DATA CATALOG SERIES FOR SPACE SCIENCE
AND APPLICATIONS FLIGHT MISSIONS

Volume 1A

Descriptions of Planetary and Heliocentric
Spacecraft and Investigations

September 1982

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Categories of Spacecraft Used in This Series

PLANETARY AND HELIOCENTRIC

This category includes probes to the various planets of the solar system and probes designed to make measurements of the characteristics of interplanetary space. Included are also the probes which will pass out of the solar system into interstellar space.

METEOROLOGY AND TERRESTRIAL APPLICATIONS

This category includes geocentric spacecraft whose primary mission is to make remote sensing measurements of the earth and its atmosphere. Spacecraft which carry instrumentation to make geodesy and gravimetry measurements are also included. Technology, engineering, and communications spacecraft or investigations are not included because NSSDC does not archive such data.

ASTRONOMY, ASTROPHYSICS, AND SOLAR PHYSICS

This category consists of scientific satellites designed to conduct investigations of the sun, stellar objects, nonstellar sources, and interstellar phenomena. These satellites are geocentric except for the selenocentric RAE-B.

GEOSTATIONARY AND HIGH-ALTITUDE SCIENTIFIC

This category includes those satellites designed to conduct investigations of the characteristics of near-earth space from orbits with apogees near geostationary altitude and higher. Three of the spacecraft are selenocentric. Communications satellites are not included because NSSDC does not archive such data.

LOW- AND MEDIUM-ALTITUDE SCIENTIFIC

This category includes those spacecraft whose apogees are well below geostationary altitude and whose primary purpose is to conduct investigations in the near-earth environment.
DATA CATALOG SERIES FOR SPACE SCIENCE
AND APPLICATIONS FLIGHT MISSIONS

Volume 1A

DESCRIPTIONS OF PLANETARY AND HELIOCENTRIC
SPACECRAFT AND INVESTIGATIONS

Edited By

Winifred Sawtell Cameron
Robert W. Vostreys

September 1982

National Space Science Data Center (NSSDC)/
World Data Center A for Rockets and Satellites (WDC-A-R&S)
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771
This volume, *Brief Descriptions of Planetary and Heliocentric Spacecraft and Investigations*, part of the *Data Catalog Series for Space Science and Applications Flight Missions*, represents the work of many people. The series will describe the data sets held by NSSDC, some of the data sets held by NASA-funded investigators, and some of the data sets held by foreign investigators; and the series will serve as pointer documents for extensive data sets held and serviced by other government agencies.

We would like to thank the many spacecraft and experiment personnel who over the years provided much of the information contained in this volume. The cooperation of the investigators in supplying current status information is gratefully acknowledged. Thanks also are extended to the other NSSDC personnel, employees of the on-site contractor, M/A-COM Sigma Data, Inc., who have been involved in the information handling necessary to produce this volume. Special acknowledgment is given to Mary Elsen for her extensive editorial assistance and to the File Management group, supervised by Dorothy Rosenblatt, for their special computer processing to accommodate the format of this volume.

The Data Center is continually striving to increase the usefulness of its data holdings, supporting indexes, and documentation. Scientists are invited to submit their space science data and comments to NSSDC. Catalog recipients are urged to inform potential data users of its availability.

Winifred Sawtell Cameron
Robert W. Vostreys
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Introduction
1.1 PURPOSE

The National Space Science Data Center (NSSDC) was established by the National Aeronautics and Space Administration (NASA) to provide data and information from space science and applications flight investigations in support of additional studies beyond those performed as the principal part of any flight mission. This volume is one of a series of eleven that will describe (1) the holdings of all spacecraft flight investigations for which NSSDC possesses data or can direct people to the data source, (2) all data sets held by NSSDC, (3) some of the data sets held and serviced by NASA-funded investigators, and (4) some of the data sets held and serviced by foreign investigators; and the series will serve as pointer documents for extensive data sets held and serviced by other government agencies, particularly the National Oceanographic and Atmospheric Administration (NOAA). There is one major omission from this series: the extensive set of data obtained from the lunar missions conducted by NASA, supplemented by a few small photographic data sets from Soviet missions. These are described in the Catalog of Lunar Mission Data (NSSDC/WDC-A-R&S 77-02) and will not be repeated in this series, except for a few cases. The data from IMP-E, Apollo 15 subsatellite, and Apollo 16 subsatellite are included in the series, since these data are important to disciplines other than those connected with lunar studies. Some of the experiments of the Apollo ALSEP missions also yielded useful data for magnetospheric and interplanetary physics, but these are not included in the series, since the instruments were confined to the surface of the moon. Readers should consult the Catalog of Lunar Mission Data if they are interested in such data sets.

The series consists of (1) five volumes that describe the spacecraft and their associated investigations (experiments) separated, mainly, into various orbit categories, (2) five corresponding volumes that describe the various orbital information and investigation data sets, and (3) a master index volume. In some cases certain data sets appear in more than one data set volume, since they are important to a discipline not normally related to most of the investigations on a given spacecraft. The five categories of spacecraft are (i) Planetary and Heliocentric, which include planetary flybys and probes, (ii) Meteorology and Terrestrial Applications, (iii) Astronomy, Astrophysics, and Solar Physics, which are all geocentric except the selenocentric RAE-B, (iv) Geostationary and High-Altitude Scientific, and (v) Low- and Medium-Altitude Scientific. It is impossible to provide an organization of categories that separates the investigations cleanly into scientific disciplines, since many missions were multidisciplinary.

Each volume is organized in a way that is believed to be most useful to the user and is described for each such volume in the Organization Section. For standard types of orbital information, i.e., predicted, refined, and definitive, the information is given in a tabular form to avoid repeating the same brief description an inordinate number of times. The standard description of a data set from an investigation is a free text brief description, since the wide variety of instruments precludes using a tabular format in most cases.
This catalog series has been prepared following a two-year survey and follow-up activity by NSSDC personnel to obtain information about the completeness of the NSSDC holdings and to solicit the description of data sets that will be serviced by individual investigators; these latter data sets are referred to as directory data sets. This survey was conducted only for NASA missions launched after December 31, 1962, but it includes the majority of NSSDC holdings. Unfortunately, of the 100 investigators surveyed, representing 346 inactive (no longer associated with an active science working team or equivalent) experiments, a small percentage failed to respond in 17 months of concerted solicitation of information. Consequently, there are now 20 investigations for which NSSDC has no data that will be dropped from this catalog series, since it would be irresponsible for NSSDC to send requesters to a possible data source that no longer has data or is non-responsive. The investigations that are being dropped from the NSSDC catalogs are identified in the appropriate volumes in the series. A small, but non-trivial, number of investigations were identified for which data no longer exist or for which the instrument failed at launch. These investigations are included in the spacecraft/investigation volumes so that users will know that it is fruitless to try to obtain such data anywhere.

