electron and proton aurorae using Far Ultraviolet (FUV) and x-rays; and the geocorona using FUV.

Launch:	Under review
Orbit:	90 degree inclination; 400 km (216 nm) perigee, by 6 Earth radii apogee orbit
Weight:	850 kg (1,870 lbs)
Launch Vehicle:	Delta

Status

Pre-phase A study has been completed. Science definition working group is in place and operational.



Inner Magnetosphere Imager

International Microgravity Laboratory Series (IML)

Objective

The objectives of the International Microgravity Laboratory (IML) series are: 1) to conduct high quality scientific investigations for disciplines that require access to the microgravity environment of space; 2) to offer U.S. scientists access to flight hardware developed independently by NASA and other nations, and 3) to provide the international scientific community access to Spacelab and its capabilities. NASA provides the flight opportunities, defines the integrated payload and maintains responsibility for mission management.

Description

IML-1 was a Spacelab mission with international participation that focused on materials, fluids, and life science; disciplines needing access to a laboratory in reduced gravity. IML missions will fly at approximately 24-month intervals so that scientists may build upon results from previous investigations, thus preparing for the Space Station era. IML is derived from a concept whereby multiple application instruments in complementary fields fly together frequently with minimal disassembly and rework between missions. The payload crew will be actively involved in many investigations as trained scientists performing experiments in orbit around the clock and providing immediate scientific assessment of experiment progress to investigators on the ground. The essential low-gravity environment is maintained with a minimum number of thruster firings by using a gravity-gradient stabilized orientation with the Space Shuttle's tail pointing toward Earth.

	IML-1	IML-2
Launch Date:	January 22, 1992	July 1994
Payload:	42 investigations	TBD
Orbit:	57 degree inclination; 297 km (163 nm) altitude	28.5 degree inclination; 259 km (140 nm) altitude
Duration:	8 days	13 days
Weight:	10,793 kg (23,985 lbs)	10,793 kg (23,985 lbs)
Diameter:	4.6 m (15 ft)	4.6 m (15 ft)
Launch Vehicle:	Space Shuttle	Space Shuttle
International Participation:	FRG, European Space Agency, Canada, Japan, and France	FRG, European Space Agency, Canada, Japan, and France

Investigations/Instruments/Principal Investigators

Life Sciences

Biostack - H. Buecker (Institute for Flight Medicine, German Aerospace Research Establishment - FRG)
Radiation Monitoring Container Device - S. Nagaoka (National Space Development Agency of Japan)
Plant Gravitational Threshold Experiment - A. Brown (University of Pennsylvania)
Plant Response to Light Stimulation: Phototropic Transients - D. Heathcote (University of Pennsyvania)
Biorack Experiments - 17 Investigators (3 from U.S. and 14 from Europe)
Microgravity Vestibular Investigations - M. Reschke (JSC)
Mental Workload and Performance Experiment - H. Alexander (Massachusetts Institute of Technology)
Space Physiology Experiments - D. Brooks (University of British Columbia - Canada), J. McClure (London Ear Clinic - Canada), H. Parsons (University of Calgary - Canada), R. Thirsk (Canadian Space Agency), P. Wing (University of British Columbia - Canada), D. Watt (McGill University-Canada)

International Microgravity Laboratory Series (IML) (Continued)

Investigations/Instruments/Principal Investigators (Continued)

<u>Microgravity Sciences</u>

Protein Crystal Growth - C. Bugg (University of Alabama-Birmingham)

Cryostat - A. McPherson (University of California-Riverside), W. Littke (University of Freiburg - FRG), G. Wagner (University of Giessen - FRG)

Fluids Experiment System - R. Lal (Alabama A&M University), M. McCay (University of Tennessee Space Institute)

Vapor Crystal Growth System - L. van den Berg (EG&G, Inc.)

Mercury Iodine Crystal Growth - R. Cadoret (University of Clermont-Ferrand - France)

Organic Crystal Growth Facility - A. Kanbayashi (National Space Development Agency of Japan)

Critical Point Facility - A. Wilkinson (LeRC), D. Beysens (French Atomic Energy Commission - France), A. Michels (Van der Waals Laboratory - the Netherlands)

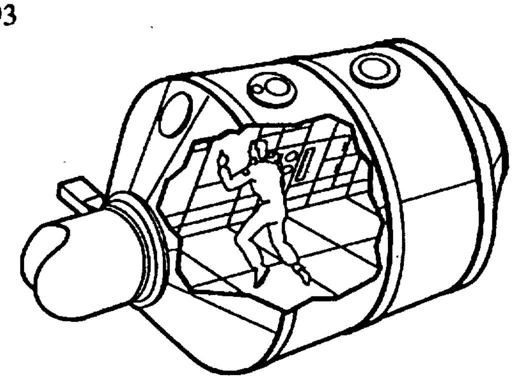
Space Acceleration Measurement System - R. DeLombard (LeRC)

Mission Events (IML-1)

Payload confirmation: July 1989
Payload specialist selected: January 1990
Start Level IV integration: January 1990
Start Level III/II integration: January 1991
Start Level I integration: November 1991

Mission Events (IML-2)

Preliminary Design Review: October 1990
Payload Specialist selection: March 1992
Critical Design Review: June 1992
Payload confirmation: October 1992
Level IV Integration Review: June 1993
Level III/II Integration Readiness Review: October 1993
Level I integration: 45 days before launch



International Microgravity Laboratory

International Microgravity Laboratory Series (IML) (Continued)

Management

NASA Headquarters
W. Richie, Program Manager
R. White, Program Scientist (IML-1)
R. Sokolowski, Program Scientist (IML-2)
Marshall Space Flight Center
R. McBrayer, Mission Manager (IML-1)
J. Frazier, Deputy Mission Manager (IML-1)
L. Upton, Mission Manager (IML-2)
M. Boudreaux, Deputy Mission Manager (IML-2)
R. Snyder, Mission Scientist
Johnson Space Center
S. Castle, Payload Integration Manager (IML-1)
F. Moreno, Payload Integration Manager (IML-2)

Status

The first International Microgravity Laboratory (IML-1) mission was successfully launched on January 22, 1992. Originally baselined as a 7-day mission, the astronauts aboard the Space Shuttle Discovery were granted a one-day flight extension to continue their investigations. The extension was made possible due to the efficiency of the Orbiter and crew in making use of their fuel, electricity, water and air. Discovery completed its mission and returned to Earth on January 30, 1992.

Laser Geodynamics Satellite II (LAGEOS-II)

Objective

The Laser Geodynamics Satellite II (LAGEOS-II) will: 1) promote research in Earth Sciences by providing very precise satellite geodetic measurements; 2) enhance research in regional crustal deformation and plate tectonics, Earth and ocean tides, and temporal variation in the geopotential; 3) make possible calculations of the Earth's orientation and satellite orbital perturbations; and 4) enhance understanding of earthquakes, sea-level change, and potential flood hazards.

Description

LAGEOS-II, a joint program between NASA and the Italian Space Agency (ASI), is a passive satellite designed specifically and dedicated exclusively for use as a target for laser ranging. The Italian-constructed LAGEOS-II (based on the same design as the NASA-produced LAGEOS-I) is a spherical satellite of aluminum with a brass core. The exterior surface is covered by 426 equally spaced laser corner-cube retroreflectors that reflect any incident optical signal (i.e., pulsed laser light) back to its source. After LAGEOS-II is released from the Space Shuttle, two solid fuel stages – the Italian Research Interim Stage (IRIS) and the LAGEOS Apogee Stage (LAS) - will engage. The first will boost the spacecraft from 296 kilometer to the satellite injection altitude of 6,000 kilometer, and the latter will place it in a circular orbit with an inclination of 52 degrees, which will complement LAGEOS-I's orbit of 101 degrees. Both LAGEOS satellites will be tracked by a global network of fixed and transportable lasers from some 65 sites.

The satellite and boosters are provided by ASI, and the launch is provided by NASA. A team of 27 investigators has been assembled, representing the following six countries: U.S., Italy, FRG, France, the Netherlands, and Hungary. Selection of the international team was based on coordinated Research Announcements released by NASA and ASI, with selections announced in March 1989.

Launch Date:	September 1992
Payload:	Corner Cube Retroreflector
Orbit:	52 degree inclination; 6,000 km (3,240 nm), circular orbit
Design Life:	10,000 years
Length:	N/A
Weight:	406 kg (893 lbs)
Diameter:	60 cm (24 inches)
Launch Vehicle:	Space Shuttle
International Participation:	Italy, FRG, France, the Netherlands, Hungary

Mission Events

Optical characterization: June 1989
Upper stage (Italian) scheduled for delivery to Kennedy Space Center (KSC): March 1992
Spacecraft scheduled for delivery to KSC: March 1992

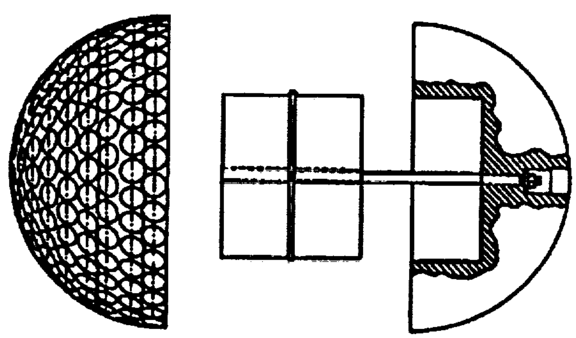
Laser Geodynamics Satellite II (LAGEOS II) (Continued)

Management

NASA Headquarters
L. Caudill, Program Manager
M. Baltuck, Program Scientist
Goddard Space Flight Center
G. Ousley, Project Manager
R. Kolenkiewicz, Project Scientist
Italian Space Agency (ASI)
R. Ibba, Project Manager
University of Bologna
S. Zerbibi, Project Scientist

Status

The LAGEOS-II spacecraft and upper stage are currently in storage. Both will be delivered to Kennedy Space Center (KSC) in March 1992. Program activities are on schedule for the planned launch readiness date of September 1992.



Laser Geodynamics Satellite

LIDAR In-Space Technology Experiment (LITE)

Objective
The LIDAR In-Space Technology Experiment (LITE) will measure: 1) stratospheric and tropospheric aerosols; 2) planetary boundary layer height; 3) cloud deck altitude; and 4) atmospheric temperature and density over the altitude range of 10 to 40 kilometers. Since Light Intensification Detection And Ranging (LIDAR) is a new space measurement technique, Space Shuttle flights are needed to develop laser and detection technology, validate data processing algorithms, and provide a sound basis for further applications.

Description
LITE is both a space systems demonstration sponsored by NASA's Office of Aeronautics and Space Technology (OAST) and an atmospheric science investigation supported by the Office of Space Science and Applications (OSSA). The LITE payload consists of a laser transmitter, telescope, optical receiver, and associated electronics. The transmitter generates 10 laser pulses per second at three wavelengths and directs them into the Earth's atmosphere where they are backscattered from aerosols and clouds. The telescope collects the backscattered signals which are then detected by the receiver.

Launch Date:	March 1994
Payload:	Laser/Telescope system mounted on Orthogrid/Spacelab pallet carrier
Orbit:	28.5 to degree inclination; 300 km (162 nm) altitude
Duration:	7 days
Length:	3.05 m (10 ft)
Weight:	2,400 kg (5,292 lbs)
Diameter:	4.4 m (14 ft)
Launch Vehicle:	Space Shuttle

Mission Events
Concept, feasibility and definition studies: August 1985
Preliminary experiment design: May 1988
Critical experiment design: July 1989
Mission implementation: Ongoing
Experiment delivery to the Kennedy Space Center: April 1993

Management
NASA Headquarters
D. Jarrett, Program Manager (Mission/OSSA)
L. Vann, Program Manager (OAST)
G. Esenwein, Program Manager (Reflight/OSSA)
J. Theon, Program Scientist

LIDAR In-Space Technology Experiment (LITE) (Continued)

Management (Continued)

Langley Research Center
J. Rogers, Project Manager
R. Couch, Instrument Manager
M. McCormick, Project Scientist
Johnson Space Center
M. Hendrix, Mission Manager

Status

Instrument is in development at Langley Research Center. Subsystems design underway and fabrication started. Preliminary Design Review and Critical Design Review completed. Integration, testing, and qualification expected to be completed in the summer of 1992. Reflight approved for 2nd Quarter fiscal year 1995.

Lunar Scout

Objectives

The objectives of the Lunar Scout Program are to provide opportunities to fly small, low-cost missions that will perform focused investigations to address the most fundamental questions in lunar science. These questions include: What is the origin of the Moon and how does it relate to the early Earth? How did the Moon differentiate? Was there ever a global magma ocean? What is the thermal and magmatic history of the Moon? How have impact processes shaped the lunar surface and how have these processes changed over time? What is the origin of lunar paleomagnetism? Is there a lunar core? What is the nature and origin of the lunar atmosphere?

Description

Lunar Scout missions will use small spacecraft. Development times will be 3 years or less. Missions will have focused science objectives with only one to three instruments per mission. This program will take advantage of the latest advances in technology and mission design. It will also offer an opportunity for industry and universities to play a larger role in planetary exploration. Candidate Instruments include: Visual and Infrared Mapping Spectrometer (VIMS), X-ray/Gamma-Ray Spectrometer (XGRS), Radar (or Laser) Altimeter (ALT), Magnetometer (MAG), Thermal Emission Spectrometer (TES), Imaging System, and Radio Science.

Launch Dates:	Multiple, TBD
Payload:	TBD
Orbit:	Lunar - circular, near polar lunar
Design Life:	Variable
Length:	TBD
Weight:	TBD
Diameter:	TBD
Launch Vehicle:	Expendable Launch Vehicles
International Participation:	TBD

Instruments

Instrument payloads to be determined.

Mission Events

None established. Missions can be initiated about 3-5 days after launch (Earth-Moon travel time).

Management

NASA Headquarters
Solar System Exploration Division
NASA Center
TBD
Major Contractors
TBD

Lunar Scout (Continued)

Status

Lunar Scout is in the OSSA Strategic Plan for a proposed 1998 new start. The science goals of the program were endorsed by a Space Science and Applications Review (May 1990) of an earlier proposed implementation, Lunar Observer. Some of the objectives of Lunar Scout may be addressed by similar missions flown by the Office of Exploration.

Mars Environmental Survey (MESUR) Mission

Objectives

The purpose of this mission is to emplace a network of landers to make both short- and long-term measurements of the Martian atmosphere, surface, and interior. These measurements are aimed at achieving established science goals and providing information of value to the Space Exploration Initiative. MESUR is part of an evolutionary strategy for Mars exploration in two respects. First, it is accomplished over several launch opportunities, providing the potential to select later sites and adjust payloads based on early mission results and other information. Second, the capability to emplace the MESUR landers on Mars can be evolved to support future small lander missions. The scientific objectives of MESUR are: 1) to conduct short-term measurements of atmospheric structure, local topography, and surface chemical composition; and 2) to conduct long-term meteorological (pressure, temperature, opacity, winds, humidity) and seismic measurements.

Description

Each MESUR launch will deliver four landers to Mars, eventually establishing a network of 16 stations distributed globally from pole to pole. The launch vehicle will be a Delta II. One launch is planned at the first launch opportunity (1999), one at the second (2001), and two at the third (2003). A communications orbiter may also be launched at the second opportunity. Landing site longitude control of individual probes is achieved by means of arrival timing. Latitude control is achieved through approach phase targeting, constrained to some extent by lighting (sun elevation) requirements for effective descent imaging. Temporary data storage is provided by the lander, as necessary, and transmitted through the medium data rate link to the relay communications orbiter (single orbiter supporting all sites) or through a low data rate backup direct to Earth. Each entry probe/lander will nominally carry the science instrument payload indicated below, but some degree of instrument changeout matched to site latitude and launch chronology may be possible.

The landers, with a forward aeroshell similar in shape to the Viking lander, are designed to permit slowing of the vehicle as it enters the Martian atmosphere. Atmospheric entry occurs at a flight path angle of -20 degrees followed by subsonic parachute deployment. This altitude permits safe deployment to sites at elevations as high as 6 kilometers, allowing exploration of most regions of the planet. Twelve nested images are taken during parachute descent (about 30 meters per second) for subsequent relay to Earth. It is feasible to land on an air bag, inflated below the lander just before impact. Trade studies evaluating the use of retro-rockets and crushable structures are underway. The lander will be powered by a small Radioisotope Thermoelectric Generator (RTG).

Candidate Instruments

Atmospheric Structure Instrument
Descent/Surface Imager
Meteorology Experiment Package
Surface Composition Instrument
Seismometer
Thermal Analysis Instrument

Mars Network (MESUR) Mission (Continued)

Management

NASA Headquarters
C. Pilcher, Chief, Advanced Studies Branch
J. Boyce, Program Scientist
Jet Propulsion Laboratory
TBD

Status

MESUR is in the OSSA Strategic Plan, slated for a fiscal year 1996 new start. The Phase A study is underway.

Mars Observer (MO)

Objective

The objectives of the Mars Observer are: 1) to determine the global elemental and mineralogical character of the Martian surface; 2) define globally the Martian topography and gravitational field; 3) establish the nature of the global magnetic field; 4) determine the time and space distribution, abundance, sources and sinks of volatile-material and dust over a seasonal cycle; and 5) explore the structure and aspects of the circulation of the Martian atmosphere.

Description

Mars Observer will use a modified Earth-orbiter spacecraft as the basic bus. The mission will be launched in September 1992, using a Titan III/Transfer Orbit Stage (TOS) combination. Arriving at Mars in September 1993, Mars Observer will first enter a highly elliptical capture orbit (period of 72 hours) for 11 days. It will then be shifted into a series of less elliptical drift orbits over a period of 50 - 70 days (depending on the exact 1992 launch date). At the end of these maneuvers (about December 1993), it will be inserted into a 378 kilometer near-polar, Martian orbit (93 degree inclination) to begin its 2-year mapping mission. In late 1995, with the arrival of the Russian Mars-94 spacecraft, Mars Observer will begin to relay data from its deployed surface packages.

Launch Date:	September 1992
Payload:	7 instruments, 25 individual investigations
Orbit:	93 degree inclination; Martian, circular, 378 km (204 nm) altitude, sun-synchronous, (2 p.m. dayside pass)
Design Life:	3 years
Length:	2.2 m (7 ft)
Weight:	Injected mass 2,570 kg (5,667 lbs); On-orbit dry mass 1,075 kg (2,370 lbs)
Diameter:	3.5 m (11 ft)
Launch Vehicle:	Titan III/Transfer Orbit Stage
International Participation:	Austria, FRG, France, United Kingdom, former Soviet Union

Instruments/Investigations/Principal Investigators

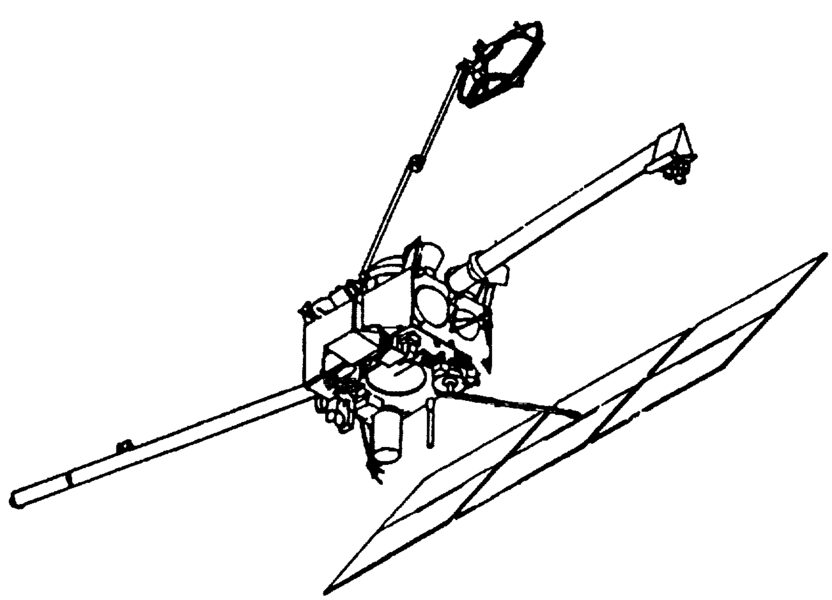
Mars Observer Laser Altimeter (MOLA) - D. Smith (GSFC)
Mars Observer Science Camera (MOC) - M. Malin (Malin Space Science Systems)
Magnetometer (MAG) - M. Acuna (GSFC)
Thermal Emission Spectrometer (TES) - P. Christensen (Arizona State University)
Gamma Ray Spectrometer (GRS) - W. Boynton (University of Arizona)
Pressure Modulator Infrared Radiometer (PMIRR) - D. McCleese (Jet Propulsion Laboratory)
Mars Balloon Relay (MBR) - J. Blamont (French Space Agency - CNES)
Ultrastable Oscillator (Radio Science) - G. Tyler (Stanford University)

Mars Observer (MO) (Continued)

Mission Events
Tentative selection of investigations: April 1986
Final confirmation and selection: April 1987
Launch: September 1992
Arrival at Mars: September 1993
End of Mission: November 1995

Management
NASA Headquarters
W. Piotrowski, Program Manager
B. French, Program Scientist
Jet Propulsion Laboratory
D. Evans, Project Manager
A. Albee, California Institute of Technology, Project Scientist
Major Contractors
General Electric (AstroSpace Division)

Status
The spacecraft subsystem assembly and test phase has been completed at General Electric/East Windsor and spacecraft system testing is underway. Six of the eight science instruments have been delivered and integrated onto the spacecraft; the other two instruments will be delivered in February 1992. Spacecraft environmental testing is planned to start in February 1992 with systems dynamic testing to follow in March 1992. Delivery of the spacecraft to Kennedy Space Center is scheduled for June 1992.