The main purpose of this series is to identify the data and the contact from whom the data can be obtained within the scope previously defined. In addition, we have tried to identify the personnel involved with the investigation, so that a user will know whom to contact for an obscure or detailed piece of information relative to a given data set that NSSDC may not possess. Consequently, we have tried to provide the current affiliation of the investigators. In some cases we know that people have retired or have gone into different areas of endeavor. The latter case is treated by showing the last affiliation of such an individual and denoting that he is no longer affiliated by printing NLA after the individual's name. Since this series is oriented toward helping interested persons to obtain data from flight investigations and helping NSSDC to serve as an effective switching center, the spacecraft/mission personnel are identified at the institution where they performed their relevant duties. The term NLA is printed with the names of these personnel if they are no longer associated with the given institution.

It is hoped that this series will serve for many years as the source documents for data in the disciplines that NSSDC handles. The annual NSSDC Data Listing will be used to update the time intervals for which data are available and to identify in brief form the new data sets that become available in the future. The annual Report of Active and Planned Spacecraft and Experiments will be used to describe the new spacecraft and experiments which are placed in orbit.
1.2 ORGANIZATION

This catalog contains descriptions of the planetary and heliocentric spacecraft launched for which NSSDC has information. Described for those spacecraft are the investigations for which NSSDC has archived data.

The catalog is organized by planet, out from the sun, and then by heliocentric missions that collected interplanetary data. Included are the Pioneers 10 and 11 spacecraft which are on trajectories to take them out of the solar system. A description of missions to the moon, with descriptions of the spacecraft, experiments, and data archived is contained in the Catalog of Lunar Missions Data (NSSDC/WDC-A-R&S 77-02) and is not repeated here. It was not possible to obtain information from the following investigations on the availability of data and they are not included in the catalog.

The format for the experiments has been ordered by categories generally in order of the number of investigations. The categories discussed are (1) Imaging, (2) Particles and Fields, (3) Ultraviolet, (4) Infrared, (5) Radio Science and Celestial Mechanics, (6) Atmospheres, (7) Surface Chemistry, (8) Biology, and (9) Polarization.

Only investigations with some data either available from NSSDC or where the source of data is known are discussed. Table 1, however, lists all the experiments that were aboard the various spacecraft and indicates the status (all or partial, no data, or failed) of the data. Since NSSDC has only a few photographs from the U.S.S.R. -- Veneras 9, 10, 13, and 14 -- and no other data, only these investigations will be presented and included in Table 1; Table 2 contains planetary missions with planetary investigations listed by categories of data that are available at NSSDC. For complete coverage of the solar system, and for reference, Table 3 (from the Catalog of Lunar Missions), similar to Table 1, except that it covers lunar missions, is presented at the end of this catalog. Appendix A is an index to planetary missions, Appendix B is an index to missions that were primarily planetary but had investigations that only collected interplanetary data in the cruise mode, and Appendix C
contains an index to missions whose investigations were designed to collect only interplanetary data. Appendix D contains definitions for terms and acronyms that may not be readily recognized by the users of this document. In Table 1 there are many similar investigations with similar names, but they are listed separately in order to indicate status of availability of data. Under Radio Science and Celestial Mechanics, for example, there is only one investigation named Radio Occultation, yet occultation data were obtained at all the planets. These will be identified in Volume 1B, which is a companion volume describing the data sets obtained by the experiments described in this volume. It should be pointed out that many of the investigations obtained data from the interplanetary region, particularly in the particles and fields category.
1.3 NSSDC PURPOSE, FACILITIES, AND SERVICES

The National Space Science Data Center (NSSDC) was established by the National Aeronautics and Space Administration (NASA) to provide data and information from space science and applications investigations in support of additional studies beyond those performed by principal investigators. As part of that support, NSSDC has prepared this series of volumes providing descriptions of archived data, divided into five categories as presented in Section 1.1 (and see inside front cover). In addition to its main function of providing selected data and supporting information for further analysis of space science flight experiments, NSSDC produces other publications. Among these are a report on active and planned spacecraft and experiments and various users guides.

Virtually all the data available at or through NSSDC result from individual experiments carried on board individual spacecraft. The Data Center has developed an information system utilizing a spacecraft/investigation/data identification hierarchy. This catalog is based on that information system.

NSSDC provides facilities for reproduction of data and for onsite data use. Resident and visiting researchers are invited to study the data while at the Data Center. The Data Center staff will assist users with additional data searches and with the use of equipment. In addition to spacecraft data, the Data Center maintains some supporting information and other supporting data that may be related to the needs of the researchers.

The Data Center's address for information (for U.S. researchers) follows:

National Space Science Data Center  
Code 601.4  
Goddard Space Flight Center  
Greenbelt, Maryland 20771  
Telephone: (301) 344-6695  
Telex No.: 89675  
TWX No.: 7108289716

Researchers who reside outside the U.S. should direct requests for information to the following address:

World Data Center A for Rockets and Satellites  
Code 601  
Goddard Space Flight Center  
Greenbelt, Maryland 20771 U.S.A.  
Telephone: (301) 344-6695  
Telex No.: 89675  
TWX No.: 7108289716
NSSDC invites members of the scientific community involved in spaceflight investigations to submit data to the Data Center or to provide information about the data sets that they prefer to handle directly. The Data Center assigns a discipline specialist to work with each investigator or science working team to determine the forms of data that are likely to be most useful to the community of users that obtain data from NSSDC. The pamphlet *Guidelines for Submitting Data to the National Space Science Data Center* can be provided on request.
Table 1. Status of Data Available from Planetary and Interplanetary Missions
(NSSDC - Named Investigations)

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Mercury
Plate 1. This is a collection of press release photographs of various aspects of the planet Mercury from the Mariner 10 mission, the only mission to go to Mercury. It was the first mission to use the gravitational assist from one planet (Venus) to go on to another planet (Mercury). (A) P14470 is a mosaic of medium-resolution images presenting the hemisphere of Mercury seen by the spacecraft on the incoming trajectory on the first encounter of the flyby. It shows the lunar highlands-like nature of Mercury. (B) P14580 is a mosaic of medium-resolution images of the hemisphere of Mercury seen by the spacecraft on its outgoing trajectory on the first encounter. It shows some smooth areas. The spacecraft later had two more encounters, each spaced 6 months apart. (C) P14469 is a high-resolution (about 100m) photo showing a two-level flow in a large crater. (D) P15046 is a high-resolution (about 100m) image showing some of the long ridges traversing all topography which are apparently unique to Mercury among the planets.
INTRODUCTION

It was felt that the presentation of investigations in categories and by planets would be most useful to the scientific community. In this way, a possible user of data could determine quickly and easily the data that have been gathered at each planet. This information can be obtained most quickly by consulting Table 1 for all investigations and their status in regard to data archived at NSSDC from planetary and interplanetary missions, Table 2 for general categories at each planet, and Appendix A for details.

The first planet to be covered in this catalog is Mercury. There has been only one mission to Mercury, namely Mariner 10. There were, however, three passes (encounters) past the planet. In the second part of this catalog, which contains discussions of the data sets pertaining to the investigations on Mariner 10 that covered Mercury, the data sets will be presented according to encounter. There were seven investigations for which NSSDC either has the data archived or knows the source of the archived data; these investigations fall under five categories: (1) Imaging, (2) Particles and Fields, (3) Ultraviolet, (4) Infrared, and (5) Radio Science and Celestial Mechanics, and they are presented in that order. All investigations that dealt with a category are discussed under that category.

Following the planetary investigations sections for the planets, those planetary missions that carried the interplanetary region investigations are presented. Appendix B indexes this section. This section, in turn, is followed by the interplanetary missions whose investigations collected only interplanetary data. These missions all had heliocentric orbits. Appendix C indexes this section in detail.
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**PERSONNEL**

1. V.C. NSS
2. D.W. LIPPS
3. Y.C. WANG

**NASA-GSFC**

**NASA-GSFC**

**EAST COAST OF AMERICA**

**BRIEF DESCRIPTION**

This experiment consisted of two triaxial fluxgate magnetometers mounted on a common base 3.5 m and 5.8 m from the spacecraft and designed to measure the vector magnetic field in the vicinity of Mercury and Venus and in the interplanetary medium. Outputs from the two magnetometers were simultaneously analyzed to separate ambient fields from spacecraft fields. Each sensor had dual operating ranges of minus to plus 16 mT and 125 mT, with digitization accuracies of 0.35 mT and 0.26 mT, respectively. This offset capability extended the operating range to minus to plus 310 mT. During the primary phase of the mission (November 3, 1973, to April 29, 1974) and during the second and third Mercury encounters, 25 vectors per second were sampled by the primary onboard magnetometer and transmitted to Earth. At other times, a lower data rate mode was used. During five vectors per second which were transmitted, the experiment functioned normally throughout the life of the spacecraft. For further details, see V.C. NSS et al., Science, v. 185, p. 1591.

**INVESTIGATION NAME: ENERGETIC PARTICLES**

**INVESTIGATIVE PROGRAM**

**CODE: UL-4, SCIENCE**

**INVESTIGATION DISCIPLINES**

**PLANETS, MOONS, ROIDS AND COMETS**

**BRIEF DESCRIPTION**

This experiment was designed to measure energetic electrons, protons, and alpha particles in the interplanetary medium and in the vicinities of Venus and Mercury. The instrumentation consisted of a main telescope and a low-energy telescope. The main telescope consisted of six collimator sensors (five silicon detectors and one scintillator) surrounded by an anticoincidence sensor with a pulse height analysis window every 0.33 s and counts associated with the window for each of the six sensors. Electron energies measured were greater than 0.06. Particles stopping in the first sensor were particles in a 41 deg aperture. Particles in a 0.49 sq cm detector at 41 deg were measured by the anticoincidence sensor. The effective field of view was 0.15 deg to 0.32 deg for coincidence counts in the first and second sensors. The low-energy telescope was a 20.5-deg half aperture with a 5.5-deg half-aperture detector and a 0.53 sq cm detector. Sensitivity was designed to measure 0.5 to 200 mT and 0.05 to 200 mT electron fluxes. The results were given in terms of number of counts in the desired energy ranges for each planet and in terms of the flux density of the particles. See J. Geophys. Res., v. 89, p. 4060 (1984) and references therein for further details.

**INVESTIGATION NAME: UV SPECTROSCOPY**

**INVESTIGATIVE PROGRAM**

**CODE: UL-4, SCIENCE**

**INVESTIGATION DISCIPLINES**

**PLANETS, MOONS, ROIDS AND COMETS**

**BRIEF DESCRIPTION**

Two instruments were flown on a surveillance spectrometer that was body-fixed to the spacecraft and an artificial light source that was mounted on the spin platform. The light was obscured by the limb of the planets, the occultation spectrometer measured the extinction properties of the atmosphere. The occultation spectrometer had a plane grating which operated at grazing incidence. The fluxes were measured at 765, 780, 790, and 800 A using channel electron multipliers. Filters defined the effective field of view of the instrument which was 0.15 deg full width at half maximum (FWHM). Isolated spectral bands at 765 A (flux) were also measured. The objective grating artificial light source was flown to measure single observations of the planet Venus and Mercury in the spectral range of 200 to 1700 A, with a spectral resolution of 20 A, the images of the artificial light source at 340, 400, 540, 570, 650, 660, 670, 700, 800, 1000, 1200, 1300, 1400, and 1500 A. In addition, to provide a check on the total incident extreme UV flux to the spectrometer, two aerometer channels were flown. The effective field of view of the instrument was 0.15 deg by 0.10 deg. More experiment details and some measurements are contained in two papers: (1) "Ultraviolet Observations from Mariner 10: Preliminary Results," A. L. Broadfoot et al., Science, v. 185, March 29, 1974, and (2) "Mercury's Atmosphere from Mariner 10, A. L. Broadfoot, et al., Science, v. 185, July 12, 1974." A description of the instrumentation of this experiment is contained in the following papers: (1) "Mariner 10 Ultraviolet Spectrometer: Regional Experiments," A. L. Broadfoot et al., Space Sci. Instr., v. 3, p. 117 (1973); (2) "Mariner 10 Ultraviolet Spectrometer: Occultation Experiments," A. L. Broadfoot et al., Space Sci. Instr., v. 3, p. 209 (1977). Data also include the investigation region.