Mars Observer

NOAA Polar Orbiting Environmental Satellites (NOAA E-M)

Objective

The NOAA Polar Orbiting Environmental Satellites (NOAA Series) will: 1) conduct global environmental observations of sea surface temperature, snow cover, cloud cover, sea ice, vegetation condition, and atmospheric temperature and moisture profiles; 2) conduct search and rescue operations; 3) conduct remote platform investigations; and 4) conduct space environment monitoring.

Description

A 1973 Basic Agreement between NASA and the National Oceanic and Atmospheric Administration (NOAA) establishes the observational requirements for both the polar and geostationary weather satellites. Acting as NOAA's agent, NASA procures the spacecraft and instruments required to meet NOAA's objectives, and provides for their launch. NASA also conducts an on-orbit checkout before tranferring the satellites to NOAA for routine operations. The requirement to replace spacecraft on an as-needed basis is determined by NOAA.

Launch Date:	1983-1997
Payload:	Weather Satellite
Orbit:	Near-polar, 833-870 km (450-470 nm) altitude
Design Life:	> 2 years
Length:	4.2 m (14 ft)
Weight:	1,028 kg (2,255 lbs)
Diameter:	1.9 m (6 ft)
Launch Vehicle:	Atlas-E through NOAA-J (Titan-II for NOAA-K, L, M)
International Participation:	United Kingdom, France, Canada

Instruments/Investigations/Principal Investigators

Advanced Very High Resolution Radiometer (AVHRR) - (International Telephone and Telegraph)
High Resolution Infrared Sounder (HIRS) - (International Telephone and Telegraph)
Stratospheric Sounding Unit (SSU) (Through NOAA-J) - (United Kingdom)
Microwave Sounding Unit (MSU) (Through NOAA-J) - (Jet Propulsion Laboratory)
Advanced Microwave Sounding Unit (AMSU) (starting with NOAA-K) - (Aerojet)
Solar Backscatter Ultraviolet Spectrometer (SBUV) (afternoon satellites only) - (Ball Aerospace)
Space Environment Monitor (SEM) - Ford Aerospace (through NOAA-J); (Panametrics) (starting with NOAA-K)
Argos (French Data Collection and Platform Location System (DCS)) - (French Space Agency/ NASA/NOAA)
Search and Rescue System Instrument - (Canada/France)

NOAA Polar Orbiting Environmental Satellites (NOAA E-M)
(Continued)

Mission Events

NOAA-8 Launch:	March 1983
NOAA-9 Launch:	December 1984
NOAA-10 Launch:	September 1986
NOAA-11 Launch:	September 1988
NOAA-12 Launch:	May 1991 (last of smaller "TIROS-N" spacecraft)
NOAA-I Launch:	June 1992
NOAA-J Launch:	December 1993
NOAA-K Launch:	January 1995
NOAA-L Launch:	July 1996
NOAA-M Launch:	August 1997

Management

NASA Headquarters
J. Greaves, Program Manager
Goddard Space Flight Center
C. Thienel, Project Manager
Major Contractors
General Electric (AstroSpace Division)
International Telephone and Telegraph

Status

The NOAA Polar Orbiting Environmental Satellites constitute an operational satellite series with morning (7:30 a.m.) and afternoon (1:30 p.m.) Sun synchronous orbits. This program is a reimbursable program in which NASA develops the satellites under contract to NOAA. NOAA-D, the last of the smaller TIROS-N spacecraft was successfully launched May 16, 1991. After checkout of spacecraft and instruments, operational control of NOAA-D was transferred to NOAA and the spacecraft was redesignated as NOAA-12.

Ocean Topography Experiment (TOPEX/POSEIDON)

Objective

The Ocean Topography Experiment (TOPEX/POSEIDON) is designed to: 1) gather information about the global oceans' general circulation and their relationship to climate change using precise measurements of ocean surface topography; 2) increase knowledge of the interaction between atmosphere and ocean, including the exchange of heat and momentum; and 3) make detailed maps of currents, eddies and other features of ocean circulation.

Description

TOPEX/POSEIDON is a joint NASA and French Space Agency (CNES) project that includes two French and three NASA instruments. Using satellite radar altimetry, the mission will make substantial contributions to the understanding of global ocean dynamics. TOPEX/POSEIDON is a vital contribution to two major international ocean/atmosphere research programs: the World Ocean Circulation Experiment (WOCE) and the Tropical Ocean Global Atmospheric (TOGA) program, both of which are components of the World Climate Research Program.

Launch Date:	July 1992
Payload:	5 instruments
Orbit:	66 degree inclination; 1,336 km (721 nm) altitude, nominally circular
Design Life:	3 years; expendables for 5 years total
Length:	5.5 m (18 ft)
Weight:	2,700 kg (5,940 lbs)
Diameter:	3.5 m (11 ft)
Launch Vehicle:	Ariane IV
International Participation:	France

Instruments/Investigations/Principal Investigators

NASA Altimeter (ALT) - (Johns Hopkins University Applied Physics Laboratory)
Solid State Altimeter (SSALT) - (Toulouse Space Center - France)
TOPEX Microwave Radiometer (TMR) - (Jet Propulsion Laboratory)
Determination d'Orbite et Radiopositionement Integre par Satellite (DORIS) - (Toulouse Space Center - France)
Global Positioning System Demonstration Receiver (GPSDR) Experiment - (Jet Propulsion Laboratory)

Mission Events

Program start: October 1986
Satellite contract award: June 1987
Preliminary Design Review: October 1988
Critical Design Review: May 1989
Start sensor integration: May 1991
Satellite delivery: April 1992

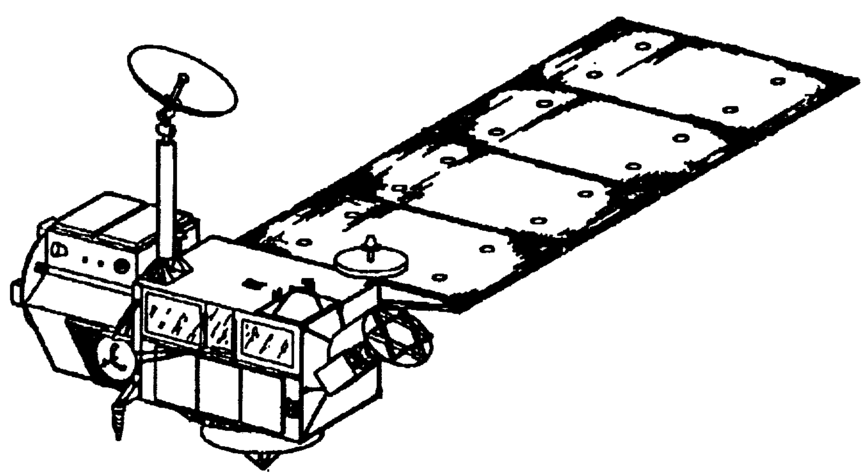
Ocean Topography Experiment (TOPEX/POSEIDON) (Continued)

Management

NASA Headquarters
L. Jones, Program Manager
W. Patzert, Program Scientist
Jet Propulsion Laboratory
C. Yamarone, Project Manager
L. Fu, Project Scientist
French Space Agency (CNES)
J. Fellous, Program Manager
A. Ratier, Program Scientist
M. Dorrer, Project Manager
M. Lefebuke, Project Scientist
Major Contractor
Fairchild Space Company

Status

A Memorandum of Understanding between NASA and CNES was signed March 1987. A contract was awarded to Fairchild for satellite development. Significant progress was made in the manufacture of the satellite subsystems and sensors during 1990. Flight hardware fabrication was completed in early 1991. Integration of the spacecraft bus, instrument module and instruments began in September 1991 and is expected to be completed by April 1992. The spacecraft will then undergo performance and environmental acceptance testing to support a May 1992 delivery of the satellite to the Kourou launch site in French Guiana for integration with the Ariane IV launch vehicle. Launch of TOPEX/POSEIDON is scheduled for July 1992.



Ocean Topography Experiment

Orbiting Solar Laboratory (OSL)

Objective

The Orbiting Solar Laboratory (OSL) will determine: 1) the physical structure, chemical composition and dynamics of the solar atmosphere; and 2) the nature of the physical processes which occur in those parts of the Sun accessible to observations, especially on temporal and spatial scales not previously attainable.

Description

OSL is a three-axis stabilized spacecraft which has a meter-class telescope and two smaller co-observing telescopes. The meter-class telescope is a visible light diffraction-limited telescope of conventional Gregorian design. Its focal plane instrument is the Coordinated Instrument Package (CIP) which has a visible spectrograph, tunable filtergraph and photometric filtergraph. The two smaller telescopes are designed to make measurements in the ultraviolet and soft x-ray spectral regions. OSL will also carry an instrument to measure total solar output. OSL will be launched into a Sun-synchronous orbit that will provide 9 months of continuous solar observations each year.

Launch Date:	Under Review
Payload:	1 m telescope and 2 smaller telescopes with 5 major instruments
Orbit:	94.7 degree inclination; 500 km (270 nm), Sun-synchronous
Design Life:	3 years
Length:	4.6 m (15 ft)
Weight:	1,730 kg (3,806 lbs)
Diameter:	2.8 m (9 ft)
Launch Vehicle:	Expendable Launch Vehicle
International Participation:	FRG, Italy

Instruments/Investigations/Principal Investigators

High Resolution Telescope and Spectrograph (HRTS) - G. Brueckner (Naval Research Laboratory)
Photometric Filtergraph - H. Zirin (California Institute of Technology)
Solar Spectrograph (KISS) - E. Schroeter (Kiepenheuer Institute for Solar Physics - FRG)
Tunable Filtergraph - A. Title (Lockheed Palo Alto Research Laboratory)
Active Cavity Radiometer Irradiance Monitor (ACRIM) - R. Willson (Jet Propulsion Laboratory)
X-Ray Ultraviolet Imager (XUVI) - E. Antonucci (University of Turin - Italy)

Mission Events

Phase A Completed: June 1988

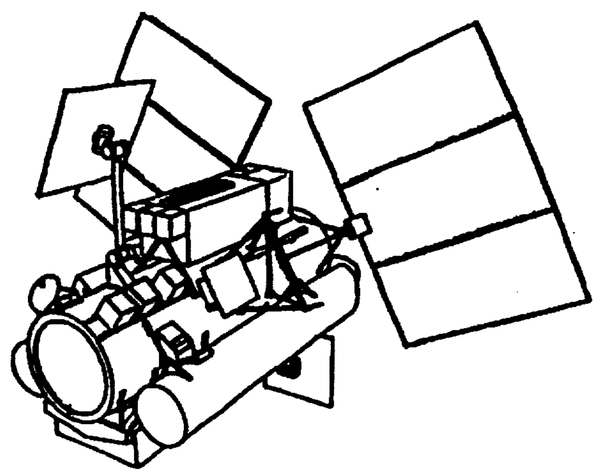
Management

NASA Headquarters
R. Howard, Program Manager
W. Wagner, Program Scientist

Orbiting Solar Laboratory (OSL) (Continued)

Status

Proposed as a new start candidate for fiscal year 1998. Phase B activities have been terminated for the near future.



Orbiting Solar Laboratory

Pluto Flyby/Neptune Orbiter Mission

Objectives

The Pluto Flyby/Neptune Orbiter/Probe is a set of missions that are paired so as to take the greatest advantage of parallel development of the Mariner Mark II spacecraft. The extreme conditions and long lifetime requirements of these outer solar system missions contribute to extensive commonality in the spacecraft design, leading to savings in mission design and cost.

Pluto Flyby

The objectives of this mission are: 1) the first close-up observations of the Pluto-Charon system; 2) studies of the geology, internal structure (by indirect means such as density measurements), surface composition and atmosphere-surface interactions on Pluto; 3) studies of the composition and distribution of volatiles on Pluto, along with their associated processes; 4) mapping of the surface composition and geology of Pluto's satellite, Charon, to determine whether surface processes or geologic features may have resulted from gravitational interactions between Pluto and Charon; 5) studies to determine the composition, structure and first order dynamics of Pluto's atmosphere; and 6) investigations aimed at elucidating processes such as photolysis and charged particle interactions that may modify Pluto's atmospheric and surface composition over time.

Neptune Orbiter

The science goals for this mission are concentrated in four areas: 1) determine the deep structure and composition of Neptune's atmosphere by in situ measurements using an atmospheric probe, combined with measurements of the global structure, composition, and dynamics of the upper atmosphere using remote sensing instruments; 2) study in detail the geology, surface composition, atmosphere and atmosphere-surface interactions on Neptune's moon, Triton, especially as those interactions pertain to the strong seasonal change that will be occurring on Triton when the orbiter arrives at Neptune; 3) study in detail the surface composition and geology of the small Neptune satellites; and 4) study the composition and dynamics of the Neptune ring system in detail, and study the interactions of the ring material with Neptune's magnetosphere and with the gravity fields of Neptune's satellites.

Description

Pluto Flyby

The reference trajectory utilizes Earth and Jupiter gravity assists to reach Pluto. After a Titan IV/Centaur launch, the Mariner Mark II spacecraft will fly by the asteroid Corvina on its 3-year Earth-Earth transfer. The spacecraft will fly through the Pluto/Charon system at a relative speed of approximately 13 kilometers per second; passing Pluto at an altitude of 2000 kilometers would permit in situ sampling of its extended atmosphere. Science opportunities also include a long Jovian magnetotail passage, and Pluto and Charon imaging, mass determination, and other in situ measurements. A desirable science enhancement would be provided by a small "daughter" spacecraft deployed from the Mariner Mark II spacecraft prior to encounter with Pluto. The three-axis stabilized daughter spacecraft, carrying only an imager, would follow 3.2 days behind the Mariner Mark II in order to obtain images of the hemispheres of Pluto and Charon that will not be visible to the main spacecraft (at comparable resolution) due to the 6.4 day rotation period of the system. The instrument complement will be derived from the Cassini mission, with possible minor changes. The spacecraft engineering subsystems will be also derived directly from the Cassini spacecraft. Two additional solid-state recorders will be added, to allow much of the data to be stored during the flyby and then returned at low rate after the encounter. The reduced data rates associated with the longer telecommunications ranges are, therefore, acceptable and major enhancements in telecom system capability are avoided.

Pluto Flyby/Neptune Orbiter Mission (Continued)

Description (Continued)

Neptune Orbiter

The reference trajectory for this mission is a Venus-Venus-Earth-Jupiter Gravity Assist (VVEJGA) to Neptune following a Titan/Centaur launch. The Mariner Mark II spacecraft inserts into a 200-day initial orbit upon Neptune arrival. The probe is released 10 days before Neptune arrival and enters the atmosphere just prior to orbit insertion. The spacecraft will orbit Neptune for approximately 3 years, utilizing Triton gravity assists to pump down the orbital period and fulfill the mission science objectives.

Science opportunities include possible asteroid flybys, a Jovian magnetotail passage, multiple flybys of Triton, possible flybys of Nereid and the moons recently discovered by Voyager, and extensive studies of the Neptune atmosphere, magnetosphere and rings. The Neptune probe will transmit data for at least 1.5 hours and will be capable of measurements to a depth of 75 bars. In addition, provision may be made for a modest set of pre-entry measurements. The probe measurements will necessitate a posigrade orbit insertion for data relay. Near apoapse of the initial orbit, the spacecraft switches to a retrograde motion in order to obtain a lower speed relative toTriton for the tour. The instrument complement and orbiter engineering subsystems will be derived directly from the Cassini spacecraft, with minor changes.

Candidate Instruments

Pluto Flyby

Plasma Spectrometer (PS)
Ion/Neutral Mass Spectrometer (INMS)
Cosmic Dust Analyzer (CDA)
Imaging Science Subsystem (ISS)
Hot Plasma Analyzer (HPA)
Radio Science Subsystem (RSS)
Magnetometer (MAG)
Radio Plasma Wave Spectrometer (RPWS)
Ultraviolet Imaging Spectrometer (UVIS)
Visual and Infrared Mapping Spectrometer (VIMS)
Gamma-ray Burst Detector (GBD)
Retarding Potential Analyzer/Langmuir Probe (RPA/LP)

Neptune Orbiter

Plasma Spectrometer (PS)
Composite Infrared Spectrometer (CIRS)
Retarding Potential Analyzer/Langmuir Probe (RPA/LP)
Imaging Science Subsystem (ISS)
Ion/Neutral Mass Spectrometer (INMS)
Magnetometer (MAG)
Neptune Atmosphere Mapper (NAM)
Gamma-ray Burst Detector (GBD)
Radio Plasma Wave Spectrometer (RPWS)
Radio Science Subsystem (RSS)
Ultraviolet Imaging Spectrometer (UVIS)
Visual and Infrared Mapping Spectrometer (VIMS)
Cosmic Dust Analyzer (CDA)
Hot Plasma Analyzer (HPA)

Pluto Flyby/Neptune Orbiter Mission (Continued)

Management

NASA Headquarters
C. Pilcher, Chief, Advanced Studies Branch
H. Brinton, Program Scientist
Jet Propulsion Laboratory
TBD

Status

Phase-A studies are underway for both the Pluto Flyby mission and the Neptune Orbiter mission. The OSSA Strategic Plan includes a proposed new start for either the Pluto Flyby mission or the Neptune Orbiter mission in fiscal year 1997. As a consequence of the cancellation of CRAF in January 1992, the use of this slot for a Pluto Flyby or Neptune Orbiter mission or for an international collaborative comet rendezvous mission is under review.

Radar Satellite (RADARSAT)

Objective

The Radar Satellite (RADARSAT) is designed to: 1) provide detailed information on sea ice and terrestrial ice sheets for climate research; 2) provide radar imagery for geographical applications in oceanography, agriculture, forestry, hydrology and geology; and 3) provide real-time products for arctic ocean navigation, including iceberg surveillance.

Description

RADARSAT is a joint project between the Canadian Space Agency (CSA), NASA, and the National Oceanic and Atmospheric Administration (NOAA) using Synthetic Aperture (Imaging) Radar (SAR) technology. CSA is providing the SAR instrument and spacecraft, with NASA providing the launch vehicle and participating in data acquisition.

Launch Date:	December 1994
Payload:	C-band Synthetic Aperture Radar
Orbit:	98.5 degree inclination; 792 km (411 nm) altitude, nominally circular
Design Life:	3 years
Length:	4.2 m (14 ft)
Weight:	3,200 kg (7,040 lbs)
Diameter:	2.8 m (9 ft)
Launch Vehicle:	Delta II
International Participation:	Canada

Instruments/Principal Investigators

Synthetic Aperture Radar - Spar Aerospace (Canada)

Mission Events

Joint U.S./Canada Study: 1979 - 1987
Program Start: June 1987
Hardware Development Initiated: February 1990
Radar Preliminary Design Review: July 1991
Spacecraft Critical Design Review: August 1991

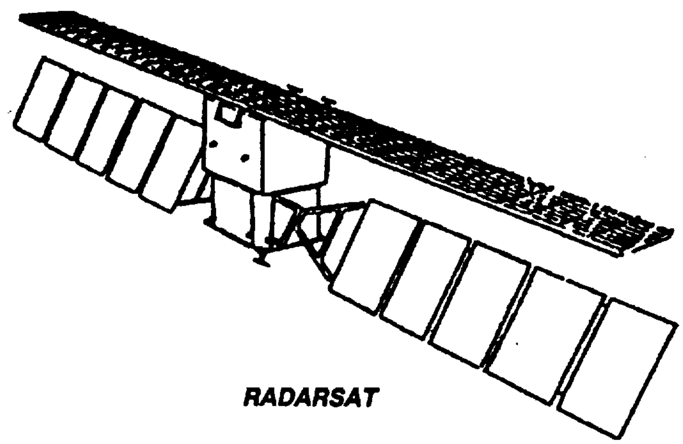
Management

NASA Headquarters
R. Monson, Program Manager
R. Thomas, Program Scientist
Canadian Space Agency (CSA)
E. Langham, Project Manager
J. McNally, Project Director
Major Contractors
Spar Aerospace
Ball Aerospace
McDonnell Douglas
MacDonald Dettwiler

Radar Satellite (RADARSAT) (Continued)

Status

RADARSAT Project approved in June 1987 by Canadian Government. Memorandum of Understanding with Canada signed in February 1991, which provides for data downlink to U.S. Alaska SAR Facility once the satellite is operational.



RADARSAT

Small-Class Explorers (SMEX)

Objective

The objectives of the Small-Class Explorers (SMEX) are to enable new areas of exploration and special topic investigations in space astrophysics, and atmospheric and space plasma physics; and to provide a quick reaction research capability, through small sized missions and frequent launch opportunities.

Description

SMEX payloads are modest size, modest capability payloads, up to 500 pounds, which make major contributions a number of NASA's space science and applications disciplines.

The Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) will be a Zenith-pointing satellite in near-polar orbit which will carry a payload of four particle detectors, each of which addresses a subset of the required measurements. The instruments can measure the electron and ion composition of energetic particle populations from approximately 0.4 million electron Volts (MeV)/nucleon to hundreds of MeV/nucleon using a coordinated set of detectors of excellent charge and mass resolution, and with higher sensitivity than previously flown instruments. SAMPEX will: 1) provide measurements on how some ions from partially ionized plasmas such as the solar corona and the very local interstellar medium are energized to nearly the speed of light by shocks or other means and reach the Earth; and, 2) monitor fluxes of fast electrons which come from space onto the Earth's atmosphere and are important in the chain of chemical reactions leading to the formation and depletion of ozone.

The Fast Auroral Snapshot Explorer (FAST) will collect measurements of electrical and magnetic fields and simultaneously correlate these with their effects on the electron and ions at altitudes of 350 to 4,200 kilometers with very high time resolution. These observations will be complemented by data from other spacecraft at higher altitudes, which will be observing fields and particles and photographing the aurora from above, thus placing FAST observations in global context. At the same time, auroral observatories and geomagnetic stations on the ground will provide measurements on how energetic processes that FAST observes affect the Earth.

The Submillimeter Wave Astronomy Satellite (SWAS) will be a three-axis stabilized, stellar-pointing spacecraft launched into a 38 degree, 600 kilometer, circular orbit. It will have a 71 centimeter off-axis Cassegrain antenna, state-of-the-art heterodyne receivers cooled to 150 degrees Kelvin (K) by passive radiators, and the highest quality Acousto-Optical Spectrometer (AOS) to be provided by the Federal Republic of Germany (FRG). In less than 20 minutes of integration, SWAS will be able to measure the full range of predicted H_2O, O_2, C, ${}_{13}CO$, and $H_2{}_{18}O$ abundances in any giant molecular cloud core within 1 kiloparsec. Of particular importance, the AOS will permit simultaneous observation of four of these lines at any one time, thus maximizing the observing efficiency and substantially increasing confidence in the spatial coincidence of maps made in the various lines. Local clouds (diameter less than 1 kiloparsec), such as Orion, Taurus, Ophiuchi, and Perseus, will be mapped in each of the four lines. A survey of galactic Giant Molecular Clouds will be performed, and a number of gas rich extra-galactic sources, such as the Magellanic Clouds, will be observed.

Small-Class Explorers (SMEX) (Continued)

Description (Continued)

	SAMPEX	FAST	SWAS
Launch Date:	June 1992	September 1994	June 1995
Payload:	4 particle detectors	4 instruments	telescope & receivers
Orbit:	82 degree inclination; 550 x 657 km (297 x 355 nm) altitude, circular	83 degree inclination; 350 x 4,200 km (189 x 2,268 nm), altitude, non-Sun synchronous	38 degree inclination; 600 km (324 nm) altitude
Design Life:	3 years	1 year	3 years
Length:	1.5 m (5 ft) (stowed)	0.86 m (3 ft) (stowed)	1.65 m (5 ft)
Weight:	158 kg (348 lbs)	162 kg (356 lbs)	218.6 kg (482 lbs)
Diameter:	0.86 m (3 ft) (stowed)	1.17 (stowed)	.97 m (3 ft)
Launch Vehicle:	SCOUT	Enhanced Pegasus	Pegasus
International Participation:	FRG	None	FRG

Instruments/Investigations/Principal Investigator

SAMPEX

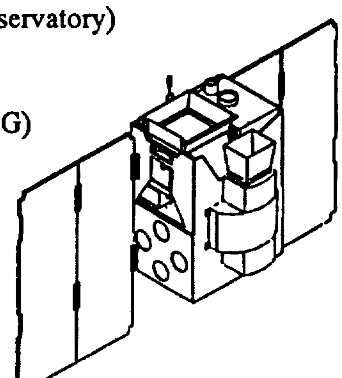
Principal Investigator - G. Mason (University of Maryland)
Low Energy Ion Composition Analyzer (LEICA) - (University of Maryland)
Heavy Ion Large Telescope (HILT) - (Max Planck Institute for Extraterrestrial Physics - FRG)
Mass Spectrometer Telescope (MAST) - (California Institute of Technology)
Proton-Electron Telescope (PET) - (California Institute of Technology)

FAST

Principal Investigator - C. Carlson (University of California-Berkeley)
Electric Field Plasma Experiment - (University of California-Berkeley)
Quadrispherical Electrostatic Electron Analyzer - (University of California-Berkeley)
Time-of-flight Energy Angle Mass Spectrograph - (University of New Hampshire and Lockheed Palo Alto Research Laboratory)
Magnetometer - (University of California-Los Angeles)

SWAS

Principal Investigator - G. Melnick (Smithsonian Astrophysical Observatory)
Antenna, Star Tracker, Instrument Integration - (Ball Aerospace)
Submillimeter Heterodyne Receiver (SHR) - (Millitech)
Acousto-Optical Spectrometer (AOS) - (University of Cologne - FRG)

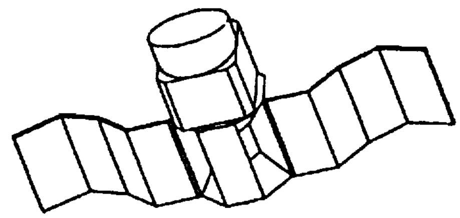


Solar, Anomalous, and Magnetospheric Particle Explorer

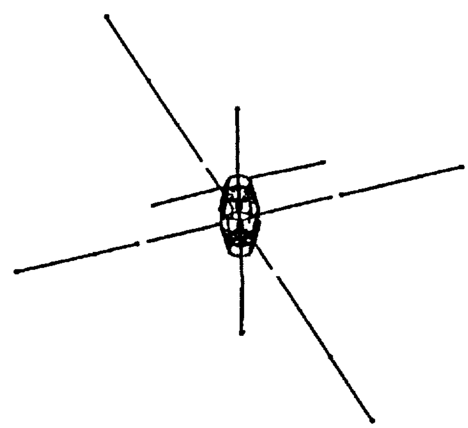
Small-Class Explorers (SMEX) (Continued)

Management

NASA Headquarters
D. Gilman, Program Manager
V. Jones, SAMPEX Program Scientist
L. Caroff, SWAS Program Scientist
E. Whipple, FAST Program Scientist
Goddard Space Flight Center
O. Figueroa, Project Manager
D. Baker, Project Scientist
G. Colon, SAMPEX Mission Manager
D. Betz, SWAS Mission Manager
G. Chin, SWAS Mission Scientist
T. Gehringer, FAST Mission Manager
Major Contractors
University of Maryland (SAMPEX)
California Institute of Technology (SAMPEX)
Max Planck Institute (SAMPEX)
Aerospace Corporation (SAMPEX)
Smithsonian Astrophysical Observatory (SWAS)
Ball Aerospace (SWAS)
University of Cologne (SWAS)
Millitech (SWAS)
University of California-Berkeley (FAST)
Lockheed Palo Alto Research Laboratory (FAST)
University of New Hampshire (FAST)



Submillimeter Wave Astronomy Satellite



Fast Auroral Snapshot Explorer

Status

SAMPEX
Critical Design Review (CDR) was completed in June 1990. Instrument integration began in September 1991. Currently in flight integration for a June 1992 launch.

FAST
Preliminary Review completed in November 1991. Currently being developed and built for a 1994 launch.

SWAS
Concept Review was completed during June 1990. The instruments and spacecraft began development in December 1991 for a 1995 launch.

Space Infrared Telescope Facility (SIRTF)

Objective

The objectives of the Space Infrared Telescope Facility (SIRTF) are to: 1) carry out high sensitivity photometric, imaging and spectroscopic observations of celestial sources; 2) study the formation of galaxies, stars and planets; 3) observe new comets and other primitive bodies in the outer solar system; 4) study disks of solid material around nearby stars (planetary system development); 5) search for Brown Dwarfs and the missing mass; 6) extend the Infrared Astronomical Satellite (IRAS) studies of forming stars to earliest phases of star formation; 7) extend Cosmic Background Explorer (COBE) studies of the infrared background to finer spatial scales; 8) identify and study powerful infrared-emitting galaxies at the edge of the Universe; and 9) provide infrared perspective for the understanding of quasars.

Description

SIRTF, the infrared element of the Great Observatories program, will cover the wavelength range from 1.8 to 700 micrometers. The scientific payload will consist of a meter-class, cryogenically cooled telescope capable of diffraction-limited observations at 3 microns. It will have a complement of three focal plane instruments: an Infrared Spectrometer (IRS), Infrared Array Camera (IRAC) and a Multiband Imaging Photometer (MIPS). Both the telescope and the instruments will be cryogenically cooled with superfluid helium. SIRTF will have 2 arcsecond images at 3 microns and a pointing stability of 0.15 arcseconds rms (root mean square). SIRTF will be launched aboard a Titan IV/Centaur expendable launch vehicle into a 100,000 kilometer altitude, 28.5 degree inclination circular orbit. The orbit has been selected to place SIRTF well above the Earth's trapped radiation zone. Mission lifetime will be a minimum of 5 years.

Launch Date:	Under Review
Payload:	3 instruments
Orbit:	28.5 degree inclination; 100,000 km (54,000 nm) altitude, circular
Design Life:	5 years (no servicing)
Length:	5.3 m (17 ft)
Weight:	Approx. 5,500 kg (12,100 lbs)
Diameter:	2.9 m (10 ft)
Launch Vehicle:	Titan IV/Centaur

Instruments/Investigations/Principal Investigators

Infrared Spectrometer (IRS) - J. Houck (Cornell University)
Infrared Array Camera (IRAC) - G. Fazio (Smithsonian Astrophysical Observatory)
Multiband Imaging Photometer (MIPS) - G. Rieke (University of Arizona)

Mission Events

Orbit option decision: March 1989
Development Center Selected: December 1989
Phase B study: TBD

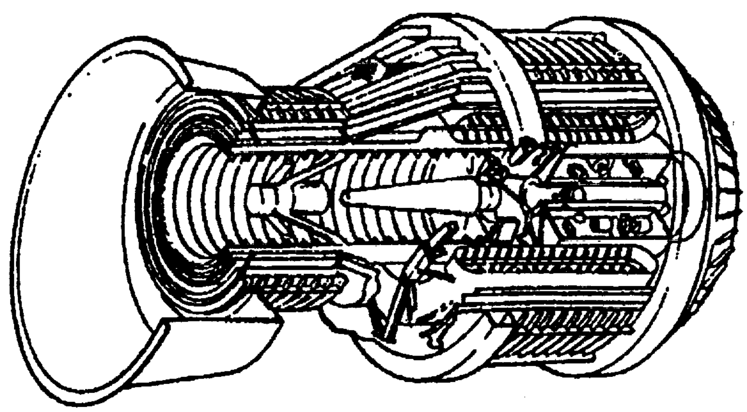
Space Infrared Telescope Facility (SIRTF) (Continued)

Management

NASA Headquarters
P. Ulrich, Study Manager
L. Caroff, Program Scientist
Jet Propulsion Laboratory
TBD, Manager
M. Werner, Scientist

Status

The Jet Propulsion Laboratory (JPL) was selected in December 1989 as the lead center for infrared detection technology development. SIRTF is a candidate for a fiscal year 1995 new start.



Space Infrared Telescope Facility

Space Radar Laboratory (SRL)

Objective

The objectives of the Space Radar Laboratory (SRL) are: 1) to take radar images of the Earth's surface for Earth system sciences studies, including geology, geography, hydrology, oceanography, agronomy, and botany; 2) gather data for future radar system designs, including Earth Observing System (EOS); and 3) take measurements of the global distribution of carbon dioxide in the troposphere.

Description

SRL carries a modified version of the Shuttle Imaging Radar (SIR-C) and a modified version of the Measurement of Air Pollution from Satellites (MAPS) instruments. The Space Shuttle's orientation will have the open cargo bay facing Earth. The radar antenna will be unfolded in orbit and used at various viewing angles. The Synthetic Aperture Radar will image a strip parallel to, but offset from, the groundtrack. Five 50-Megabytes per second digital data channels are recorded on special high-rate recorders. Some recorded data and some real-time data will be transmitted to the ground. Preplanned experiment sequences will be initiated by commands issued via the Space Shuttle's general purpose computer. Two additional flights of this laboratory are planned at approximately 18-month intervals.

The Shuttle Imaging Radar/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) system provides map-like images that are useful in delineating geological features and evaluating resources. The SIR-C system can be operated in a variety of modes to adapt to different investigative requirements. It has a wide range of configuration flexibility and can be modified and controlled by ground commands, crew commands, or pre-programmed commands. The 12 meter (40 foot) antenna operates at L-band (23.5 centimeter wavelength), C-band (5.7 centimeter wavelength), and X-band (2 centimeter wavelength).

The Measurement of Air Pollution from Satellites (MAPS) instrument is a gas filter radiometer operating in the 4.67 micrometer band. The MAPS is used to measure the carbon monoxide mixing ratio in the middle troposphere, upper troposphere, and lower stratosphere during both daytime and nighttime.

Launch Date:	September 1993
Payload:	SIR-C/X-SAR, MAPS
Orbit:	57 degree inclination, 240 km (130 nm) altitude
Duration:	9 Days
Length:	12.2 m (40 ft) (antenna)
Weight:	12,094 kg (26,607 lbs)
Diameter:	4 m (13 ft)
Launch Vehicle:	Space Shuttle
International Participation:	Italy, FRG

Instruments/Investigations/Principal Investigators

Shuttle Imaging Radar-C (SIR-C) - C. Elachi (Jet Propulsion Laboratory)
X-Band Synthetic Aperture Radar (X-SAR) - H. Öttl (German Aerospace Research Establishment - FRG), P. Pampaloni (Italian Space Agency - ASI)
Measurement of Air Pollution from Satellites (MAPS) - H. Reichle (LaRC)

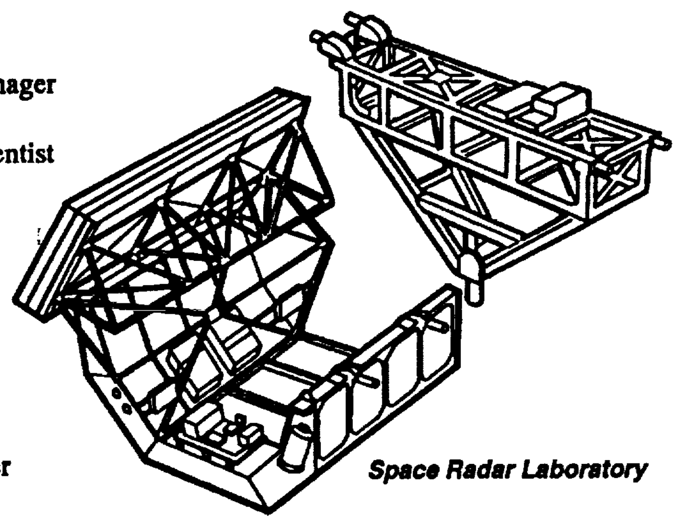
Space Radar Laboratory (SRL) (Continued)

Mission Events

SRL-1
Mission concept, feasibility studies: March 1990
Mission definition studies: July 1990
Instrument development: Ongoing
Instrument delivery to Kennedy Space Center begins: January 1993
Payload integration: TBD

Management

NASA Headquarters
W. Huddleston, SRL Program Manager
R. Monson, SIR-C/X-SAR Program Manager
G. Esenwein, MAPS Program Manager
M. Baltuck, SIR-C/X-SAR Program Scientist
J. McNeil, MAPS Program Scientist
Johnson Space Center
L. Wade, SRL Mission Manager
E. Jung, Payload Integration Manager
Jet Propulsion Laboratory
M. Sander, SIR-C Project Manager
E. Carrow, SIR-C Project Manager
Kennedy Space Center
B. Cerrato, Launch Site Support Manager
German Space Agency (DARA)
M. Wahl, X-SAR Project Manager
Italian Space Agency (ASI)
P. Ammendola, X-SAR Project Manager
P. Pampoloni, X-SAR Project Scientist
German Aerospace Research Establishment (DLR)
H.Öttl, X-SAR Project Scientist
Major Contractor
Messerschmitt-Boelkow-Blohm


Space Radar Laboratory

Status

SIR-C/X-SAR antenna design has been baselined; L-, C-band antenna fixed, X-band antenna moveable. Designs of all systems are being finalized; fabrication and testing are underway. MAPS is ready to fly. Progress continues toward a 1993 launch.

Spacelab-J (SL-J)

Objective
Spacelab-J (SL-J) will conduct basic and applied materials science processing research and life sciences investigations that can be conducted only in the microgravity environment of space.

Description
The Spacelab-J mission is jointly sponsored by NASA and the National Space Development Agency of Japan (NASDA). NASA will be partially reimbursed for the cost of a dedicated Space Shuttle flight, including the use of Spacelab systems. The Japanese are providing two Spacelab double racks for the materials science facilities and one double rack for life sciences experiments. The remaining space in the long module will be devoted to NASA materials sciences and life sciences experiments, Spacelab avionics (computers, environmental control, etc.), common support equipment (video recorders, fluid pumps, etc.), and storage space for materials needed for experiments. The crew of seven will include the Commander, Pilot, orbiter mission specialist, two payload mission specialists, one U.S. science mission specialist and one Japanese payload specialist. Mission and payload operations centers in the U. S. will support the crew in 24-hour operations.

Launch Date:	September 1992
Investigations:	44
Orbit:	57 degree inclination; 296 km (160 nm) altitude
Duration:	7 days
Length:	7 m (23 ft)
Weight:	11,423 kg (25,131 lbs)
Diameter:	4.8 m (16 ft)
Launch Vehicle:	Space Shuttle
International Participation:	Japan

Instruments/Investigations/Principal Investigators
Microgravity Science

Crystal Growth Chamber - C. Bugg (University of Alabama-Birmingham)

Space Acceleration Measurement System (SAMS) - R. DeLombard (LeRC)

Gradient Heating Furnace - T. Yamada (Nippon Telephone and Telegraph Corporation); A. Kamio (Tokyo Institute of Technology); N. Tatsumi (Sumitomo Electric Industries, Ltd)

Image Furnace - Y. Segawa (Institute of Physical and Chemical Research); I. Nakatani (National Research Institute for Metals); N. Soga (Kyoto University); S. Takekawa (National Institute for Research)

Continuous Heating Furnace - K. Togano (National Research Institute for Metals); T. Dan (National Research Institute for Metals); T. Suzuki (Tokyo Institute of Technology); Y. Hamakawa (Osaka University); A. Ohnu (Chiba Institute of Technology)

Large Isothermal Furnace - A. Fukuzawa (National Research Institute for Metals); Y. Muramatsu (National Research Institute for Metals); S. Kohara (Science University of Tokyo)

Crystal Growth Experiment Facility - T. Nishinaga (University of Tokyo); N. Wada (Nagoya University)

Liquid Drop Experiment Facility - T. Yamanaka (National Aerospace Laboratory)

Bubble Behavior Experiment - H. Azuma (National Aerospace Laboratory)

Acoustic Levitation Furnace - J. Hayakawa (Government Industrial Research Institute, Osaka)

Marangoni Convection Experiment Unit - S. Enya (Ishikawajima-Harima Heavy Industries, Ltd.)