**INFRARED**

**INVESTIGATION NAME: TWO-CHANNEL INFRARED RADIOMETER**

**INVESTIGATIVE PROGRAM**

**CODE: UL-4, SCIENCE**

**INVESTIGATION DISCIPLINES**

**PLANETS, MOONS, ROIDS AND COMETS**

**BRIEF DESCRIPTION**

An infrared radiometer having two channels 2.2 to 39 micrometers was flown. The purpose of the experiment was to observe the thermal emission from Venus and Mercury. In two broad spectral bands, the 18 thermal emission could be observed from the surface of Mercury between late afternoon and early morning (local time). Deviations from the average thermal behavior of the surface were measured. Measurements were also made of the brightness temperatures of Venusian cloud tops and limb darkening phenomena. Attempts were made to correlate unusual temperature maps with observations of atmospheric structures and measurements by other instruments to identify mountains, valleys, volcanoes, and unusual surface materials.

**RADIO SCIENCE AND CELESTIAL MECHANICS**

**INVESTIGATION NAME: S- AND X-BAND RADIO PROPAGATION**

**INVESTIGATIVE PROGRAM**

**CODE: UL-4, SCIENCE**

**INVESTIGATION DISCIPLINES**

**IONOSPHERES AND RADIO PHYSICS**

**PLANETS, MOONS, ROIDS AND COMETS**

**BRIEF DESCRIPTION**

This experiment used S- (2442 MHz) and X- (8153 MHz) bands on-board radio systems for various scientific purposes, including determination of the radio-hop delay of communication between the spacecraft and the Earth. The delay was utilized to determine the ionospheric characteristics of Venus and Mercury. A measurement of the ionospheric characteristics was obtained in the 2- to 1700 A range, with a spectral resolution of 20 A, the images of the artificial light source at 340, 400, 540, 570, 650, 660, 670, 700, 800, 1000, 1200, 1300, 1400, and 1500 A. In addition, to provide a check on the total incident extreme UV flux to the spectrometer, two aerometer channels were flown. The effective field of view of the instrument was 0.15 deg by 0.10 deg. More experiment details and some measurements are contained in two papers: (1) "Ultraviolet Observations from Mariner 10: Preliminary Results," A. L. Broadfoot et al., Science, v. 185, March 29, 1974, and (2) "Mercury's Atmosphere from Mariner 10, A. L. Broadfoot, et al., Science, v. 185, July 12, 1974." A description of the instrumentation of this experiment is contained in the following papers: (1) "Mariner 10 Ultraviolet Spectrometer: Regional Experiments," A. L. Broadfoot et al., Space Sci. Instr., v. 3, p. 117 (1973); (2) "Mariner 10 Ultraviolet Spectrometer: Occultation Experiments," A. L. Broadfoot et al., Space Sci. Instr., v. 3, p. 209 (1977). Data also include the investigation region.
Venus
Plate 2. This is a composite of press release illustrations of features on the surface of Venus. (A) P80-25 is an artist's rendition of the continent-sized structures and most of the planet's surface derived from the results from the Radar Altimeter investigation on the Pioneer Venus 1 - Orbiter spacecraft. (B) P80-13A is an artist's rendition of the continent-sized mass, Aphrodite, with the outline of the United States on it for comparison. This was also derived from the Pioneer Venus 1 - Orbiter Radar Altimeter. (C) P80-17 is an air brush map of the surface of Venus as revealed by the Pioneer Venus 1 - Orbiter Radar Altimeter measurements. (D) YI-000811 is a reproduction of the photos of the surface of Venus surrounding each Descent Craft landing area of Veneras 9 and 10 launched by the U.S.S.R. Note the different appearance of the rocks at the two sites which are separated by several thousand kilometers. (E) YG-06848 is a photograph of the surface surrounding the USSR's Venera 14 Descent Craft at its landing site. Note the still different structure of the platy, rocky outcrops compared with those of Veneras 9 and 10. Venera 14 landed in still another part of Venus, near the Phoebe Regio part of Venus.
PRELIMINARY TOPOGRAPHIC MAP OF VENUS
CONTOUR INTERVAL 1 km ALL ELEV REFER TO A RADIUS OF 6045 kilometers
The next planet out from the sun is Venus. There were four U.S. missions and four U.S.S.R. missions (for which data are available) that either flew by, orbited, or entered the atmosphere and landed on the surface of Venus. The last U.S. mission, Pioneer Venus was composed of six separate spacecraft: (1) Pioneer Venus 1 - Orbiter, (2) Pioneer Venus 2 - Bus, (3) Pioneer Venus - Large Probe, (4) Pioneer Venus - Small Probe 1, (5) Pioneer Venus - Small Probe 2, and (6) Pioneer Venus - Small Probe 3. All of the probes and the bus traveled together as one unit, Pioneer Venus 2, from the earth to Venus. The Large Probe and Small Probe 3 entered on the day side of Venus, and the Small Probes 1 and 2 entered on the night side. Two of the Small Probes actually survived and transmitted data for a short time, while the other two may have survived but were oriented wrong to transmit their data to the Orbiter. There were 65 separate investigations when each spacecraft on the Pioneer Venus mission is treated separately. These cover seven categories which are (1) Imaging, (2) Particles and Fields, (3) Ultraviolet, (4) Infrared, (5) Radio Science and Celestial Mechanics, (6) Atmosphere, and (7) Polarization. See Tables 1 and 2 and Appendix A for more details. The U.S.S.R. has sent many missions to Venus, many of which were successful. NSSDC, however, has data archived from only four missions -- namely Veneras 9, 10, 13 and 14 -- from which imaging was obtained. Only these are presented in this catalog.
SPACECRAFT

********************************** SPACESHIP 2 **********************************

SPACECRAFT COMMON NAME - SPACESHIP 2
ALTERNATE NAMES -...
LAUNCH DATE - 06/27/72
WEIGHT - 203.1 KG
LAUNCH SITE - CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE - ATLAS
SPONSORING COUNTRY/AGENCY - UNITED STATES
INITIAL ORBIT PARAMETERS - ORBIT TYPE - VENUS
PERSONNEL - PM - J.D. MARTIN (NLA) NASA-JPL
SP - R.J. WIDOFF (NLA) NASA-JPL
BRIEF DESCRIPTION - The Mariner 2 spacecraft was the second of a series of spacecraft used for planetary exploration in the 1960s, which followed the Mariner 1 mission, after launch in Venus. The spacecraft was attitude-stabilized using the sun and earth as references. It was solar-powered and capable of continuous telemetry operation. The spacecraft obtained data on the interplanetary medium during the flight in Venus and beyond, and it obtained planetary data during the encounter of Venus. The spacecraft passed Venus at a distance of 41,000 km on December 14, 1962.

********************************** SPACESHIP 5 **********************************

SPACECRAFT COMMON NAME - SPACESHIP 5
ALTERNATE NAMES -...
LAUNCH DATE - 06/24/67
WEIGHT - 249.1 KG
LAUNCH SITE - CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE - ATLAS
SPONSORING COUNTRY/AGENCY - UNITED STATES
PERSONNEL - PM - D. SCHNEIDER NASA-JPL
PM - T.U. PARKER (NLA) NASA-JPL
PM - G.A. RIEFLER (NLA) NASA HEADQUARTERS
SP - C.W. DREW NASA-JPL
BRIEF DESCRIPTION - The Mariner 5 spacecraft was the fifth in a series of spacecraft used for planetary exploration in the 1960s, following the Mariner 4 mission, and was converted from a Mars mission to a Venus mission. The spacecraft was attitude-stabilized using the sun and earth as references. It was solar-powered and capable of continuous telemetry operation. The spacecraft passed Venus at a distance of 41,000 km on October 19, 1967. The spacecraft instruments measured both interplanetary and Venusian magnetic fields, charged particles, and plasma, as well as the radio reflectivity and UV emissions of the Venusian atmosphere. The mission was deemed a success.

********************************** SPACESHIP 11 **********************************

SPACECRAFT COMMON NAME - SPACESHIP 11
ALTERNATE NAMES -...
LAUNCH DATE - 11/03/73
WEIGHT - 380.4 KG
LAUNCH SITE - CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE - ATLAS
SPONSORING COUNTRY/AGENCY - UNITED STATES
INITIAL ORBIT PARAMETERS - ORBIT TYPE - MERCURY FLYBY
PERSONNEL - PM - C.J. HALL (NLA) NASA-JPL
PS - L. COLIN NASA-JPL
BRIEF DESCRIPTION - The Pioneer Venus 1 spacecraft was the first of two missions designed to conduct a comprehensive investigation of the Venusian atmosphere. The spacecraft was a solar-powered, cylindrical body 12.5 m in diameter with its spin axis stabilized perpendicular to the ecliptic plane. High gain antennae mechanically despun to remain fixed on the earth. The instruments were mounted on a shelf within the spacecraft, except for a Magnetometer mounted at the end of a boom to ensure against magnetic interference from the spacecraft. Pioneer Venus 1 measured the detailed structure of the upper atmosphere and lower stratosphere of Venus, investigated the interaction of the solar wind with the ionosphere and the magnetic field in the vicinity of Venus, determined the characteristics of the atmosphere and surface of Venus on a planetary scale, determined the planet's gravitational field, and observed perturbations of the spacecraft orbit, and detected gamma-ray bursts.

********************************** SPACESHIP 22 **********************************

SPACECRAFT COMMON NAME - SPACESHIP 22
ALTERNATE NAMES -...
LAUNCH DATE - 11/17/78
WEIGHT - 380.3 KG
LAUNCH SITE - CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE - ATLAS
SPONSORING COUNTRY/AGENCY - UNITED STATES
INITIAL ORBIT PARAMETERS - ORBIT TYPE - MERCURY FLYBY
PERSONNEL - PM - C.J. HALL (NLA) NASA-JPL
PS - J.A. DUNNE NASA-JPL
BRIEF DESCRIPTION - This spacecraft was the first to use the gravitational pull of one planet (Venus) to reach another (Mercury). The spacecraft was a solar-powered, cylindrical body 12.5 m in diameter with its spin axis stabilized perpendicular to the ecliptic plane. High gain antennae mechanically despun to remain fixed on the earth. The instruments were mounted on a shelf within the spacecraft, except for a Magnetometer mounted at the end of a boom to ensure against magnetic interference from the spacecraft. Pioneer Venus 1 measured the detailed structure of the upper atmosphere and lower stratosphere of Venus, investigated the interaction of the solar wind with the ionosphere and the magnetic field in the vicinity of Venus, determined the characteristics of the atmosphere and surface of Venus on a planetary scale, determined the planet's gravitational field, and observed perturbations of the spacecraft orbit, and detected gamma-ray bursts.
**ORBIT**

**released local information took the PIONEER VENUS PROBE the atmosphere of Venus for the first time. On this mission, four small Probes were released. Simultaneous measurements by the Probes and Orbiter permitted relating specific local measurements to the general state of the planet and its environment as observed from orbit.**

**INITIAL ORDER PARAMETERS**

**ORBIT TYPE- VENUS PROBE**

**PERSONNEL**

PM = C.F. HALL(NASA)  PS = L. COLIN  NASA-ARC

**Brief Description**

The spacecraft was the first Small Probe of the Pioneer Venus Multiprobe mission. On this mission four instrumented atmospheric entry probes were carried by a spacecraft due to the vicinity of Venus for descent through the atmosphere to the planetary surface. Two Small Probes entered on the nightside, and one Small Probe and one Large Probe entered on the dayside of the planet. The spacecraft bus entered the atmosphere and obtained atmospheric composition data until burnup. Investigations emphasized the study of the structure composition and nature of the atmosphere down to the surface and of the clouds, the radiation field and energy exchange in the lower atmosphere and local information on the atmospheric circulation pattern. A sister mission Pioneer Venus orbiter, placed an orbiting spacecraft around Venus two weeks before the Probes were released. Simultaneous measurements by the Probes and Orbiter permitted relating specific local measurements to the general state of the planet and its environment as observed from orbit.