Organic Crystal Growth Facility - H. Anzai (National Electrotechnical Laboratory)

Spacelab-J (SL-J) (Continued)

Life Sciences

Autogenic Feedback Training Equipment - P. Cowlings (ARC)
Cell Culture Chambers - N. Partridge (St. Louis University); A. Krikorian (State University of New York-Stony Brook); A. Sato (Tokyo Medical and Dental University)
Fluid Therapy System, - C. Lloyd (JSC); G. Creager (JSC)
Frog Embryology Unit - K. Souza (ARC)
Lower Body Negative Pressure (LBNP) Device, AFE and LSLE Computer - J. Charles (JSC)
MRI Unit (Pre-flight and Post-flight only) - A. LeBlanc (Baylor College of Medicine and Methodist Hospital)
Physiological Monitoring System - C. Sekiguchi (National Space Development Agency of Japan); K. Koga (Nagoya University)
Urine Monitoring System - N. Matsui (Nagoya University)
Vestibular Function Experiment Unit - S. Mori (Nagoya University)
Free Flow Electrophoresis Unit - M. Kuroda (Osaka University); T. Yamaguchi (Tokyo Medical and Dental University)
Light Impulse Stimulator - K. Koga (Nagoya University)
Crystal Growth Cell - Y. Morita (Kyoto University)
Incubator - T. Suda (Showa University)
Fly Container - M. Ikenaga (Kyoto University)
Double Integral Control Element - A. Tada (National Aerospace Laboratory)
Radiation Monitoring Container - S. Nagaoka (National Space Development Agency of Japan)
Fungi Growth Chamber - Y. Miyoshi (Tokyo University)

Mission Events

Payload Specialists Selection: October 1989
Payload Confirmation: January 1990
Investigators Working Group: August 1991
Experiment Delivery to Kennedy Space Center: November 1991
Launch Readiness Review: September 1992

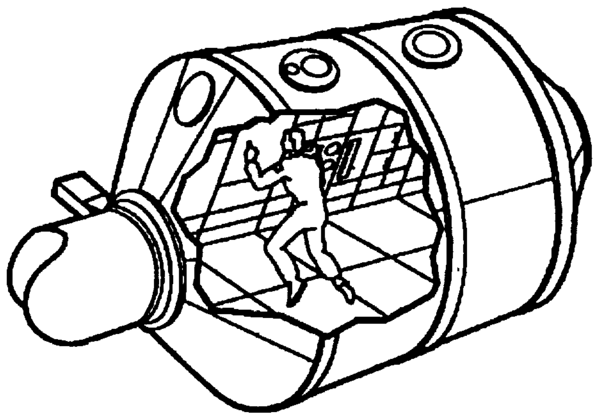
Management

NASA Headquarters
G. McCollum, SL-J Program Manager
R. Sokolowski, SL-J Science Program Scientist
Marshall Space Flight Center
A. King, Mission Manager
F. Leslie, Mission Scientist
National Space Development Agency of Japan (NASDA)
N. Soichi, Project Manager
Y. Fujimori, Project Scientist
Major Contractor
Teledyne Brown Engineering

Spacelab-J (SL-J) (Continued)

Status

NASA sponsored Life Science investigations are on schedule for September 1992 launch date. Experimental Verification Tests (EVT's) have been successfully completed. The payload is presently being integrated at Kennedy Space Center.



Spacelab-J

Spacelab Life Sciences (SLS) Series

Objective

The Spacelab Life Sciences (SLS) missions are devoted to research related to the future health, safety and productivity of humans in space. On each mission a set of coordinated and complementary investigations will focus on observations of the physiological responses to weightlessness. The study of existing problems associated with weightlessness, such as acute fluid shift, cardiovascular adaptation and space motion sickness, will foster new insights into the responsible physiological mechanisms. Confidence in estimates of the consequences of sustained weightlessness will be increased and attempts to manage or reduce adverse effects of microgravity will be enhanced.

Description

SLS-1 was the first Space Shuttle mission dedicated to life sciences research. The payload included in-flight experiments employing human, rodent, and jellyfish subjects, which tested the early stages of physiological adaptation responses to spaceflight within the constraints of a 9-day Space Shuttle mission. Proposed by an international team of investigators, 18 life sciences investigations, two microgravity investigations and seven other studies or facilities tests were selected for flight. The scientific objectives of the SLS-1 mission required data and specimen samples to be gathered from animal and human subjects. In addition to acting as test subjects, the crew was involved in the acquisition and evaluation of data. Life Sciences hardware included the Small Mass Measurement Instrument (SMMI), the Spacelab Refrigerator/Freezer, the General Purpose Work Station (GPWS), the General Purpose Transfer Unit (GPTU), the Physiological Monitoring System (PMS), cardiovascular testing apparatus, and the echocardiograph. An upgraded version of the Research Animal Holding Facility (RAHF) also held up to 20 rodents.

SLS-2 is primarily a reflight of several of the SLS-1 investigations. Two additional Research Animal Holding Facilities will be included to accommodate sufficient rodent populations to complete the investigations begun on SLS-1. This will be the first life sciences mission to use an Extended Duration Orbiter (EDO) kit to enable a 13-day stay in space. The EDO Medical Program will develop countermeasures and procedures to minimize the negative impacts of space flight and ensure the safety and success of extended duration shuttle missions.

SLS-3 has yet to be fully defined, but will be the first mission to include the NASA/French Space Agency (CNES) Rhesus facility. It will be a 16-day EDO mission.

	SLS-2	SLS-3
Launch Date:	August 1993	2nd Quarter FY 1996
Investigations:	14	TBD
Orbit:	28.5 degrees inclination; 296 km (160 nm) altitude	TBD
Design Life:	13 days	16 days
Length:	7 m (23 ft)	7 m (23 ft)
Weight:	TBD	TBD
Diameter:	4.8 m (16 ft)	4.8 m (16 ft)
Launch Vehicle:	Space Shuttle	Space Shuttle
International Participation:	Switzerland, Australia, France and former Soviet Union	Switzerland, Australia, France and former Soviet Union

Spacelab Life Sciences (SLS) Series (Continued)

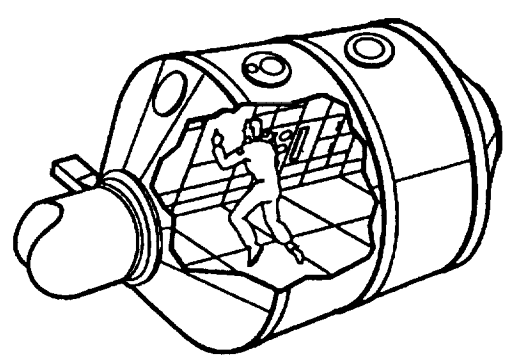
Investigations (SLS-2)/Principal Investigators

Inflight Study of Cardiovascular Deconditioning - L. Fahri (State University of New York-Buffalo)
Pulmonary Functions in Weightlessness - J. West (University of California-San Diego)
Cardiovascular Adaptation to Zero Gravity - C. Blomquist (University of Texas Health Sciences Center)
Fluid-Electrolyte Regulation During Spaceflight - C. Leach (JSC)
Vestibular Experiments in Spacelab - L. Young (Massachusetts Institute of Technology)
Effects of Zero Gravity on Mammalian Gravity Receptors - M. Ross (ARC)
Regulation of Erythropoiesis During Spaceflight - R. Lange (University of Tennessee Medical School)
Regulation of Blood Volume During Spaceflight - C. Alfrey (Baylor College of Medicine)
Influence of Spaceflight on Erythokinetics in Man - C. Alfrey (Baylor College of Medicine)
Protein Metabolism During Spaceflight - T. Stein (University of Medicine and Dentistry of New Jersey)
Bone, Calcium, and Spaceflight - E. Holton (ARC)
Pathophysiology of Mineral Loss During Spaceflight - C. Arnaud (Veterans Administration Hospital)
Effects of Microgravity on the Electron Microscopy, Histochemistry and Motion Activities of Rat Hindlimb Muscle - D. Riley (Medical College of Wisconsin)
Effects of Zero Gravity on Biochemical and Metabolic Prospectives of Skelatal Muscle in Rats - K. Baldwin (University of California College of Medicine at Irvine)

Mission Events

<u>SLS-2</u>
Preliminary equipment design: 1979
Mission concept, feasibility studies: September 1981
Mission definition studies: 1983
Preliminary Design Review: August 1990
Mission implementation: Ongoing
Payload Confirmation Review: January 1992
Critical Design Review: February 1992
Experiment delivery to Kennedy Space Center: August 1992

<u>SLS-3</u>
Preliminary equipment design: Ongoing
Mission concept and feasibility studies: Ongoing
Mission definition studies: Ongoing



Spacelab Life Sciences

Spacelab Life Sciences (SLS) Series (Continued)

Management

NASA Headquarters
G. McCollum, SLS Program Manager
W. Gilbreath, Life Sciences Program Manager
F. Sulzman, Life Sciences Program Scientist (SLS-2 & 3)
Johnson Space Center
H Schneider, Mission Scientist
K. Newkirk, Mission Manager (SLS-2)
Major Contractors
General Electric
Lockheed

Status

SLS-1: Launch occurred on June 5, 1991. Payload activities exceeded expectations on each flight day, with the orbiter and Spacelab performing well without major anomalies. Extensive research was conducted on seven human body systems: the cardiovascular/cardiopulmonary, hematological, muscular, skeletal, vestibular, immune, and renal-endocrine systems. The mission was completed and the Space Shuttle landed on June 14, 1991.

SLS-2: Project Offices at the Johnson Space Center and the Ames Research Center are preparing for the Integrated Payload Critical Design Review and the Phase II Flight Safety Review, both scheduled for February 1992.

SLS-3: Investigations tentatively selected for definition in 1984 are being prioritized for flight and some initial work on required hardware has begun.

Submillimeter Intermediate Mission (SMIM)

Objective

The objectives of the Submillimeter Intermediate Mission (SMIM) are to: 1) obtain a complete, high-resolution (up to 0.1 kilometers per second) spectral line survey of an estimated 100 astronomical sources or positions during its 1- to 2-year lifetime; 2) obtain clues to the processes by which diffuse gas clouds are assembled into stars and planetary systems; 3) measure the thermodynamic properties, and provide a detailed chemical analysis of star and planet forming clouds; and 4) extend proposed SIRTF and SOFIA submillimeter capabilities by studying many lines of each of hundreds of molecular and atomic species at extremely high spatial and spectral resolution.

Description

SMIM will perform a complete, high resolution spectral line survey between 100 and 750 microns for about 100 sources during its 1- to 2-year mission. Heterodyne and Fabry-Perot techniques on SMIM will give spectral resolutions up to 3×10^6 (0.1 kms^{-1}) and 10^4 (30 kms^{-1}), respectively, and its 2.5 meter telescope will yield an angular resolution of 10 arcseconds at 100 microns.

SMIM consists of a passively cooled, f/10 Cassegrain telescope with a 2.5 meter, composite honeycomb primary reflector and an 18 centimeter composite secondary reflector. Passive temperature control is provided by an inflatable, space-rigidized sunshade which allows the primary reflector to use the entire launch shroud dynamic envelope. The science instruments are contained in a 385 liter helium cryostat based on Infrared Radio Astronomy Satellite (IRAS) and Cosmic Background Explorer (COBE) technology.

The mission will use an expendable launch vehicle to reach a high Earth orbit. In this orbit, science activities will take place above 40,000 kilometers where the spacecraft is clear of the Van Allen radiation belts. This maximizes time available for science observations.

Launch Date:	TBD
Payload:	Heterodyne and Far-Infrared Spectrometer
Orbit:	high Earth orbit
Design Life:	1-2 years
Length:	3 m (10 ft)
Weight:	1000 kg (2,200 lbs)
Diameter:	3 m (10 ft)
Launch Vehicle:	Expendable Launch Vehicle

Candidate Instruments

Far-Infrared Fabry-Perot Spectrometer (FIRS)
SIS Tunnel Junction Heterodyne Receivers (SISH)

Submillimeter Intermediate Mission (SMIM) (Continued)

Management

NASA Headquarters
M. Kaplan, Program Manager
L. Caroff, Program Scientist
Jet Propulsion Laboratory
B. Gray, Study Manager
Major Contractor
California Institute of Technology

Status

SMIM Mission concept studies and technology development activities are ongoing at the Jet Propulsion Laboratory.

Tethered Satellite System (TSS)

Objective

The objectives of the Tethered Satellite System (TSS) are: 1) to verify the engineering performance of the TSS; 2) to determine and understand the electromagnetic interaction between the tether/satellite/Space Shuttle system and the ambient space plasma; 3) to investigate and understand the dynamical forces acting upon a tethered satellite; and 4) to develop the capability for future tether applications.

Description

TSS is a cooperative program between NASA and the Italian Space Agency (ASI). NASA is responsible for the TSS deployer and systems integration, while Italy is building the satellite; both are providing scientific investigations. On its first flight, the satellite will be deployed on a conducting tether above the Space Shuttle to a distance of 20 kilometers. The deployer consists of a Spacelab pallet, a reel for deployment and final retrieval of the satellite, an electrical power and distribution subsystem, a communications and data management subsystem, and a tether control capability. A separate support structure will carry science instrumentation. The satellite is spherical with a diameter of 1.6 meters. The upper hemisphere will house the scientific payload, while the lower hemisphere will contain the support equipment. The satellite is equipped with cold gas (nitrogen) thrusters used for deployment, retrieval, and altitude control.

Launch Date:	August 1992
Payload:	Deployer, Satellite and Pallet-mounted Experiments
Orbit:	28.5 degree inclination; 300 km (162 nm) altitude, circular
Duration:	36 hours
Length:	5.76 m (19 ft)
Weight:	5,840 kg (12,848 lbs)
Diameter:	1.6 m (5 ft) (Satellite)
Launch Vehicle:	Space Shuttle
International Participation:	Italy

Instruments/Investigations/Principal Investigators

A Theoretical and Experimental Investigation of TSS Dynamics (TEID) - S. Bergamaschi (University of Padova - Italy)

Detection of the Earth's Surface of ULF/VLF Emissions by TSS (OESEE) - G. Tacconi (University of Genoa - Italy)

Investigation and Measurement of Dynamic Noise in TSS (IMDN) - G. Gulhorn (Smithsonian Astrophysical Observatory)

Investigation of Electromagnetic Emissions from Electrodynamic Tether (EMET) - R. Estes (Smithsonian Astrophysical Observatory)

Italian Core Equipment for Tether Current/Voltage Control (DCORE) - C. Bonifazi (Italian Space Agency - ASI)

Magnetic Field Experiment for the TSS Missions (TMAG) - F. Mariani (Second University of Rome - Italy)

Research on Electrodynamic Tether Effects (RETE) - M. Dobrowolny (National Center for Scientific Research - France)

Research on Orbital Plasma Electrodynamics (ROPE) - N. Stone (MSFC)

Shuttle Electrodynamic Tether System (SETS) - P. Banks (Stanford University)

Shuttle Potential and Return Electron Experiment (SPREE) - M. Oberhardt (Air Force Geophysical Laboratory)

Tethered Optical Phenomena (TOP) - S. Mende (Lockheed Palo Alto Research Laboratory)

Tethered Satellite System (TSS) (Continued)

Mission Events

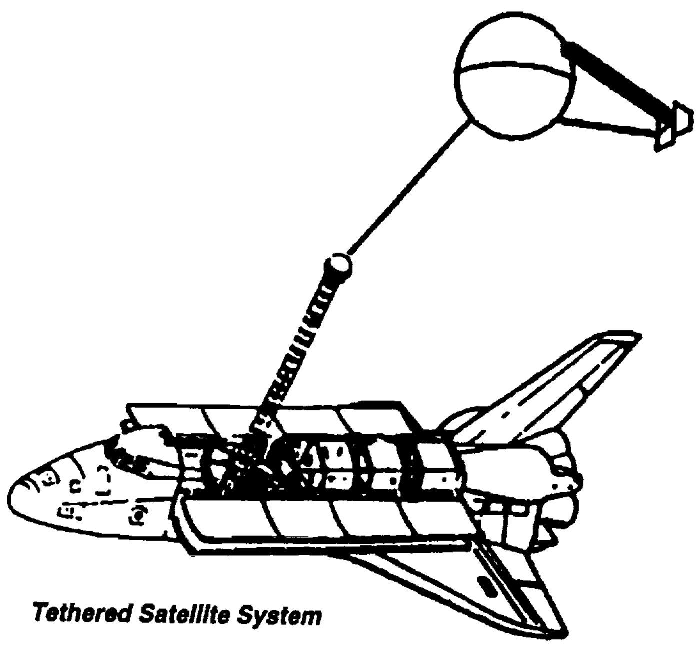
NASA/ASI MOU: March 1984
Announcement of Opportunity signed: June 1985
Science investigation selected: July 1985
Deployer Delivered to Kennedy Space Center: August 1990
Satellite delivered to Kennedy Space Center: November 1990

Management

NASA Headquarters
T. Stewart, Deployer Program Manager
R. Howard, Science Payload Program Manager
D. Reasoner, Program Scientist
Marshall Space Flight Center
J. Price, Project Manager
N. Stone, Project Scientist
Italian Space Agency (ASI)
G. Manarini, Program Manager
F. Mariani, Program Scientist
M. Dobrowolny, Project Scientist

Status

Deployer and satellite have been delivered to Kennedy Space Center. Integration with Space Shuttle system proceeding on schedule.



Tethered Satellite System

Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED)

Objective

TIMED will carry out the first comprehensive space-borne investigation of the physical and chemical processes acting in the terrestrial mesosphere and lower thermosphere/ionosphere (MLTI) between approximately 60 to 180 kilometers. TIMED will be an exploratory mission to characterize and understand the interplay of composition, energetics, radiation and dynamics of this region. It will complement the NASA Upper Atmosphere Research Satellite (UARS) (stratospheric) and International Solar-Terrestrial Physics (ISTP) (magnetospheric) missions and contribute to the international Solar-Terrestrial Energy Program (STEP) program. TIMED will also contribute to the study of human-induced changes in the atmosphere. Specifically, the mesosphere is sensitive to increasing levels of methane and carbon dioxide and may be an important harbinger of global change.

Description

The satellite and instrument requirements for the TIMED mission are derived from prioritized objectives calling for measurements of the energy and momentum sources, state variables, dynamics, and the related ionospheric structure and electrodynamics. The resulting mission comprises two nearly identical spacecraft in different orbits to provide extensive coverage of MLTI parameters in latitude, altitude, local time, and season. The spacecraft are launched on separate Delta-class expendable launch vehicles into orbit shaving inclinations of 95 degrees and 49 degrees. Both spacecraft have on-board propulsion capabilities to allow for circular and eccentric orbits. The operating lifetime of each spacecraft is 48 months.

Instruments

The instruments are TBD pending the NASA Announcement of Opportunity; selection is anticipated in December 1992.

Mission Events

Release of Announcement of Opportunity: February 1992
Non-advocacy Review: July 1992
Completion of Phase A study: July 1992
Selection of instruments: December 1992
Phase B studies: July 1992 - January 1994

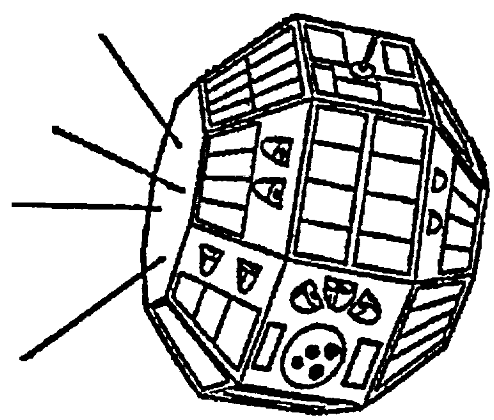
Management

NASA Headquarters
R. Howard, Program Manager
D. Reasoner, Program Scientist
Goddard Space Flight Center
H. McCain, Project Manager
H. Mayr, Project Scientist

Thermosphere-Ionosphere-Mesophere Energetics and Dynamics (TIMED) (Continued)

Status

TIMED was selected as the highest priority intermediate mission new start by NASA's Space Science and Applications Advisory Committee. It is a candidate fiscal year 1994 new start.



Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics

United States Microgravity Laboratory (USML) Series

Objective
The United States Microgravity Laboratory (USML) Series will: 1) establish a space laboratory program with long-term continuity to define, establish, and quantify selected materials, fluid, and biological processes and processing applications requiring the low gravity environment of Earth orbit; and 2) offer the U.S. scientific and commercial communities access to Spacelab and its capabilities, thereby, fostering development of a science and technology base for Space Station Freedom applications.

Description
The USML series will focus on materials and fluids sciences and applications experiments, as well as technology development. USML missions will fly at approximately 2.5 year intervals in order that scientists may build upon results from previous investigations. The payload crew will be actively involved in many investigations as trained scientists performing experiments in orbit and providing immediate scientific assessment of experiment progress to investigators on the ground. NASA provides the flight opportunities, defines and integrates the payload, and maintains responsibility for mission management.

The USML program will use an Extended Duration Orbiter (EDO) capability which, through use of additional cryogenic tankage in the cargo bay, can extend flight duration up to 16 days. The EDO kit offers an increase in total flight energy (kilowatt hours) over that provided in a fifth energy kit-outfitted Space Shuttle. The USML program will also conduct experiments in which flight hardware is mounted on the cargo bay and exposed to the space environment (rather than inside the pressurized volume offered by the Spacelab long module). This payload configuration is designated the United States Microgravity Payload (USMP).

Launch Date:	USML-1: June 1992
	USML-2: 3rd Quarter FY 1995
	USML-3: 3rd Quarter FY 1997
Investigations:	13 investigations, 17 demonstration experiments (USML-1)
Orbit:	28.5 degree inclination; 297 km (160 nm) altitude
Duration:	13 Days
Length:	10 m (33 ft)
Weight:	15,385 kg (33,847 lbs) (maximum)
Diameter:	4.6 m (15 ft)
Launch Vehicle:	Spacelab/Space Shuttle

Investigations/Instruments/Principal Investigators
Crystal Growth Furnace (CGF) - D. Larsen (Grumman Aerospace), S. Lehoczky (MSFC), D. Matthiesen (GTE Laboratories, Inc.), H. Weidemeier (Rensselaer Polytechnic Institute)
Drop Physics Module (DPM) - T. Wang (Vanderbilt University), M. Weinberg (University of Arizona), R. Apfel (Yale University)
Protein Crystal Growth (PCG-II) - C. Bugg (University of Alabama-Birmingham)
Solid Surface Combustion Experiment (SSCE) - R. Altenkirch (Mississippi State University)
Surface Tension Driven Convection Experiment (STDCE) - S. Ostrach (Case Western Reserve University)
USML-1 Glovebox Experiments Module (GEM) (17 activities) - various
Spacecraft Acceleration Movement System (SAMS) - R. De Lombard (LeRC)
Extended Duration Orbiter Medical Program (EDOMP) - C. Savin (JSC)
Zeolite Crystal Growth (ZCG) - A. Sacco (Worcester Polytechnic Institute)
Commercial Generic Bioprocessing Apparatus (CGBA) - L. Stodieck (Bioserve Technologies)
Astroculture (ASC) - T. Tibbets (Wisconsin Center for Space Automation and Robotics)

United States Microgravity Laboratory (USML) Series (Continued)

Mission Events

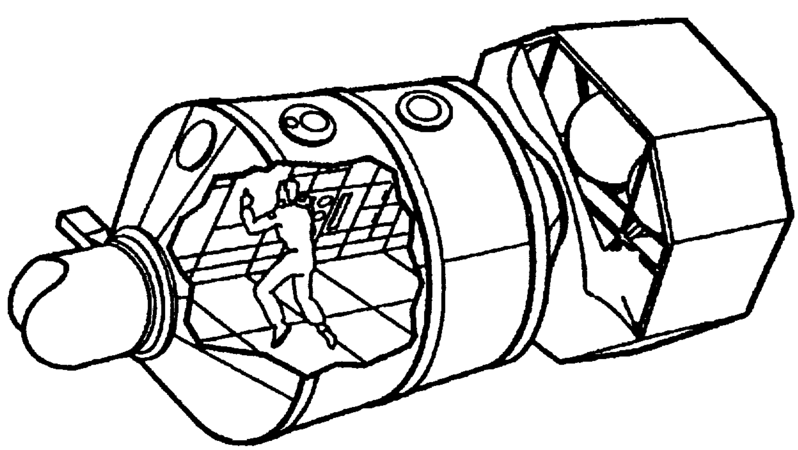
USML-1:
Authorization to proceed: June 1988
Mission Preliminary Design Review: October 1989
Mission Critical Design Review: July 1990
Cargo Integration Review: April 1991
Payload Readiness Review: March 1992
Flight Readiness Review: May 1992

Management

NASA Headquarters
J. McGuire, Program Manager
R. Crouch, Program Scientist
Marshall Space Flight Center
C. Sprinkel, Mission Manager
D. Frazier, Mission Scientist

Status

Major experiments have been integrated into Spacelab racks at Kennedy Space Center.



United States Microgravity Laboratory

United States Microgravity Payload (USMP)

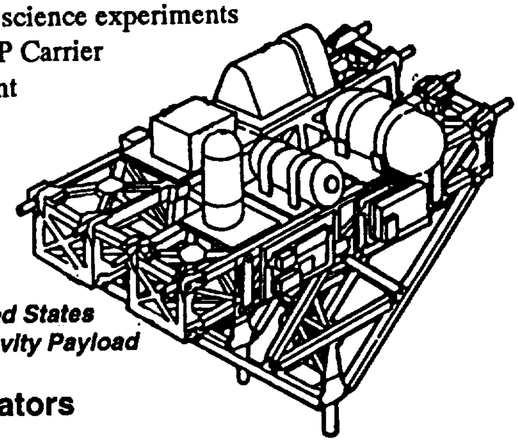
Objective

The United States Microgravity Payload (USMP) will perform materials and fundamental science experiments in the microgravity space environment with in-flight monitoring of important experiment parameters, and post-flight analysis of samples. Such activities are expected to advance significantly basic knowledge of materials science and fundamental science.

Description

The USMP series of mixed cargo flights will employ flight-proven experiment support systems. The USMP carrier structure is derived from the Mission Peculiar Equipment Support Structure (MPESS) which was first flown on the second Office of Space and Terrestrial Applications payload (OSTA-2). The power, data, and thermal control services developed for the Materials Science Laboratory-2 that flew on STS 61-C (January 1986) are also incorporated into the USMP carrier. The facilities on the carrier are exposed to the space environment, rather than being inside Spacelab's pressurized long module. The payload will be controlled remotely by investigators on Earth. A launch rate of one USMP flight per year has been requested to facilitate follow-ups on experimental results.

Launch Date:	USMP-1: September 1992 USMP-2: January 1994 USMP-3: 2nd Quarter FY 1995 USMP-4: 2nd Quarter FY 1997 USMP-5: 2nd Quarter FY 1998
Payload:	Various microgravity science experiments mounted on the USMP Carrier
Orbit:	No special requirement
Design Life:	Variable
Length:	3 m (10 ft)
Weight:	4,714 kg (10,395 lbs)
Diameter:	4.6 m (15 ft)
Launch Vehicle:	Space Shuttle
International Participation:	France



United States Microgravity Payload

Investigations/Instruments/Principal Investigators

USMP-1

Lambda Point Experiment (LPE) - J. Lipa (Stanford University)

Material pour l'Etude des Phenomènes Interessant la Solidification sur Terre et en Orbite (MEPHISTO) - J. Favier (Commission of Atomic Energy - France)

Space Acceleration Measurement System (SAMS) - R. DeLombard (LeRC)

Mission Events

Preliminary instrument design: March 1990

Mission concept, feasibility studies: March 1990

Mission definition studies: February 1991

Mission implementation: Ongoing

Instrument delivery to Kennedy Space Center: January 1992

United States Microgravity Payload (USMP) (Continued)

Management

NASA Headquarters
D. Jarrett, Program Manager
S. Davidson, Program Scientist
Marshall Space Flight Center
R. Valentine, Mission Manager
S. Lehoczky, Mission Scientist

Status

<u>USMP-1</u>

The USMP-1 payload includes: the Lambda Point Experiment, which will investigate the unique properties of liquid helium as its temperature is changed through the superfluid region; the Space Acceleration Measurements Systems (SAMS), which will measure and record disturbances in the microgravity environment of the USMP carrier; and MEPHISTO, which has been provided by the French Space Agency (CNES) to investigate the influence of various parameters on the directional solidification of metallic alloys and doped semiconductors.

The integrated payload Preliminary Design Review (PDR) was held in March 1990. The integrated payload Critical Design Review was held in February 1991, and USMP-1 Payload Configuration Meeting was held on May 22, 1991.

<u>USMP-2</u>

The USMP-2 payload includes: the Advanced Automated Directional Solidification Furnace (AADSF), a furnace used for crystal growth of semiconductor materials; the Critical Fluid Light Scattering Experiment (CFLSE/Zeno), which will investigate the properties of xenon during phase transitions; the Isothermal Dendritic Growth Experiment (IDGE), which will probe the fundamental behavior of materials as they solidify into structures, known as dendrites; the French MEPHISTO experiment; and the SAMS acceleration measurement package.

The integrated payload Preliminary Design Review was held in July 1991. The integrated payload Critical Design Review is scheduled for March 1992.

<u>USMP-3</u>

The USMP-3 payload includes the Shuttle Test of the Relativity Experiment (STORE), which will test critical components of the proposed Gravity Probe-B mission, as well as reflights of the AADSF, SAMS and MEPHISTO experiments.

<u>USMP-4</u>

The USMP-4 payload includes reflights of the AADSF, IDGE, SAMS, and MEPHISTO experiments.

<u>USMP-5</u>

The USMP-5 payload includes the Critical Fluid Viscosity Measurement Experiment (CFVME), which will investigate the changing viscosity of a test fluid as it undergoes its phase change, as well as reflights of the IDGE, SAMS, and MEPHISTO experiments.

SSA

On-Going Flight Projects

Compton Observatory

Objective

Scientific objectives of the Compton Observatory include: 1) studying gamma ray emitting objects in our Milky Way galaxy and beyond; 2) investigating evolutionary forces in neutron stars and black holes; 3) searching for evidence of nucleosynthesis; and 4) searching for primordial black hole emissions.

Description

Compton is the gamma-ray element of the Great Observatories program. It is a free-flying astrophysical observatory with a 2-year operational lifetime that can be extended to 10 years through occasional altitude reboost with its on-board propulsion system. Compton will examine the gamma-ray wavelength range from 0.01 to 30,000 million electron volts (MeV) and its 15,634 kilogram mass orbits Earth at an altitude of 450 kilometers with an inclination of 28.5 degrees. The Compton payload consists of four science instruments, the Oriented Scintillation Spectrometer Experiment (OSSE), the Imaging Compton Telescope (COMPTEL), the Energetic Gamma Ray Experiment (EGRET), and the Burst and Transient Source Experiment (BATSE). The COMPTEL instrument was developed in the Federal Republic of Germany (FRG).

Launch Date:	April 5, 1991
Payload:	4 science instruments
Orbit:	28.5 degree inclination; 450 km (243 nm) altitude, circular orbit
Design Life:	2 years
Length:	7.62 m (24 ft) (stowed)
Weight:	15,634 kg (34,394 lbs)
Width:	4.57 m (15 ft) (stowed)
Launch Vehicle:	Space Shuttle
International Participation:	FRG, the Netherlands, United Kingdom, European Space Agency

Instruments/Investigations/Principal Investigators

Burst and Transient Source Experiment (BATSE) - G. Fishman (MSFC)
Oriented Scintillation Spectrometer Experiment (OSSE) - J. Kurfess (Naval Research Laboratory)
Imaging Compton Telescope Experiment (COMPTEL) - V. Schonfelder (Max Planck Institute for Extraterrestrial Physics - FRG)
Energetic Gamma Ray Experiment (EGRET) - C. Fichtel (GSFC); R. Hofstadter (Stanford)*; K. Pinkau (Max Planck Institute for Extraterrestrial Physics - FRG)
*Deceased November 1990.

Mission Events

On-Orbit Calibration Testing: June 1991
Nominal End of Primary Mission: 1993

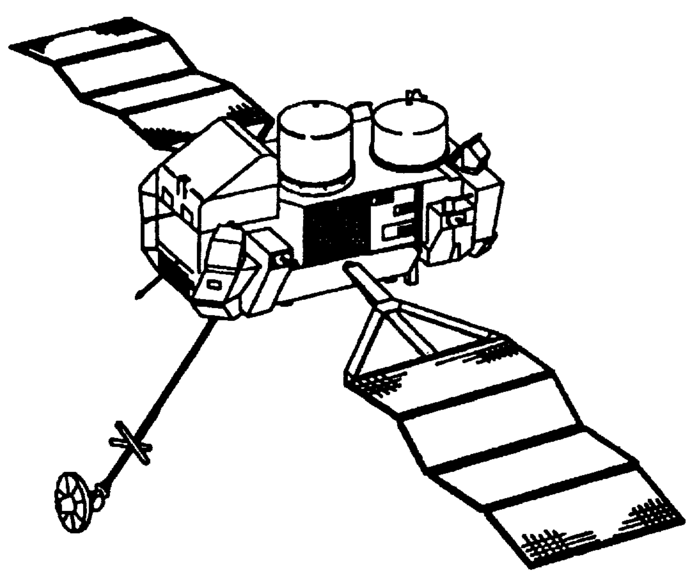
Compton Observatory (Continued)

Management

NASA Headquarters
G. Reigler, Program Manager
A. Bunner, Program Scientist
Goddard Space Flight Center
R. Wilson, Project Manager
N. Gehrels, Project Scientist
Major Contractors
TRW
Fairchild/IBM
Ball Aerospace
McDonnell Douglas
Messerschmitt-Boelkow-Blohm

Status

The Compton Observatory was launched on April 5, 1991, and is now operational on orbit. All instruments and the spacecraft are functioning well and are making routine observations. New discoveries have been reported from all instruments; these discoveries have already broadened our understanding of many objects, from pulsars to gamma-ray bursts to quasars.



Compton Observatory

Cosmic Background Explorer (COBE)

Objective

The Cosmic Background Explorer (COBE) is: 1) investigating the beginnings of organization of matter into galaxies, voids and clusters of galaxies following the Big Bang; 2) examining departures from perfect uniformity that must have occurred shortly after the Big Bang, appearing as spectral irregularities and anisotropy in the microwave and far infrared cosmic background radiation; and 3) searching for the accumulated light from the very first stars and galaxies.

Description

The Cosmic Background Explorer (COBE) is a free-flying Explorer mission that is surveying the sky for diffuse emissions in the wavelength range from 1 micrometer (μm) to 1 centimeter. At long wavelengths, the Far Infrared Absolute Spectrophotometer (FIRAS) measures the spectrum of the cosmic microwave background while the Differential Microwave Radiometer (DMR) measures the anisotropy. At shorter wavelengths, the search for the first stars and galaxies is conducted by the Diffuse Infrared Background Experiment (DIRBE). FIRAS and DIRBE are cooled to near absolute zero inside the observatory's dewar of liquid helium. COBE was developed "in-house" at the Goddard Space Flight Center (GSFC) with subsystems procured from private industry.

Launch Date:	November 18, 1989
Payload:	3 instruments
Orbit:	99 degree inclination; 900 km (486 nm) altitude
Design Life:	1 year (dewar coolant lifetime)
Length:	5.4 m (18 ft) (deployed)
Weight:	2,206 kg (4,864 lbs)
Diameter:	8.4 m (27 ft) (deployed)
Launch Vehicle:	Delta 5920

Instruments/Investigations/Principal Investigators

Far Infrared Absolute Spectrophotometer (FIRAS) - J. Mather (GSFC)
Differential Microwave Radiometer (DMR) - G. Smoot (GSFC)
Diffuse Infrared Background Experiment (DIRBE) - M. Hauser (GSFC)

Mission Events

Completion of all-sky survey: June 18, 1990
Helium Depletion: September 21, 1990
End of (currently approved) Extended Mission: November 1992

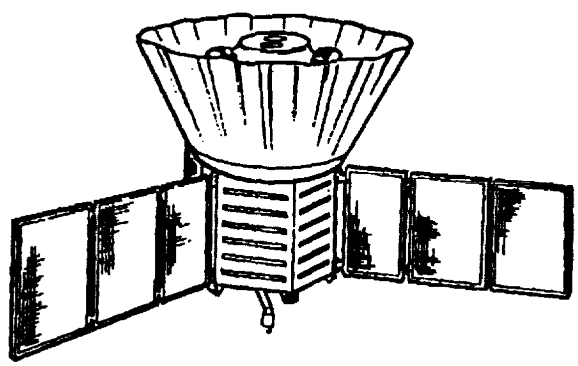
Management

NASA Headquarters
G. Riegler, Program Manager
D. Weedman, Program Scientist
Goddard Space Flight Center
P. Pashby, Project Manager
J. Mather, Project Scientist
Major Contractor
COBE is an in-house project with GSFC serving in the role of the systems contractor.

Cosmic Background Explorer (COBE) (Continued)

Status

COBE was launched successfully on November 18, 1989. COBE completed its first all-sky survey on June 18, 1990. On September 21, 1990, COBE's supply of cryogenic helium coolant was depleted. Four of the ten channels of DIRBE, and the DMR will continue to operate for a third year.



Cosmic Background Explorer

Galileo

Objective
Galileo will investigate the chemical composition and physical state of Jupiter's atmosphere and satellites and will investigate the structure and physical dynamics of Jupiter's magnetosphere.

Description
An instrumented probe will enter the Jovian atmosphere and take in situ measurements for at least 60 minutes, down to a pressure level of 10 bars, and relay its data to the orbiter for real-time transmission to Earth. The orbiter will then be injected into a highly elliptical orbit around Jupiter. The four major Jovian satellites – Io, Europa, Ganymede, and Callisto – will be studied in detail, in addition to Jupiter.

Launch Date:	October 18, 1989
Payload:	13 instruments on orbiter and 6 instruments on probe
Orbit:	Dual-spin orbiter for stabilization
Design Life:	> 6 years to Jupiter, at least 23 months of study (mission duration) by orbiter, 1 hour of probe data
Length:	9 m (29 ft)
Weight:	2,668 kg (5,883 lbs)
Diameter:	4.8 m (16 ft) (antenna)
Launch Vehicle:	Space Shuttle/Inertial Upper Stage
International Participation:	FRG

Investigations/Instruments/Principal Investigators
<u>Probe</u>
Atmospheric Structure - A. Seiff (ARC)
Neutral Mass Spectrometer - H. Niemann (GSFC)
Helium Abundance - U. von Zahn (University of Bonn - FRG)
Net Flux Radiometer - L. Sromovsky (University of Wisconsin)
Lightning/Energetic Particles - L. Lanzerotti (Bell Laboratories)
Nephelometer - B. Ragent (ARC)

<u>Orbiter</u>
Solid-State Imaging Camera - M. Belton (National Optical Astronomy Observatory)
Near-Infrared Mapping Spectrometer - R. Carlson (Jet Propulsion Laboratory)
Ultraviolet Spectrometer - C. Hord (University of Colorado)
Photopolarimeter Radiometer - J. Hanssen (Goddard Institute of Space Science)
Magnetometer - M. Kivelson (University of California-Los Angeles)
Energetic Particles Detector - D. Williams (Johns Hopkins University/Applied Physics Laboratory)
Plasma - L. Frank (University of Iowa)
Plasma Wave Spectrometer - D. Gurnett (University of Iowa)
Dust Detector - E. Grun (Max Planck Institute for Extraterrestrial Physics - FRG)
High-Energy Ion Counter - E. Stone (California Institute of Technology)
Extreme Ultraviolet Spectrometer - L. Broadfoot (University of Arizona)
Radio Science: Celestial Mechanics - J. Anderson (Jet Propulsion Laboratory)
Radio Science: Propagation - H. Howard (Stanford University)

Mission Events

Venus Flyby: February 1990
Earth Flyby 1: December 1990
Gaspra Encounter: October 1991
Earth Flyby 2: December 1992
Ida Encounter: August 1993
Jupiter Arrival: December 1995
End of Mission: November 1997

Management

NASA Headquarters
D. Ketterer, Program Manager
H. Brinton, Program Scientist
Jet Propulsion Laboratory
W. O'Neil, Project Manager
T. Johnson, Project Scientist
Ames Research Center
B. Chin, Probe Operations Manager
Major Contractors
German Aerospace Research Establishment
Hughes Aircraft
Messerschmitt-Boelkow-Blohm

Status

The Galileo spacecraft, a combined orbiter and atmospheric probe, was successfully launched from the Kennedy Space Center on October 18, 1989, by the Space Shuttle Atlantis. After deployment from the Shuttle cargo bay, an Inertial Upper Stage placed the spacecraft on a near perfect trajectory toward the planet Venus and the beginning of its 6-year journey to Jupiter.

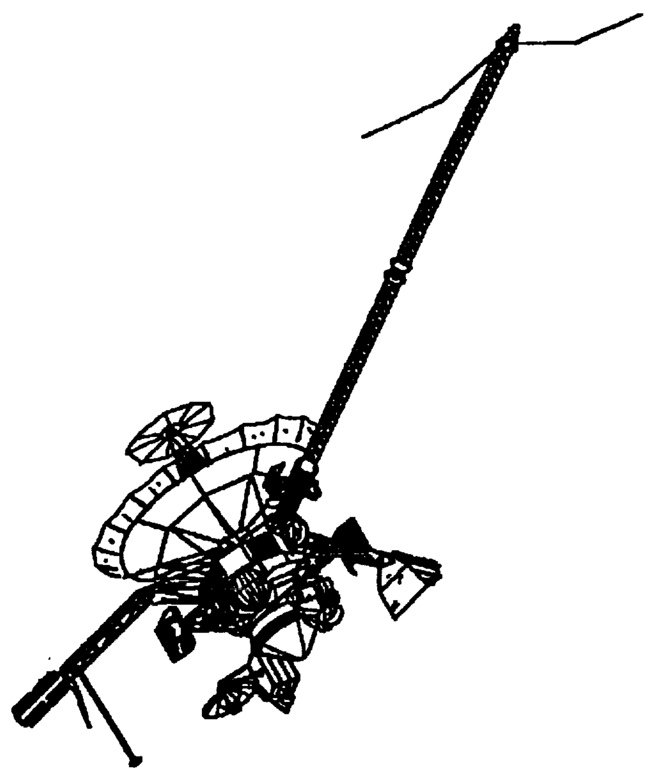
Galileo flew by Venus in February 1990, conducting the first of three planetary gravity assists. During its encounter with Venus, the Galileo spacecraft conducted the first infrared imagery and spectroscopy below the planet's cloud deck. In December 1990, Galileo became the first planetary exploration satellite to encounter Earth, providing important scientific insight into the Earth/Moon system. The Galileo spacecraft also successfully conducted the first ever spacecraft encounter with an asteroid on October 29, 1991, when it passed within 1600 kilometers of the asteroid Gaspra. This encounter produced the first ever close-up image of an asteroid.

The data from the Venus and Gaspra encounters was stored in the onboard tape recorders and played back through the spacecraft's Low Gain Antenna (LGA). The Spacecraft's High Gain Antenna (HGA) experienced problems during its planned deployment in April 1991 and is not fully deployed. The alignment pins of three adjacent antenna ribs are believed stuck in their receptacles at the mid-rib restraint point on the antenna tower. Analysis indicates that the pins may be "walked" out of their receptacles by

Status (Continued)

alternately heating and cooling the antenna tower to relieve restraining pin stresses in their receptacles. Minor movement of the pins with each thermal cycle is expected to accumulate until the pins are free. To date a series of four heating and cooling maneuvers have been performed and at least five more are tentatively planned before the second Earth encounter in December 1992. Galileo's HGA is not essential for mission operations until the spacecraft is in orbit around Jupiter in December 1995.

The Galileo spacecraft is now scheduled to pass by Earth for its third gravity assist in December 1992. Galileo will again enter the asteroid belt located between the orbits of Mars and Jupiter to conduct a close-up observation of the asteroid Ida in August 1993, and will reach Jupiter in December 1995 to begin its 23-month study of the Jovian system.



Galileo

Hubble Space Telescope (HST)

Objective

The Hubble Space Telescope (HST) is: 1) investigating the constitution, physical characteristics, and dynamics of celestial bodies; 2) determining the nature of processes occurring in stellar and galactic objects; 3) studying the history and evolution of the universe; 4) confirming universality of physical laws; and 5) providing a long-term space research facility for optical astronomy.

Description

HST, the first of the Great Observatories, provides coverage of the visible and ultraviolet portions of the electromagnetic spectrum. It is a free-flying observatory with a 15-year operational lifetime achieved through on-orbit servicing. HST has a 2.4-meter optical telescope with a cluster of Principal Investigator-developed scientific instruments at its focal plane. The European Space Agency (ESA) provided one of the science instruments (Faint Object Camera), the solar arrays and some operational support to the program. HST science instruments are replaceable to maintain state-of-the-art performance.

Launch Date:	April 24, 1990
Payload:	5 instruments
Orbit:	28.5 degree inclination; 620 km (335 nm) altitude, circular
Design Life:	15 years (with servicing)
Length:	13.1 m (16 ft)
Weight:	11,000 kg (24,255 lbs)
Diameter:	4.3 m (14 ft)
Launch Vehicle:	Space Shuttle
International Participation:	European Space Agency

Instruments/Principal Investigators

Faint Object Camera (FOC) - D. Macchetto (European Space Agency - ESA)
Faint Object Spectrograph (FOS) - D. Harms (ARC)
Goddard High Resolution Spectrometer (GHRS) - J. Brandt (University of Colorado)
High Speed Photometer (HSP) - R. Bless (University of Wisconsin)
Wide Field/Planetary Camera (WF/PC) - J. Westphal (California Institute of Technology)
Fine Guidance Sensor (FGS) Astrometry - W. Jeffreys (University of Texas)
Wide Field/Planetary Camera (WF/PC)-II* - J. Trauger (California Institute of Technology)
Space Telescope Imaging Spectometer (STIS)* - B. Woodgate (GSFC)
Near Infrared Camera (NIC)* - R. Thompson (University of Arizona)
Corrective Optics Space Telescope Axial Replacement (COSTAR)* - H. Ford (Space Science Telescope Institute)
*Instruments under development for servicing missions

Mission Events

Servicing mission: late 1993, early 1994

Hubble Space Telescope (HST) (Continued)

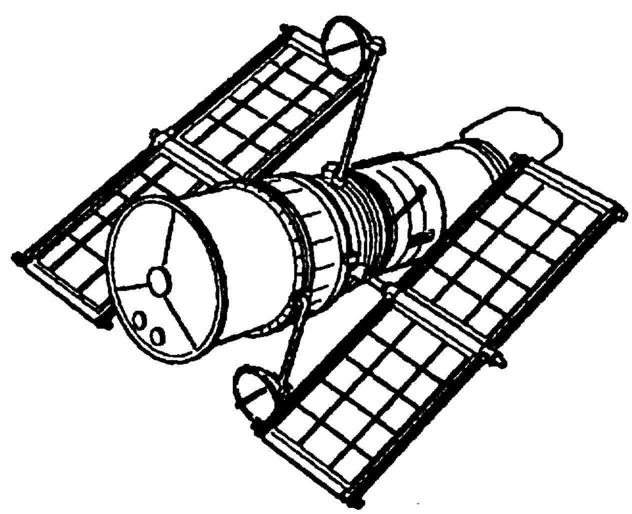
Management

NASA Headquarters
A. Fuchs, Program Manager
E. Weiler, Program Scientist
Goddard Space Flight Center
J. Rothenberg, Project Director
A. Merwarth, Project Manager (Operations)
F. Ceppolina, Project Manager (Flight Systems & Servicing)
TBD, Project Scientist
Major Contractors
Lockheed Missiles and Space Company
Hughes Danbury Optical Systems (Formerly Perkin-Elmer)
Space Telescope Science Institute
Ball Aerospace

Status

HST was successfully launched on the Space Shuttle Discovery on April 24, 1990. During HST's on-orbit verification period, a problem in the optical system was identified. This problem results in spherical aberration. In addition, a design flaw in the ESA-provided solar arrays was found to produce an out-of-specification jitter in the observatory.

HST's scientific capabilities are limited by the spherical aberration only for faint objects or objects in very crowded fields. For brighter objects, the effects of the spherical aberration are minimal; HST fully meets its spatial resolution specification for these objects. Planning for HST's first shuttle servicing mission to fix Hubble's spherical aberration and solar array jitter in late 1993/early 1994 is ongoing. Definition of the mission baseline is ongoing.



Hubble Space Telescope

Magellan

Objective
Magellan is: 1) improving knowledge of the surface tectonics and geologic history of Venus by analyzing the surface morphology and the processes that control it; 2) improving knowledge of the geophysics of Venus, principally its density distribution and dynamics; 3) improving knowledge of the small-scale physics of the planet; 4) obtaining global imagery to better than 1 kilometer resolution; and 5) obtaining topography to 50 meter resolution.

Description
The Magellan spacecraft was launched on May 4, 1989, by the Space Shuttle and Inertial Upper Stage on an interplanetary trajectory to Venus. The selected trajectory had a heliocentric transfer angle slightly greater than 540 degrees and required 15 months of flight time. Upon arrival at Venus on August 10, 1990, the spacecraft used its solid rocket motor to enter an elliptical near-polar orbit around Venus. During a Prime Mission mapping period of 8 months, the Synthetic Aperture Radar (SAR) obtained radar images of 84 percent of the planet, with a resolution about ten times better than that achieved by the Soviets' earlier Venera 15 and 16 missions. Precise radio tracking of the spacecraft will provide gravity information. The resulting geological maps will permit the first global geological analysis of the planet.

Launch Date:	May 4, 1989
Payload:	1 instrument (Radar Sensor)
Orbit:	Elliptical, Venusian, with 290 km (157 nm) periapsis, 3.26 hr-period, 86 degree inclination
Design Life:	2 years
Length:	6.4 m (10 ft) with Solid Rocket Motor
Weight:	Injected Mass 3,450 kg (7,607 lbs) on-orbit dry mass 1,035 kg (2,282 lbs)
Diameter:	3.7 m (12 ft)
Launch Vehicle:	Space Shuttle/2-stage Inertial Upper Stage
International Participation:	Australia, France, United Kingdom, former Soviet Union

Instrument/Principal Investigator
Synthetic Aperture Radar (SAR) - G. Pettengill (Massachusetts Institute of Technology)

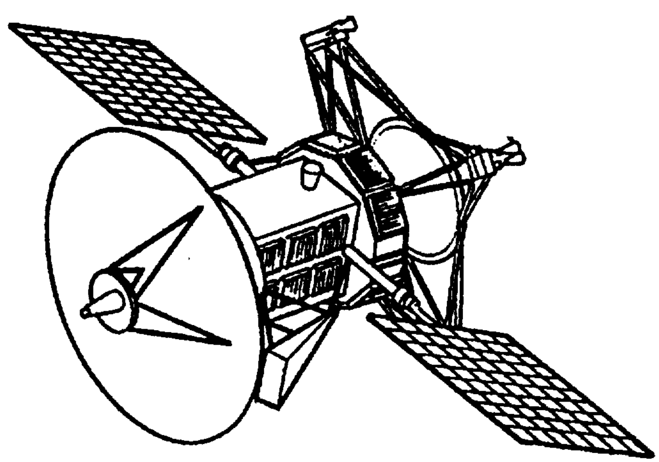
Mission Events
Venus orbit insertion: August 10, 1990
Start mapping: September 1, 1990
End nominal mapping mission: May 1991
End second mapping cycle: January 1992

Management

NASA Headquarters
E. Beyer, Program Manager
J. Boyce, Program Scientist
Jet Propulsion Laboratory
J. Scott, Project Manager
R. Saunders, Project Scientist
Major Contractors
Martin Marietta
Hughes Aircraft Co.

Status

Magellan was launched on May 4, 1989, by the Space Shuttle and an Inertial Upper Stage (IUS) on an interplanetary trajectory to Venus. Assembly and test of the spacecraft prior to launch demonstrated all the functional elements of the system, but substantial development has continued after launch in preparation for mapping operations. An initial test of the radar instrument during the cruise phase of Magellan's mission was completed in December 1989, and a full simulation of mapping operations was conducted in May 1990. Venus Orbit Insertion (VOI) occurred on August 10, 1990. Standard mapping began on September 15, 1990. The first full mapping cycle was completed on May 15, 1991, with the goal of mapping 70 percent of Venus exceeded by 14 percent. The second cycle of 243 days of mapping was completed on January 15, 1992. During the first cycle of mapping the spacecraft experienced problems which resulted in safe modes and the loss of mapping orbits; a subtle software problem, which explains most of the loss of signal events was fixed early in the second cycle. The spacecraft and radar are in good health with only redundancy lost in the tape recorders and transmitters.



Magellan

Roentgen Satellite (ROSAT)

Objective

The Roentgen Satellite (ROSAT) is: 1) studying coronal x-ray emission from stars of all spectral types; 2) detecting and mapping x-ray emission from galactic supernova remnants; 3) evaluating the overall spatial and source count distributions for various x-ray sources; 4) performing detailed study of various populations of active galaxy sources (Seyferts, Quasars, etc.); 5) performing morphological study of the x-ray emitting clusters of galaxies; and 6) performing detailed mapping of the local interstellar medium (by the extreme ultraviolet (EUV) survey).

Description

ROSAT is an Earth-orbiting x-ray observatory orbiting at a 57 degree inclination and 580 kilometers altitude. It has a fourfold nested grazing incidence mirror system with 83 centimeter aperture and 240 centimeter focal length, and covers the wavelength range from 0.1 to 2.0 thousand electron volts (keV). The ROSAT expected lifetime is approximately 2.5 years. This mission is a cooperative NASA/FRG/ United Kingdom x-ray astronomy mission viewed by NASA as a stepping stone toward the Advanced x-ray Astrophysics Facility (AXAF). The Federal Republic of Germany (FRG) built the spacecraft and main telescope, the United Kingdom provided a wide field camera, and NASA provided the High Resolution Imager (HRI) and launch services.

Launch Date:	June 1, 1990
Payload:	3 Instruments
Orbit:	57 degree inclination; 580 km (313 nm) altitude
Design Life:	2.5 years
Length:	4.5 m (15 ft) (at launch)
Weight:	2,424 kg (5,345 lbs)
Diameter:	3 m (10 ft)
Launch Vehicle:	Delta II
International Participation:	FRG, United Kingdom

Instruments/Investigations/Principal Investigators

High Resolution Imager (HRI) - (Smithsonian Astrophysical Observatory)
Position-Sensitive Proportional Counters (PSPC's) - J. Truemper (Max Plank Institute for Extraterrestrial Physics - FRG)
Wide-Field Camera (WFC) - K. Pounds (University of Leicester - UK)

Mission Events

In-orbit Checkout complete: July 30, 1990
Survey Phase complete: January 1991
Guest Observation Phase began: February 1991
End of Mission: TBD

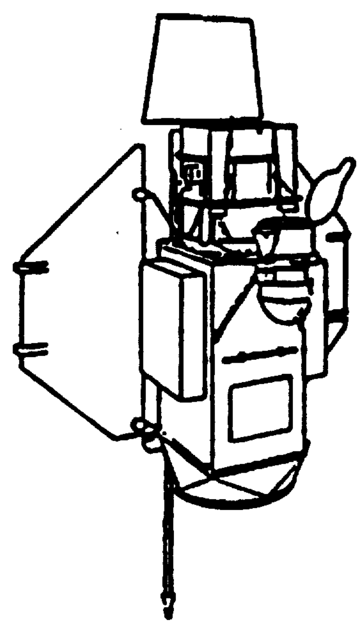
Roentgen Satellite (ROSAT) (Continued)

Management

NASA Headquarters
G. Riegler, Program Manager
A. Bunner, Program Scientist
Goddard Space Flight Center
G. Ousley, Project Manager
R. Petre, Project Scientist
Major Contractors
Dornier systems

Status

The observatory completed its 6-month survey phase in January 1991, and began its pointed observation phase in February 1991.



Roentgen Satellite

Ulysses

Objective

Ulysses will perform investigations as a function of solar latitude of the following: 1) the physics of the outer corona of the Sun; 2) the origin and acceleration of the solar wind; 3) the internal dynamics of the solar wind, shock waves, and other discontinuities; 4) the propagation, composition and acceleration of energetic particles; 5) the energy spectra, composition, isotopes and anisotopes of the heliosphere; and 6) source locations of interstellar gamma rays.

Description

Ulysses, formerly known as the International Solar Polar Mission (ISPM), has been launched into a trajectory to intercept Jupiter and use its gravity well to leave the elliptic plane and achieve high latitudes (above 70 degrees) relative to the Sun. Ulysses will assume a heliocentric orbit of 5 astronomical units (AU) by 1.3 AU. The European Space Agency (ESA) provided the spacecraft, five of nine instruments, and was responsible for instrument integration. The United States provided the launch vehicle, Radioisotope Thermoelectric Generator (RTG) power source, four science instruments, and mission operations facilities.

Launch Date:	October 6, 1990
Payload:	9 instruments
Investigations:	40
Orbit:	Heliocentric, 5 x 1.3 AU
Design Life:	5 years (mission duration)
Length:	2.2 m (7.2 ft)
Weight:	365.9 kg (807 lbs)
Diameter:	4.1 m (13.5 ft) (including booms)
Launch Vehicle:	Space Shuttle/Inertial Upper Stage/Payload Assistant Module
International Participation:	European Space Agency

Investigations/Instruments/Principal Investigators

Magnetic Field Measurements (HED) - A. Balogh (Imperial College of Science and Technology - UK)
Solar Wind Plasma (BAM) - S. Bame (Los Alamos National Laboratory)
Solar-Wind Ion Composition (GLG) - G. Gloeckler (University of Maryland)
Cosmic Ray and Solar Charged Particle (SIM) - J. Simpson (University of Chicago)
Low Energy Charged Particle (LAN) - J. Lanzerotti (Bell Laboratories)
Radio and Plasma Wave Experiment (STO) - R. Stone (GSFC)
Medium Energy Isotopic Particle Detection (KEP) - E. Keppler (Max Planck Institute for Aeronomy - FRG)
Solar X-rays and Cosmic Gamma-Ray Burst Experiment (HUS) - K. Hurley (French Space Agency-CNES)
Cosmic Dust Experiment (GRU) - E. Grun (Max Planck Institute for Nuclear Physics - FRG)
Radio Science (RSI) - H. Volland (University of Bonn - FRG)
Gravitational Wave (GWE) - B. Bertotti (University of Pavia - Italy)

Ulysses (Continued)

Mission Events

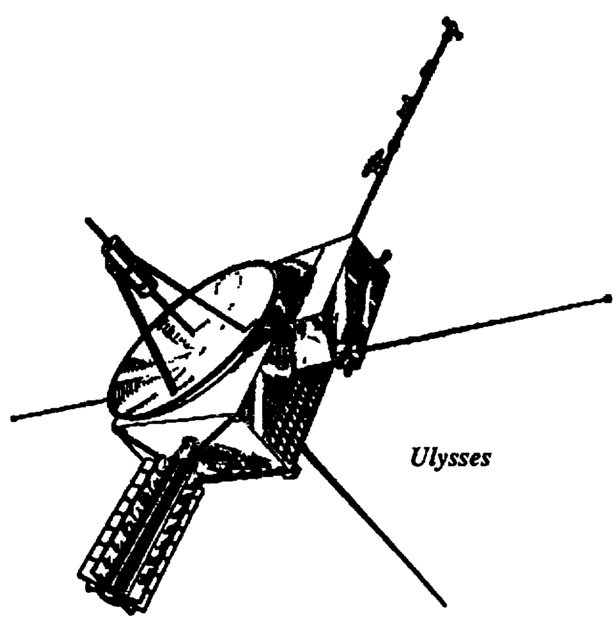
Jupiter encounter: February 1992
First polar pass of the Sun: May - September 1994
Second polar pass of the Sun: May - September 1995
End of Mission: December 1995

Management

NASA Headquarters
J. Willett, Program Manager
V. Jones, Program Scientist
Jet Propulsion Laboratory
W. Meeks, Project Manager
E. Smith, Project Scientist
European Space Agency (ESA)
D. Eaton, Project Manager
P-K. Wenzel, Project Scientist
Major Contractor
Dornier

Status

Ulysses was launched on a Shuttle/Inertial Upper Stage/Payload Assist Module (PAM-S) combination on October 6, 1990. After launch, the Inertial Upper Stage and PAM-S directed Ulysses on a trajectory toward Jupiter. Upon reaching Jupiter, Ulysses will be projected out of the elliptic plane and directed toward the Sun's southern pole. Ulysses will conduct its investigation of the higher latitudes of the Sun's southern pole for 5 months beginning in May 1994. Investigations of the Sun's other regions will follow. The conclusion of Ulysses' mission will occur in September 1995 at the Sun's northern pole.