**SPACER-SPOT/PROBE NAME- PIONEER VENUS PROBE SN2 ALTERNATE NAMES- PIONEER VENUS 1978**

**NAME**

**WEIGHT**

**LAUNCH DATE- 01/08/78**

**LAUNCH SITE- CAPE CANAVERAL, UNITED STATES**

**LAUNCH VEHICLE- ATLAS**

**SPONSORING COUNTRY/AGENCY**

**UNITED STATES NASA-OSSA**

**INITIAL ORDER PARAMETERS**

**ORBIT TYPE- VENUS PROBE**

**PERSONNEL**

PM = C.F. HALL(NASA)  PS = L. COLIN  NASA-ARC

**Brief Description**

This spacecraft was the second Small Probe of the Pioneer Venus Multiprobe mission. On this mission four instrumented atmospheric entry probes were carried by a spacecraft due to the vicinity of Venus for descent through the atmosphere to the planetary surface. Two Small Probes and one Large Probe entered on the dayside of the planet. The spacecraft bus entered the atmosphere and obtained atmospheric composition data until burnup. Investigations emphasized the study of the structure composition and nature of the atmosphere down to the surface and of the clouds, the radiation field and energy exchange in the lower atmosphere and local information on the atmospheric circulation pattern. A sister mission Pioneer Venus orbiter, placed an orbiting spacecraft around Venus two weeks before the Probes were released. Simultaneous measurements by the Probes and Orbiter permitted relating specific local measurements to the general state of the planet and its environment as observed from orbit.

**SPACER-SPOT/PROBE NAME- PIONEER VENUS PROBE SN3 ALTERNATE NAME- PIONEER VENUS 1978**

**NAME**

**WEIGHT**

**LAUNCH DATE- 05/08/78**

**LAUNCH SITE- CAPE CANAVERAL, UNITED STATES**

**LAUNCH VEHICLE- ATLAS**

**SPONSORING COUNTRY/AGENCY**

**UNITED STATES NASA-OSSA**

**INITIAL ORDER PARAMETERS**

**ORBIT TYPE- VENUS PROBE**

**PERSONNEL**

PM = C.F. HALL(NASA)  PS = L. COLIN  NASA-ARC

**Brief Description**

This spacecraft was the third Small Probe of the Pioneer Venus Multiprobe mission. On this mission four instrumented atmospheric entry probes were carried by a spacecraft due to the vicinity of Venus for descent through the atmosphere to the planetary surface. Two Small Probes entered on the nightside, and one Small Probe and one Large Probe entered on the dayside of the planet. The spacecraft bus entered the atmosphere and obtained atmospheric composition data until burnup. Investigations emphasized the study of the structure composition and nature of the atmosphere down to the surface and of the clouds, the radiation field and energy exchange in the lower atmosphere and local information on the atmospheric circulation pattern.
VENERA 9 DESCENT CRAFT

**SPACECRAFT COMMON NAME** - VENERA 9 DESCENT CRAFT

**ALTERNATE NAMES** -

**NSSDC ID** - 75-0520

**LAUNCH DATE** - 10/20/75

**WEIGHT** - KG

**LAUNCH SITE** - TYURATAM (BAIKONUR COSMODROME), U.S.S.R.

**LAUNCH VEHICLE** - 8-1-1

**SPONSORING COUNTRY/AGENCY** - SAS

**INITIAL ORBIT PARAMETERS**

**ORBIT TYPE** - VENUS LANDER

**PERSONNEL**

**PM** - UNKNOWN

**PS** - UNKNOWN

**BRIEF DESCRIPTION**

On October 20, 1975, this spacecraft was separated from the orbiter, and landing was made with the sun near zenith at 1313 UT on October 22. A system of circulating fluid was used to distribute the heat load. This system plus precooling prior to entry, permitted operation of the spacecraft for 55 min after landing. During descent, heat dissipation and deceleration were accomplished sequentially by: (1) protective hemispheric shells; three parachutes; a disk-shaped drag brake and a compatible, metal doug link-shaped landing chute. The landing was about 2200 km distant from the Venera 9 orbiter, and landing positions: (1) profile of altitude (km)/pressure (earth atmospheres)/temperature (deg C) of 42/3/313, 10/3/330, and 0/0/465; (2) successful TV photography showing large pancake rocks with lava or other weathered rocks in between; and (3) surface wind speed of 3.5 m/sec.

VENERA 10 DESCENT CRAFT

**SPACECRAFT COMMON NAME** - VENERA 10 DESCENT CRAFT

**ALTERNATE NAMES** -

**NSSDC ID** - 75-0540

**LAUNCH DATE** - 11/14/75

**WEIGHT** - KG

**LAUNCH SITE** - TYURATAM (BAIKONUR COSMODROME), U.S.S.R.

**LAUNCH VEHICLE** - 8-1-1

**SPONSORING COUNTRY/AGENCY** - SAS

**INITIAL ORBIT PARAMETERS**

**ORBIT TYPE** - VENUS LANDER

**PERSONNEL**

**PM** - UNKNOWN

**PS** - UNKNOWN

**BRIEF DESCRIPTION**

On November 14, 1975, this spacecraft was separated from the orbiter, and landing was made with the sun near zenith at 1313 UT on November 16. A system of circulating fluid was used to distribute the heat load. This system plus precooling prior to entry, permitted operation of the spacecraft for 66 min after landing. During descent, heat dissipation and deceleration were accomplished sequentially by: (1) protective hemispheric shells; three parachutes; a disk-shaped drag brake and a compatible, metal doug link-shaped landing chute. The landing was about 2200 km distant from the Venera 10 orbiter, and landing positions: (1) profile of altitude (km)/pressure (earth atmospheres)/temperature (deg C) of 42/3/313, 10/3/330, and 0/0/465; (2) successful TV photography showing large pancake rocks with lava or other weathered rocks in between; and (3) surface wind speed of 3.5 m/sec.