Ulysses

Upper Atmosphere Research Satellite (UARS)

Objective

The Upper Atmosphere Research Satellite (UARS) is accumulating the global database necessary for: 1) understanding the coupled chemistry and dynamics of the stratosphere and mesosphere; 2) the role of solar radiation in driving the atmospheric chemistry and dynamics; and 3) the susceptibility of the upper atmosphere to long-term changes in the concentration and distribution of key atmospheric constituents, particularly ozone. It is a crucial element of NASA's long term program in upper atmospheric research, a program initiated in response to concerns about stratospheric ozone depletion. It is also the first major NASA launch of the Mission to Planet Earth era.

Description

UARS will provide the first integrated global measurements of the chemistry, dynamics, and energetics of the stratosphere, mesosphere, and lower thermosphere. The mission consists of a free-flying experiment with nine instruments dedicated to upper atmosphere research and one flight of opportunity instrument.

Launch Date:	September 12, 1991
Payload:	10 instruments
Orbit:	57 degree inclination; 585 km mean altitude,circular
Design Life:	36 months
Length:	9.75 m (32 ft)
Weight:	6,818 kg (15,000 lbs)
Diameter:	4.58 m (15 ft)
Launch Vehicle:	Space Shuttle
International Participation:	Canada, France, United Kingdom

Instruments/Investigations/Principal Investigators

Cryogenic Limb Array Etalon Spectrometer (CLAES) - A. Roche (Lockheed Palo Alto Research Laboratory)
Improved Stratospheric and Mesospheric Sounder (ISAMS) - F. Taylor (Oxford University - UK)
Microwave Limb Sounder (MLS) - J. Waters (Jet Propulsion Laboratory)
Halogen Occultation Experiment (HALOE) - J. Russell (LaRC)
High Resolution Doppler Imager (HRDI) - P. Hays (University of Michigan)
Wind Imaging Interferometer (WINDII) - G. Shepherd (York University - UK)
Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) - G. Brueckner (Naval Research Laboratory)
Solar/Stellar Irradiance Comparison Experiment (SOLSTICE) - G. Rottman (University of Colorado)
Particle Environment Monitor (PEM) - J. Winningham (Southwest Research Institute)
Active Cavity Radiometer Irradiance Monitor II (ACRIM II) - R. Willson (Jet Propulsion Laboratory) - Flight of Opportunity Instrument

Mission Events

Announcement of Opportunity (AO): September 1978
UARS Mission new start: Fiscal Year 1985
Initial instrument deliveries: January 1990
Observatory shipped to KSC: May 1991
Fully operational: October 10, 1991

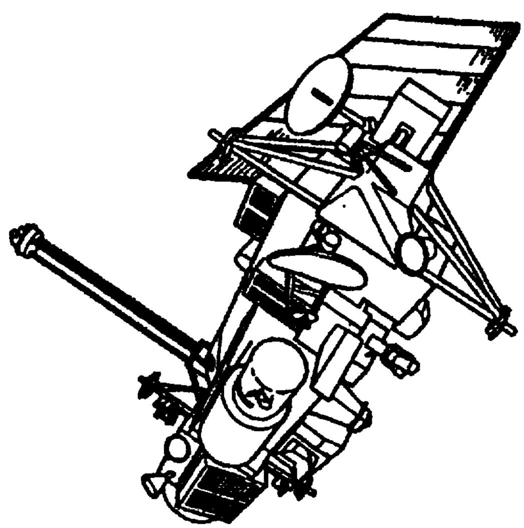
Upper Atmosphere Research Satellite (UARS) (Continued)

Management

NASA Headquarters
M. Luther, Program Manager
R. McNeal, Program Scientist
Goddard Space Flight Center
C. Trevathan, Project Manager
C. Reber, Project Scientist
Major Contractor
General Electric

Status

The spacecraft was successfully launched September 12, 1991, deployed September 15, and boosted to its operational mean altitude September 17-19. The spacecraft is operating nominally, with all instruments activated and tested by mid-October, and making routine observations since that time.



Upper Atmosphere Research Satellite

Yohkoh
(Formerly Solar-A)

Objective
The primary objectives of NASA's participation in the Japanese Yohkoh mission are to: 1) obtain simultaneous images of solar flares with high time and spatial resolutions in both hard and soft x-rays in order that the full morphology of the flare can be observed with sufficient precision to reveal the underlying physical processes; 2) image the solar corona in soft x-rays, with high time and spatial resolution, to reveal properties of the global magnetic fields; and 3) measure variations of photospheric brightness with modest spatial resolution for studies of solar irradiance variations and global oscillations.

Description
Yohkoh is a low Earth-orbit, three-axis stabilized spacecraft about twice the size of a Small Explorer. It carries a coordinated payload of four instruments to investigate high temperature structure on the Sun. An international team operates this satellite, which is the only orbital solar observing platform during the peak of this present solar cycle activity. The Soft X-ray Telescope (SXT), one of the major instruments on Yohkoh, is the product of the collaboration between the U.S. and Japan. Soft X-ray images are focused by a grazing-incidence mirror on a two-dimensional CCD detector. The other major experiment is the Japanese Hard X-Ray Telescope which uses apertures from grids to provide pictures of the hottest flare kernels for comparison to those from SXT. A Bragg Crystal Spectrometer, produced jointly by the United Kingdom and Japan, and the Wide-Band Spectrometer from Japan diagnose the high temperature plasmas and energetic particles of flares.

Launch Date:	August 30, 1991
Payload:	4 instruments
Orbit:	31 degree inclination, 518 km (280 nm) by 793 km (429 nm) slightly elliptical
Design Life:	3 years
Length:	2.0 m (6 ft)
Weight:	390 kg (860 lbs)
Diameter:	1 m (3 ft) square cross-section
Launch Vehicle:	M-3SII-6
International Participation:	Japan, United Kingdom

Instruments/Investigations/Principal Investigators
Soft X-ray Telescope (SXT) - T. Hirayama (National Astronomical Observatory of Japan); L. Acton (Lockheed Palo Alto Research Laboratory)
Hard X-ray Telescope (HXT) - K. Makishima (University of Tokyo - Japan)
Bragg Crystal Spectrometer (BCS) - E. Hiei (National Astronomical Observatory of Japan); J. Culhane (Mullard Space Science Laboratory - UK)
Wide Band Spectrometer (WBS) - J. Nishimura (Institute of Space and Astronautical Science - Japan)

Yohkoh (Continued)
(Formerly Solar-A)

Mission Events

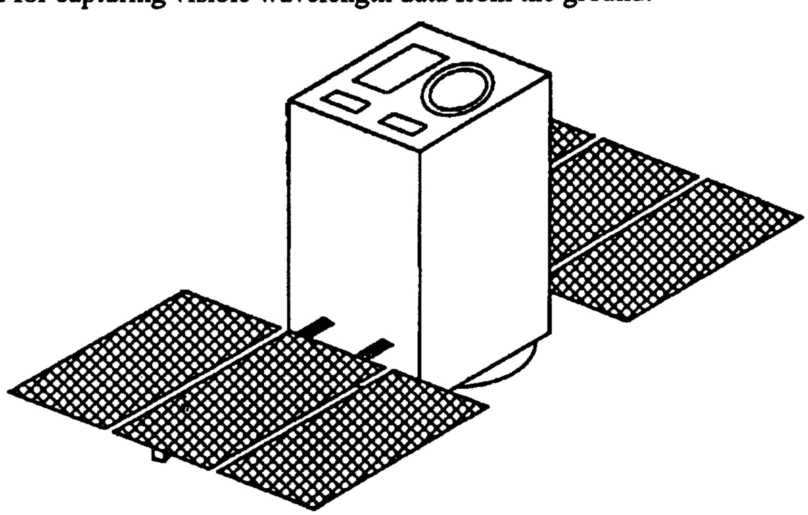
DSN tracking support begins: December 1991
Initiation of Guest Investigator Program: Fall 1993
Nominal End of Mission: Fall 1994

Management

NASA Headquarters
L. Demas, Program Manager
W. Wagner, Program Scientist
Institute for Space and Astronautical Sciences (ISAS)
Y. Ogawara, Program Manager
Y. Uchida, Project Scientist
Marshall Space Flight Center
J. Owen, Project Manager
J. Davis, Project Scientist
Jet Propulsion Laboratory
T. Bursch, CCD Camera Manager
Major Contractors
Lockheed Palo Alto Research Center
United Technology Optical System

Status

Yohkoh began operations smoothly following launch and has been extremely busy due to the high level of solar activity during the current maximum. To date, the Yohkoh instrument complement, aided by sophisticated onboard microprocessors, has observed a considerable number of the largest (X-class) solar flares. Scientific objectives are being coordinated by investigators working at the mission operations center in Tokyo. An international network of observatories is informed of the daily satellite program and maintained alert for capturing visible wavelength data from the ground.



Yohkoh

Appendix A: Index of Missions by Division

APPENDIX A: Index of Missions by Division

PAGE

** Shared Responsibility

PAGE

Flight Systems Division (Continued)

Life Sciences Division

Microgravity Science and Applications Division

Solar System Exploration Division

Space Physics Division

** Shared Responsibility

PAGE

Space Physics Division (Continued)

** Shared Responsibility

SSA

Appendix B:
Terms of Reference

Appendix B: Terms Of Reference

TERM	DEFINITION/DESCRIPTION
3-D PLASMA	Energetic Particles and 3-D Plasma Analyzer (Wind Instrument)
AADSF	Advanced Automated Directional Solidification Furnace (USMP component)
ACE	Advance Composition Explorer (Explorer Mission)
ACIS	AXAF CCD Imaging Spectrometer (AXAF Instrument)
ACR	Active Cavity Radiometer (ATLAS Investigation)
ACRIM	Active Cavity Radiometer Irradiance Monitor (EOS Instrument)
ACTS	Advanced Communications Technology Satellite
ADEOS	Advanced Earth Observation System (Japanese Platform for TOMS)
AEPI	Atmospheric Emission Photometric Imaging (ATLAS Investigation)
ALAE	Investigation on Atmospheric H and D through the Measurement of Lyman Alpha (ATLAS Investigation)
ALT	Altimeter (EOS, TOPEX, Lunar Scout Instruments)
AMIE	Airglow Measurements of Infrared Measurements Emissions (CRISTA Investigation)
AMOR	Adaptation to Microgravity of Oculomotor Reflexes (Cosmos Investigation)
AMSU	Advanced Microwave Sounding Unit (NOAA Series Instrument)
AMSU-A	Advanced Microwave Sounding Unit-A (EOS Instrument)
AO	Announcement of Opportunity
AOS	Acousto-Optical Spectrometer (SWAS Instrument)
ARC	NASA Ames Research Center
ASC	Astroculture (USML Investigation)
ASI	Agenzia Spaziale Italiano (Italian Space Agency)
ASM	All-Sky Monitor (XTE Instrument)
ASPOC	Active Spacecraft Potential Control (Cluster Instrument)
ASTRO-1, -2	Ultraviolet/Visible Shuttle Attached Observatory
ASTRO-D	Spectroscopic X-ray Observatory
ATLAS	Atmospheric Laboratory for Applications and Science (Spacelab Series)
ATMOS	Atmospheric Trace Molecules Observed by Spectroscopy (ATLAS Instrument)
AU	Astronomical Unit (Average Distance Between Earth and the Sun)
AVHRR	Advanced Very High Resolution Radiometer (POES, TRMM Instruments)
AXAF	Advanced X-ray Astrophysics Facility
BAM	Solar Wind Plasma (Ulysses Investigation)
BATSE	Burst And Transient Source Experiment (Compton Instrument)
BCS	Bragg Crystal Spectrometer (AXAF Instrument)
bps	bits per second
BR	Biorack Systems (IML Investigation)
BSK	Biostack (IML Investigation)
CAMMICE	Charge and Mass Magnetospheric Ion Composition Experiment (Polar Instrument)
CCD	Charge-coupled device
CDA	Cosmic Dust Analyzer (Cassini Instrument)
CDR	Critical Design Review
CDS	Coronal Diagnostic Spectrometer (SOHO Instrument)
CELIAS	Charge, Element and Isotope Analysis (SOHO Instrument)
CEP	Communications Electronics Package (ACTS component)
CEPADD	Comprehensive Energetic Particle Pitch Angle Distribution (Polar Instrument)

TERM	DEFINITION/DESCRIPTION
CERES	Clouds and Earth's Radiant Energy System (TRMM Instrument)
CFLSE	Critical Fluid Light Scattering Experiment (USMP Investigation)
CFVME	Critical Fluid Viscosity Measurement Experiment (USMP Investigation)
CGBA	Commercial Generic Bioprocessing Apparatus (USML Instrument)
CGF	Crystal Growth Furnace (USML Investigation)
CGIM	Conical Grazing Incidence Mirrors (ASTRO-D component)
CI	CCD Imager (Discovery Program Candidate Instrument)
CI	Coronagraphic Imager (TOPS Instrument)
CIP	Coordinated Instrument Package (OSL Instrument)
CIR	Cargo Integration Review
CIRS	Infrared Composite Spectrometer (Cassini Instrument)
CIS	Cluster Ion Spectometery (Cluster Instrument)
CITE	Cargo Integration Test Equipment
CLAES	Cryogenic Limb Array Etalon Spectrometer (UARS Instrument)
Cluster	A COSTR Mission
cm	centimeter
CNES	Centre National d'Etudes Spatiales (French Space Agency)
CNRS	Centre National de la Recherche Scientifique (National Center for Scientific Research - France)
COBE	Cosmic Background Explorer
COMPTEL	Imaging Compton Telescope (Compton Instrument)
COSTEP	Suprathermal and Energetic Particle Analyzer (SOHO Instrument)
COSTR	Collaborative Solar-Terrestrial Research Program (Cluster, Geotail and SOHO Missions)
CPF	Critical Point Facility (IML component)
CPI	Comprehensive Particles Investigation (Geotail Instrument)
CPS	Cassini Plasma Spectrometer (Cassini Instrument)
CRAF	Comet Rendezvous Asteroid Flyby
CRIS	Cosmic Ray Isotope Spectrometer (ACE Instrument)
CRISTA	Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere
CRY	Cryostat (IML Investigation/Instrument)
CSA	Canadian Space Agency
DARA	Deutsche Agentur für Raumfahrtangelgenheiten (German Space Agency)
DCD	Dust Collection Device (Discovery Program Candidate Instrument)
DCORE	Italian Core Equipment for Tether Current/Voltage Control (TSS Investigation)
DCS	Argos - French Data Collection and Platform Location System (POES Instrument)
DIRBE	Diffuse Infrared Background Experiment (COBE Instrument)
DLR	Deutsche Forschungsanstalt für Luft und Raumfahrt (German Aerospace Research Establishment)
DMR	Differential Microwave Radiometer (COBE Instrument)
DoD	Department of Defense
DOE	Department of Energy
DORIS	Determination d'Orbite et Radiopositionement Integre par Satellite (TOPEX Instrument)
DPM	Drop Physics Module (USML Investigation)
DSN	Deep Space Network
DTMAG	Dual Technique Magnetometer (Cassini Instrument)
DWP	Digital Wave Processor (Cluster Instrument)
DXS	Diffuse X-ray Spectrometer
EDI	Electron Drift Instrument (Cluster Instrument)
EDO	Extended Duration Orbiter
EDOMP	Extended Duration Orbiter Medical Program (USML Investigation)

TERM	DEFINITION/DESCRIPTION
EFD	Electric Field Detector (Geotail Instrument)
EFI	Electric Fields Instrument (Polar Instrument)
EFW	Electric Fields and Waves (Cluster Instrument)
EGRET	Energetic Gammá Ray Experiment (Compton Instrument)
EIT	Extreme Ultraviolet Imaging Telescope (SOHO Instrument)
ELV	Expendable Launch Vehicle
EMET	Investigation of Electromagnetic Emissions from Electrodynamic Tether (TSS Investigation)
EMFI	Electric and Magnetic Field Instrumentation (FAST Instrument)
ENAP	Energetic Neural Atoms Precipitation (ATLAS Investigation)
EOS	Earth Observing System
EOSAT	Earth Observation Satellite Corporation
EOSDIS	EOS Data and Information System
EPACT	Energetic Particles Acceleration Composition Transport (Wind Instrument)
EPIC	Energetic Particle and Ion Composition (Geotail Instrument)
ERNE	Energetic Particle Analyzer (SOHO Instrument)
ESA	European Space Agency
ESMC	Eastern Space Missile Center (Patrick AFB)
ESOC	European Space Operations Center
ESTEC	European Space Research and Technology Center
EUV	Extreme Ultraviolet
EUVE	Extreme Ultraviolet Explorer
EVA	Extravehicular Activity
EVT	Experimental Verification Test (Spacelab-J)
FAST	Fast Auroral Snapshot Explorer (SMEX Mission)
FAUST	Far Ultraviolet Astronomy (ATLAS Investigation)
FES	Fast Electron Spectrograph (FAST Instrument)
FES	Fluids Experiment System (IML Investigation)
FGM	Fluxgate Magnetometer (Cluster Instrument)
FGS	Fine Guidance Sensor (HST Instrument)
FIRAS	Far Infrared Absolute Spectrophotometer (COBE Instrument)
FIRS	Far-Infrared Fabry-Perot Spectrometer (SMIM Instrument)
FOC	Faint Object Camera (HST Instrument)
FOS	Faint Object Spectrograph (HST Instrument)
FRG	Federal Republic of Germany
FUSE	Far Ultraviolet Spectroscopy Explorer (Explorer Mission)
FUV	Far Ultraviolet
FY	Fiscal Year
g	Gravity
GBD	Gamma-ray Burst Detector (Pluto Flyby/Neptune Orbiter Candidate Instrument)
GE	General Electric
GEM	Glovebox Experiments Module (USML-1 Instrument)
Geotail	A COSTR Mission
GGS	Global Geospace Science Program
GHRS	Goddard High Resolution Spectrograph (HST Instrument)
GHz	Gigahertz
GLG	Solar-Wind Ion Composition (Ulysses Investigation)
GOES	Geostationary Operational Environmental Satellites
GOLF	Global Oscillations at Low Frequencies (SOHO Instrument)
GP-B	Gravity Probe-B
GPPF	Gravitational Plant Physiology Facility (IML Investigation)

TERM	DEFINITION/DESCRIPTION
GPSDR	Global Positioning System Demonstration Receiver (TOPEX Instrument)
GPTU	General Purpose Transfer Unit (SLS Instrument)
GPWS	General Purpose Work Station (SLS Instrument)
GRILLE	Grille Spectrometer (ATLAS Instrument)
GRS	Gamma Ray Spectrometer (MO Instrument)
GRU	Cosmic Dust Experiment (Ulysses Investigation)
GS	Grille Spectrometer (ATLAS Investigation)
GSFC	NASA Goddard Space Flight Center
GSIS	Gas Scintillation Imaging System (ASTRO-D component)
GTC	Grand Tour Cluster mission
GWE	Gravitational Wave (Ulysses Investigation)
H-II	Japanese Launch Vehicle for Earth Probe
HALOE	Halogen Occultation Experiment (UARS Instrument)
HEAO	High Energy Astronomical Observatory
HED	Magnetic Field Measurements (Ulysses Investigation)
HEI	Human Exploration Initiative (former name for SEI)
HEP	High Energy Particle Experiment (Geotail Instrument)
HESP	High Energy Solar Physics mission
HETGS	High Energy Transmission Grating Spectrometer (AXAF Instrument)
HEXTE	High Energy X-ray Timing Experiment (XTE Instrument)
HGA	High Gain Antenna
HILT	Heavy Ion Large Telescope (SAMPEX Instrument)
HIRDLS	High Resolution Dynamics Limb Sounder (EOS Instrument)
HIRIS	High Resolution Imaging Spectrometer (EOS Instrument)
HIRS	High Resolution Infrared Sounder (POES Instrument)
HPA	Hot Plasma Analyzer (Pluto Flyby/Neptune Orbiter Candidate Instrument)
HRC	High Resolution Camera (AXAF Instrument)
HRDI	High Resolution Doppler Imager (UARS Instrument)
HRI	High Resolution Imager (ROSAT Instrument)
HRMA	High Resolution Mirror Assembly (AXAF Mirror System)
HRS	High Resolution Spectrograph (FUSE Instrument)
HRTS	High Resolution Telescope and Spectrograph (OSL Instrument)
HSP	High Speed Photometer (HST Instrument)
HST	Hubble Space Telescope
HUS	Solar X-rays and Cosmic Gamma-Ray Burst Experiment (Ulysses Investigation)
HYDRA	Fast Plasma Analyzer (Polar Instrument)
IAM	Interface Adapter Module
IDGE	Isothermal Dendritic Growth Experiment (USMP Investigation)
ILAS	Improved Limb Atmospheric Spectrometer (USMP Investigation)
IMAPS	Interstellar Medium Absorption Profile Spectrograph (ORFEUS Instrument)
IMDN	Investigation and Measurement of Dynamic Noise in TSS
IMI	Inner Magnetosphere Imager mission
IML	International Microgravity Laboratory
IMON	Investigation of Dynamic Noise (TSS Investigation)
INMS	Ion and Neutral Mass Spectrometer (Cassini Instrument)
IR	Infrared
IRAC	Infrared Array Camera (SIRTF Instrument)
IRAS	Infrared Astronomical Satellite
IRIS	Italian Research Interim Stage
IRMA	Infrared Measurements of the Atmosphere (CRISTA Instrument)

TERM	DEFINITION/DESCRIPTION
IRS	Infrared Spectrometer (SIRTF Instrument)
ISAMS	Improved Stratospheric and Mesospheric Sounder (UARS Instrument)
ISAS	Institute of Space and Astronomical Science of Japan
ISCCP	International Satellite Cloud Climatology Project
ISM	Infrared Spectral Mapper (Discovery Program Candidate Instrument)
ISO	Imaging Spectrometric Observatory (ATLAS Investigation)
ISPM	International Solar Polar Mission (former name for Ulysses)
ISS	Imaging Science Subsystem (Cassini Instrument)
ISTP	International Solar-Terrestrial Physics mission
IUS	Inertial Upper Stage
JPL	Jet Propulsion Laboratory
JSC	NASA Johnson Space Center
K	Kelvin
kbps	kilobits per second
KEP	Medium Energy Isotopic Particle Detection (Ulysses Investigation)
keV	thousand electron volts
kg	kilogram
KISS	Kiepenheuer Institute Solar Spectrograph (OSL Instrument)
km	kilometer
KONUS	Gamma Ray Spectrometer (Wind Instrument)
KSC	NASA Kennedy Space Center
L1	Sun-Earth Lagrangian Point
LA	Laser Altimeter (Discovery Program Candidate Instrument)
LAGEOS II	Laser Geodynamics Satellite II
LAN	Low Energy Charged Particle Investigation (Ulysses Investigation)
Landsat	Land Remote Sensing Satellite
LANL	Los Alamos National Laboratory (Department of Energy Facility)
LaRC	NASA Langley Research Center
LAS	LAGEOS Apogee Stage
LASCO	Large Angle and Spectrometric Coronagraph (SOHO Instrument)
LASER	Light Amplication by Stimulated Emissions of Radiation
LASSII	Low Altitude Satellite Studies of Ionospheric Irregularities (CRRES Instrument)
LBNP	Lower Body Negative Pressure Device (Spacelab-J Investigation)
lbs	pounds
LEICA	Low Energy Ion Compostition Analyzer (SAMPEX Instrument)
LEP	Low Energy Particle Experiment (Geotail Instrument)
LeRC	NASA Lewis Research Center
LETGS	Low Energy Transmission Grating Spectrometer (AXAF Instrument)
LGA	Low Gain Antenna (Galileo Instrument)
LIDAR	Light Intersection Direction and Ranging (LITE Instrument)
LITE	LIDAR In-Space Technology Experiment
LMSC	Lockheed Missile and Space Company
LPE	Lambda Point Experiment (USMP Investigation)
m	meter
M3S-II	Japanese Launch Vehicle for Astro-D Mission
MAG	Magnetometer (MO, Lunar Scout Instruments)
MAP	Multichannel Astrometric Photometer (TOPS Instrument)
MAPS	Measurement of Air Pollution from Satellites
MAS	Microwave Atmospheric Sounder (ATLAS Investigation)
MAST	Mass Spectrometer Telescope (SAMPEX Instrument)
MBA	Multi-Beam Antenna (ACTS component)
MBB	Messerschmitt-Boelkow-Blohm (German Aerospace Firm)
Mbps	megabits per second

TERM	DEFINITION/DESCRIPTION
MBR	Mars Balloon Relay Experiment (MO Investigation)
MDI	Michelson Doppler Imager (SOHO Instrument)
MEPHISTO	Material pour l'Etude des Phenomenes Interessant la Solidification sur Terre et en Orbite (USMP Investigation)
MESUR	Mars Network mission
MeV	million electron volts
MFE	Magnetic Fields Experiment (Polar Instrument)
MFI	Magnetic Fields Investigation (Wind Instrument)
MGF	Magnetic Field Experiment (Geotail Instrument)
MHD	Magneto-hydrodynamics
MICG	Mercuric Iodide Crystal Growth Experiment (IML Investigation)
MIMI	Magnetospheric Imaging Instrument (Cassini Instrument)
MIPS	Multiband Imaging Photometer (SIRTF Instrument)
MIT	Massachusetts Institute of Technology
MLS	Microwave Limb Sounder (UARS Instrument)
MLTI	Mesosphere and Lower Thermosphere/Ionosphere
mm	millimeter
MO&DA	Mission Operations and Data Analysis
MOA	Memorandum of Agreement
MOC	Mars Observer Camera (MO Instrument)
MOLA	Mars Observer Laser Altimeter (MO Instrument)
MOU	Memorandum of Understanding
MPESS	Mission Peculiar Equipment Support Structure (USMP Facility)
MRI	Magnetic Resonance Imager (SL-J Instrument)
MSAT	Mobile Satellite
MSFC	NASA Marshall Space Flight Center
MSL	Materials Science Laboratory
MST	Mission Sequence Test
MSU	Microwave Sounding Unit (POES Instrument)
MVI	Microgravity Vestibular Investigations (IML Investigations)
MWPE	Mental Workload and Performance Evaluation (IML Investigation)
NACA	National Advisory Committee for Aeronautics (NASA's predecessor agency)
NAM	Neptune Atmosphere Mapper (Neptune Orbiter Candidate Instrument)
NAR	Non-Advocate Review
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NEAR	Near Earth Asteroid Redezvous (Discovery Mission)
NIC	Near-Infrared Camera
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration (Operates GOES and POES)
NRA	NASA Research Announcement
NRCC	National Research Council of Canada (predessor of CSA)
NRL	Naval Research Laboratory
NSCAT	NASA Scatterometer (Earth Probe)
OAET	Office of Aeronautics, Exploration and Technology
OAST	Office of Aeronautics and Space Technology
OCGP	Organic Crystal Growth Facility (IML Investigation)
ORFEUS	Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer
OSL	Orbiting Solar Laboratory
OSSA	Office of Space Science and Applications
OSSE	Oriented Scintillation Spectrometer Experiment (Compton Instrument)

TERM	DEFINITION/DESCRIPTION
OSTA	Office of Space and Terrestrial Applications
OTA	Optical Telescope Assembly (HST Component)
PAM/PAM-S	Payload Assist Module
PCA	Proportional Counter Array (ROSAT, XTE Instruments)
PCG	Protein Crystal Growth Experiment (IML Investigation)
PCG-II	Protein Crystal Growth-II (USML Investigation)
PDR	Preliminary Design Review
PEACE	Plasma Electron and Current Analyzer (Cluster Instrument)
PEM	Particle Environment Monitor (UARS Instrument)
PET	Proton-Electron Telescope (SAMPEX Instrument)
PF	Photometric Filtergraph (OSL Instrument)
Phase C	Detailed Design Phase
Phase D	Development Phase
PI	Principal Investigator
PIDDP	Planetary Instrument Definition and Development Program
PIP	Payload Integration Plan
PIXIE	Polar Ionospheric X-Ray Imaging Experiment (Polar Instrument)
PMIRR	Pressure Modulator Infrared Radiometer (MO Instrument)
PMOD	Physikalisch Meterologisches Observatorium Davos (SOHO Instrument)
PMS	Physiological Monitoring System (SLS Instrument)
POCC	Payload Operations Control Center
POES	NOAA Polar Orbiting Environmental Satellites
Polar	A GGS Mission
PR	Precipitation Radar (TRMM Instrument)
PS	Plasma Spectrometer (Pluto Flyby/Neptune Orbiter Candidate Instrument)
PSPC	Position-Sensitive Proportional Counter (ROSAT Instrument)
PWI	Plasma Wave Instrument (Polar Instrument)
PWI	Plasma Waves Investigation (Geotail Instrument)
RADAR	Radio Detection and Ranging
RADAR	Titan Radar Mapper (Cassini Instrument)
RADARSAT	Radar Satellite
RAHF	Research Animal Holding Facility (SLS Instrument)
RAPID	Research with Adaptive Particle Imaging Detectors (Cluster Instrument)
RETE	Research on Electrodynamic Tether Effects (TSS Investigation)
RFP	Request for Proposal
RIM	Refrigerator/Incubator Module (SLS Instrument)
RMCD	Radiation Monitoring Container/Dosimeter (IML Investigation/Instrument)
RMS	Remote Manipulator System (Space Shuttle robotic arm)
rms	root mean square
ROPE	Research on Orbital Plasma Electrodynamics (TSS Investigation)
ROSAT	Roentgen Satellite
RPA/LP	Retarding Potential Analyzer/Langmuir Probe (Pluto Flyby/Neptune Orbiter Instrument)
RPWS	Radio and Plasma Wave System (Cassini Instrument)
RS	Radio Science (MO Investigation)
RSI	Radio Science Investigation (Ulysses Investigation)
RSS	Radio Science Subsystem (Cassini Instrument)
RTG	Radioisotope Thermoelectric Generator
SAMPEX	Solar, Anamalous, and Magnetospheric Particle Explorer (SMEX Mission)

TERM	DEFINITION/DESCRIPTION
SAMS	Spacecraft Acceleration Movement System (USML Investigation)
SAO	Smithsonian Astrophysical Observatory
SAR	Synthetic Aperture Radar (Magellan Instrument)
SBUU	Solar Backscatter Ultraviolet Spectrometer (POES Instrument)
SeaWiFS	Sea-Viewing Wide Field Sensor
SEI	Space Exploration Initiative (formerly HEI)
SEM	Space Environment Monitor (GOES, POES Instruments)
SEPAC	Space Experiements with Particle Accelerators (ATLAS Investigation)
SEPICA	Solar Energetic Particle Ionic Charge Analyzer (ACE Instrument)
SERC	Science and Engineering Research Council (United Kingdom)
SESAM	Surface Effects Sample Monitor (Astro-SPAS Investigation)
SETI	Search for Extraterrestrial Intelligence
SETS	Shuttle Electrodynamic Tether System (TSS Investigation)
SHEAL	Shuttle High Energy Astrophysics Laboratory
SHR	Submillimeter Heterodyne Receiver (SWAS Instrument)
SIM	Cosmic Ray and Solar Charged Particle (Ulysses Investigation)
SIR-C	Shuttle Imaging Radar-C (SRL Instrument)
SIRTF	Space Infrared Telescope Facility
SIS	Solar Isotope Spectrometer (ACE Instrument)
SISH	SIS Tunne Junction Heterodyne Receivers (SMIM Instrument)
SL	Spacelab
SL - J	Spacelab J
SLS	Spacelab Life Sciences
SMEX	Small Class Explorers (SAMPEX, SWAS, FAST missions)
SMIM	Submillimeter Intermediate Mission
SMMI	Small Mass Measurement Instrument (SLS Instrument)
SMS	Solar Wind and Suprathermal Ion Composition Studies (Wind Instrument)
SOHO	Solar and Heliospheric Observatory Mission (part of COSTR Program)
SOLCON	Solar Constant Radiometer (ATLAS Investigation)
SOLSPEC	Solar Spectrum Investigation (ATLAS Investigation)
SOLSTICE	Solar/Stellar Irradiance Comparison Experiment (UARS Instrument)
SPAS	Shuttle Pallet Satellite
SPE	Space Physiology Experiment (IML Investigation)
SPOC	Shuttle Payload of Opportunity Carrier
SPREE	Shuttle Potential and Return Electron Experiment (TSS Investigation)
SRL	Space Radar Laboratory
SSAAC	Space Science and Applications Advisory Committee
SSALT	Solid State Altimeter (TOPEX Instrument)
SSBUV	Shuttle Solar Backscatter Ultraviolet Experiment (ATLAS Investigation)
SSC	NASA Stennis Space Center
SSCE	Solid Surface Combustion Experiment (USML Investigation)
SSF	Space Station Freedom
SSM/I	Special Sensor Microwave/Imager (TRMM Instrument)
SSR	Science Status Review
SSU	Stratospheric Sounding Unit (POES Instrument)
STA	Science and Technology Agency of Japan
STAFF	Spatio-Temporal Analysis of Field Fluctuations (Cluster Instrument)
STDCE	Surface Tension Driven Convection Experiment (USML Investigation)
STEP	Solar-Terrestrial Energy Program (TIMED Mission)
STIS	Space Telescope Imaging Spectrometer
STO	Radio and Plasma Wave Experiment (Ulysses Investigation)

TERM	DEFINITION/DESCRIPTION
STORE	Shuttle Test of Relativity Experiment
STS	Space Transportation System (Space Shuttle)
STScI	Space Telescope Science Institute
SUMER	Solar Ultraviolet Measurements of Emitted Radiation (SOHO Instrument)
SUNY	State University of New York
SUSIM	Solar Ultraviolet Spectral Irradiance Monitor (UARS, ATLAS Instruments)
SWAN	Solar Wind Anisotrophies (SOHO Instrument)
SWAS	Submillimeter Wave Astronomy Satellite (SMEX Mission)
SWE	Solar Wind Experiment (Wind Instrument)
SWICS	Solar Wind Ion Composition Spectrometer (ACE Instrument)
SWIMS	Solar Wind Ion Mass Spectrometer (ACE Instrument)
SXO	Spectroscopic X-ray Observatory (ASTRO-D)
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TEID	Theoretical and Experimental Investigation of TSS Dynamics (TSS Investigation)
TEM	Technical Exchange Meeting
TES	Thermal Emission Spectrometer (MO, Lunar Scout Instruments)
TF	Tunable Filtergraph (OSL Instrument)
TGRS	Transient Gamma Ray Spectrometer (Wind Instrument)
TIDE	Thermal Ion Dynamics Experiment (Polar Instrument)
TIMAS	Toroidal Ion Mass Spectrograph (Polar Instrument)
TIMEAS	Toroidal Ion Mass-Energy-Angle Spectrograph (FAST Instrument)
TIMED	Thermospher Ionosphere Mesosphere Energetics and Dynamics mission
TMAG	Magnetic Field Experiment for the TSS Mission (TSS Investigation)
TMR	TOPEX Microwave Radiometer (TOPEX Instrument)
TOGA	Tropical Ocean Global Atmospheric Program (see TOPEX/POSEIDON)
TOMS	Total Ozone Mapping Spectrometer (Earth Probe)
TOP	Tethered Optical Phenomena (TSS Investigation)
TOPEX	Ocean Topography Experiment
TOS	Transfer Orbit Stage
TRMM	Tropical Rainfall Measuring Mission (Earth Probe)
TSS	Tethered Satellite System
U.S.	United States
UARS	Upper Atmosphere Research Satellite
UCB	University of California-Berkeley
UCLA	University of California-Los Angeles
UCSB	University of California-Santa Barbara
UHF	Ultra High Frequency
UK	United Kingdom
ULEIS	Ultra-Low Energy Isotope Spectrometer (ACE Instrument)
USAF	United States Air Force
USGS	United States Geological Survey
USML	United States Microgravity Laboratory
USMP	United States Microgravity Payload
UV	Ultraviolet
UVCS	Ultraviolet Coronagraph Spectrometer (SOHO Instrument)
UVI	Ultraviolet Imager (Polar Instrument)
UVIS	Ultraviolet Imaging Spectrograph (Cassini Instrument)
VAS	VISSR Atmospheric Sounder (GOES Instrument)
VCGS	Vapor Crystal Growth System (IML Investigation/Instrument)

TERM	DEFINITION/DESCRIPTION
VHF	Very High Frequency
VIMS	Visual and Infrared Mapping Spectrometer (Cassini, Lunar Scout Instruments)
VIRGO	Variability of Solar Irrandiance (SOHO Instrument)
VIS	Visible Imaging System (Polar Instrument)
VISSR	Visible Infrared Spin-Scan Radiometer (GOES Instrument)
VOI	Venus Orbit Insertion
VOSTOK	Launch Vehicle for COSMOS Program
VVEJGA	Venus-Venus-Earth-Jupiter-Gravity-Assist
WAVES	Radio/Plasma Wave Experiment (Wind Instrument)
WCRP	World Climate Research Program
WF/PC	Wide Field/Planetary Camera (HST Instrument)
WFC	Wide-Field Camera (ROSAT Instrument)
WFF	Wallops Flight Facility
WHISPER	Waves of High Frequency and Sounder for Probing of Density by Relaxation (Cluster Instrument)
Wind	A GGS Mission
WINDII	Wind Imaging Interferometer (UARS Instrument)
WOCE	World Ocean Circulation Experiment (see TOPEX/POSEIDON)
WSMC	Western Space and Missile Center
X-SAR	X-Band Synthetic Aperture Radar (SRL Instrument)
XGRS	X-ray/Gamma-Ray Spectrometer (Lunar Scout Candidate Instrument)
XRS	X-ray Spectrometer (AXAF Instrument)
XTE	X-ray Timing Explorer (Explorer Mission)
XUV	Extreme Ultraviolet
XUVI	X-Ray Ultraviolet Imager (OSL Instrument)
ZCG	Zeolite Crystal Growth (USML Investigation)

Appendix C:
Major Events

OFFICE OF SPACE SCIENCE & APPLICATIONS

Major, Moderate, Small, Spacelab, and Shuttle Attached Missions

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1992	IML-1		ATLAS-1 SSBUV-1		D2 EUVE	AE NOAA-I; USML-1; S SAMPEX	Ar4 TOPEX/ POSEIDON; S MSTI; D2 Geotail	TSS-1	SL-J; USMP-1 LAGEOS-II CANEX-2; T3 Mars Observer			
1993	DXS		SL-D2	ACTS ORFEUS-SPAS	ATLAS-2 SSBUV-2			SLS-2; D2 Wind	SRL-1			AI GOES-I; HST-SM-1; P TOMS; AE NOAA-J
1994	USMP-2		LITE		D2 Polar; LAGEOS-III	ATLAS-3 CRISTA-SPAS SSBUV-3	IML-2	ASTRO-2	P FAST	FY - 1st Quarter	SRL-2; GOES-J AI	P SAC-B/HETE; D2 RADARSAT
	FY - 2nd Quarter			FY - 3rd Quarter			FY - 4th Quarter					
1995	T2 NOAA-K	LITE-2 USMP-3		SL-D3; D2 LRM	USML-2	P SWAS	AS SOHO	ATLAS-4 WISP SSBUV-4		SSF/MB-1		
1996		SSF/MB-2	SLS-3; D2 LGS	SRL-3; D2 XTE	SSF/MB-3	P SMEX-4	SSF/MB-4; T2 NOAA-L			SSF/MB-5	SSF/MB-6	
1997	USMP-4	HST-SM-2		SSF/MB-7	SSF/UF-1	P SMEX-5; TDRS-II	ATLAS-5 SSBUV-5	D2 ACE; T2 NOAA-M; SSF/MB-8	SSF/UF-2	T4 Cassini; SSF/MB-9		SL-E2
1998	SSF/UF-3	NOAA-N	USMP-5	SSF/MB-10	SSF/MB-11	TDRS-II-2; P SMEX-6; EOS-AM1	SSF/UF-4	SSF/MB-12	SSF/UF-5			

STS LAUNCHES (Planned)
STS LAUNCHES (Accomplished)
ELV LAUNCHES (Planned)
ELV LAUNCHES (Accomplished)

Ar - ARIANE
AC - ATLAS CENTAUR
AI - ATLAS I
AE - ATLAS E
AS - ATLAS IIAS

D - DELTA
P - PEGASUS
T - TITAN
S - SCOUT

* Based on January 1992 Manifest

SP-033-7d
2/4/92