VENERA 13 DESCENT CRAFT

**SPACECRAFT COMMON NAME** - VENERA 13 DESCENT CRAFT

**ALTERNATE NAMES** -

**NSSDC ID** - 81-1100

**LAUNCH DATE** - 1/21/81

**WEIGHT** - KG

**LAUNCH SITE** - TYURATAM (BAIKONUR COSMODROME), U.S.S.R.

**LAUNCH VEHICLE** - 10-81-1113

**SPONSORING COUNTRY/AGENCY** - SAS

**INITIAL ORBIT PARAMETERS**

**ORBIT TYPE** - VENUS LANDER

**PERSONNEL**

**PM** - UNKNOWN

**PS** - UNKNOWN

**BRIEF DESCRIPTION**

Venera 13 landed at 13 deg 15 min N by 132 deg E on December 13, 1981. Surface temperature was 465 deg C and pressure was 100 km southwest of Venera 13. Surface temperature was 465 deg C and pressure was 94% earth atmospheres. Venera 13 carried instruments to take chemical and isotopic measurements; monitored the spectrum of scattered sunlight; and recorded electric discharges during its descent phase through the Venusian atmosphere. The spacecraft utilized a camera system, an X-ray fluorescence spectrometer, and a spectrometer to conduct investigations on the surface.

VENERA 14 DESCENT CRAFT

**SPACECRAFT COMMON NAME** - VENERA 14 DESCENT CRAFT

**ALTERNATE NAMES** -

**NSSDC ID** - 81-1110

**LAUNCH DATE** - 2/18/81

**WEIGHT** - KG

**LAUNCH SITE** - TYURATAM (BAIKONUR COSMODROME), U.S.S.R.

**LAUNCH VEHICLE** - 10-81-1113

**SPONSORING COUNTRY/AGENCY** - SAS

**INITIAL ORBIT PARAMETERS**

**ORBIT TYPE** - VENUS LANDER

**PERSONNEL**

**PM** - UNKNOWN

**PS** - UNKNOWN

**BRIEF DESCRIPTION**

Venera 14 landed at 13 deg 15 min N by 313 deg E on February 28, 1981. Surface temperature was 465 deg C and pressure was 94% earth atmospheres. Venera 14 carried instruments to take chemical and isotopic measurements; monitored the spectrum of scattered sunlight; and recorded electric discharges during its descent phase through the Venusian atmosphere. The spacecraft utilized a camera system, an X-ray fluorescence spectrometer, and a spectrometer to conduct investigations on the surface.
blue bandpass. (5) UV polarimeter. (6) EUV high pass. (7) clearing. (8) EUV high pass. (9) diffusing lens (for calibration), and (10) yellow bandpass. About 7500 photographs were obtained of Venus and Mercury with a maximum resolution of 100 m for Mercury. These photographic plates separated by 50,000 intervals, were used for Mercury. Further details of the experiment can be obtained from NSSC 19-15. Science results in Mercury may be obtained from J. van Zijl, Res. Inst. v. Rijss, p. 16, June 1975, and on Venus in Science, v. 152, p. 431, March 1966.

--- PIONEER VENUS 1: HANSEN

INVESTIGATION NAME: CLOUD PHOTOPOLARIMETER

NSSC ID: 76-0514-06

INVESTIGATIVE PROGRAM CODE 6L+4: SCIENCE

INVESTIGATION DISCIPLINE(S) PLANETARY ATMOSPHERES

PERSONNEL

PI: J. E. HANSEN 
GS: NASA-GISS
01: M. H. STONE 
02: A. A. LACIS 
03: J. J. COFFEE 
04: L. P. TRAVIS 
GS: NASA-GISS

BRIEF DESCRIPTION

This experiment used a modified version of the imaging photopolarimeter (IIP) flown on Pioneers 10 and 11 to provide observational data for color studies of the Venetian clouds and dayglow. The principal objective of this investigation was to determine the properties of the clouds and haze, including the vertical and horizontal distribution of the particle size and refractive index, the altitude, and the number density of particles.

--- VENUS 9 DESCENT CRAFT: UNKNOWN

INVESTIGATION NAME: PANORAMIC TELEPHOTO TELEMETRY FOR SURFACE IMAGERY

NSSC ID: 75-0500-01

INVESTIGATIVE PROGRAM CODE 6L+4: SCIENCE

INVESTIGATION DISCIPLINE(S) LUNAR AND PLANETARY

PERSONNEL

PI: UNKNOWN

BRIEF DESCRIPTION

This experiment used a television camera to photograph the surface of Venus. One successful image was obtained.

--- VENUS 9 DESCENT CRAFT: UNKNOWN

INVESTIGATION NAME: PANORAMIC TELEPHOTO TELEMETRY FOR SURFACE IMAGERY

NSSC ID: 75-0540-01

INVESTIGATIVE PROGRAM CODE 6L+4: SCIENCE

INVESTIGATION DISCIPLINE(S) PLANETOLOGY

PERSONNEL

PI: UNKNOWN

BRIEF DESCRIPTION

This experiment used a television camera to photograph the surface of Venus. One successful image was obtained.

--- VENUS 10 DESCENT CRAFT: UNKNOWN

INVESTIGATION NAME: PANORAMIC TELEPHOTO TELEMETRY FOR SURFACE IMAGERY

NSSC ID: 81-0160-01

INVESTIGATIVE PROGRAM CODE 6L+4: SCIENCE

INVESTIGATION DISCIPLINE(S) PLANETOLOGY

PERSONNEL

PI: UNKNOWN

BRIEF DESCRIPTION

The camera system carried on Venus 10 was an improvement of one carried on Venus 9 and 10. Eight photographs were obtained, one of which was taken through multiple filters to provide information on the distribution of the particles. Details as large as 4 to 5 km across a distance of 1.5 km.

--- VENUS 11 DESCENT CRAFT: UNKNOWN

INVESTIGATION NAME: PANORAMIC TELEPHOTOMETRIC TELEMETRY FOR SURFACE IMAGERY

NSSC ID: 82-0500-01

INVESTIGATIVE PROGRAM CODE 6L+4: SCIENCE

INVESTIGATION DISCIPLINE(S) PLANETOLOGY

PERSONNEL

PI: H. S. BROGDE 
GS: NASA-GISS
01: J. M. DINNEN 
02: A. J. LAYRUS 
03: S. CLAY 
04: J. E. HANSEN 
GS: NASA-GISS
05: L. P. TRAVIS 
GS: NASA-GISS
06: K. W. GOLIVER 
07: I. V. BURILLO 
08: K. W. SHYNE 
09: G. L. SIDIOE 
GS: NASA-GISS

BRIEF DESCRIPTION

The camera system carried on Venus 10 was an improvement of one carried on Venus 9 and 10. Eight photographs were obtained, one of which was taken through multiple filters to provide information on the distribution of the particles. Details as large as 4 to 5 km across a distance of 1.5 km.
parameters is necessarily dependent on the validity of the spacecraft sheath model employed in the analysis, and is thus affected by flow charges in the ambient solar wind.

------ PIONEER VENUS 1: SCRAFT-------------------------------

INVESTIGATION NAME- ELECTRIC FIELD DETECTOR

NSSDC 10- 7E-0514-12 INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE

INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS

SPACE PLASMAS

PERSONNEL

PI - F.J. SCRAFT
01 - I.W. GREEN

TV SYSTEMS GROUP

TV SYSTEMS GROUP

BRIEF DESCRIPTION

The investigation was performed by a modified version of the Pioneer 8 and Pioneer 9 experiments to measure the electric fields at several times in the Venusian ionosphere. The fields were measured using a pair of Langmuir-probe type sensors mounted on the spacecraft. The sensors were located near the spacecraft's magnetic equator, and were designed to measure the electric fields in the vicinity of the Venusian ionosphere. The data were analyzed using a quasi-spherical model to determine the electric field structure in the Venusian ionosphere.

------ PIONEER VENUS 1: KNUSEN-----------------------------------

INVESTIGATION NAME- REVERSAL POTENTIAL ANALYZER

NSSDC 10- 7E-0514-17 INVESTIGATIVE PROGRAM CODE EL-4/M-09, SCIENCE

INVESTIGATION DISCIPLINE(S) PLANETARY ATMOSPHERES

PLANETARY IONOSPHERES

PERSONNEL

PI - R.C. KNUSEN
01 - K. SPEIKER
01 - R.C. WHITTEN

NASA-ARC

BRIEF DESCRIPTION

This investigation was performed using a Langmuir-probe type sensor designed to measure the reversal potentials in the Venusian ionosphere. The sensor was located near the spacecraft's magnetic equator, and was used to measure the reversal potentials in the Venusian ionosphere. The data were analyzed using a quasi-spherical model to determine the reversal potentials in the Venusian ionosphere.

------ PIONEER VENUS 1: WOLFE-------------------------------

INVESTIGATION NAME- PLASMA ANALYZER (CPA)

NSSDC 10- 7E-0514-18 INVESTIGATIVE PROGRAM CODE EL-4/A-4, SCIENCE

INVESTIGATION DISCIPLINE(S) SPACE PLASMAS

PARTICLES AND FIELDS

PERSONNEL

PI - J.H. WOLFE
01 - A. BARNES
01 - R.C. WHITTEN
01 - S.J. MCKNIGHT
01 - J.R. WHITTEN

NASA-ARC

BRIEF DESCRIPTION

The instrument for this experiment was a quadrupole mass spectrometer to determine the energy and charge of the charged particles in the Venusian ionosphere. The data were analyzed using a quasi-spherical model to determine the energy and charge of the charged particles in the Venusian ionosphere.

------ PIONEER VENUS 2: BRIDGE-----------------------------------

INVESTIGATION NAME- INTERPLANETARY ION PLASMA PROBE FOR E/V OF 40 TO 9400 VOLTS

NSSDC 10- 67-060A-03 INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE

INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS

INTERPLANETARY PHYSICS

PERSONNEL

PI - H.S. BRIDGE
01 - H.J. SYMMES

MASS INST OF TECH

BRIEF DESCRIPTION

This experiment consisted of two sets of plasma analyzers mounted on the Pioneer 8 and Pioneer 9 spacecrafts. The analyzers were designed to measure the energy and charge of the charged particles in the interplanetary space. The data were analyzed using a quasi-spherical model to determine the energy and charge of the charged particles in the interplanetary space.
This experiment used a triaxial fluxgate magnetometer with two ring-core sensors at the end of a magnetometer boom and one ring-core sensor, 45 deg to the spin axis, halfway down the boom. The drive and electronics design had been used on the Apollo 15 and 16 subsatellites. The objectives were to determine any planetary and remnant magnetic fields, to define the location and strength of the terrestrial current system, to determine the energy and mass balance in the upper atmosphere of Venus, to determine the nature of the solar wind interaction with Venus, and to study the near-surface region of Venus and the structure of the hazelblue shock. Interplanetary objectives were to determine the perturbation of the near-planet region by Venus to determine the properties of the surface field at 1.1 and 1.0 AU. The instrument was interred in the worst case of low- and low-rate rates, and the sample vector per 1.63 kV. While in Venus orbit, the spacecraft was coasting through the interplanetary region in the spacecraft's orbit. The sample rate was one vector per 5 s, while the spacecraft was passing through the Venusian foreshock in the perigee mode, the sample rate was four vectors per s.

Mariner 5: Smith

INVESTIGATION NAME: TRIAXIAL LOW FIELD HELIUM MAGNETOMETER
NSSDC ID: 67-068A-05
INVESTIGATIVE PROGRAM: CODE E6-9, SCIENCE
INVESTIGATION DISCIPLINE(S): PARTICLES AND FIELDS
PERSONNEL
PI: J.J. Smith

NASA-JPL

BRIEF DESCRIPTION
For this experiment a low-field helium magnetometer was used to obtain triaxial measurements of interplanetary and venusian magnetic fields. The experiment depended on the variation in susceptibility of excited helium to circularly polarized light with applied magnetic fields. Small helium-filled tubes null the ambient field by use of feedback circuits. Mounted on a 1.25 cm boom, the instrument's dynamic ranges were plus or minus 204 nT per axis, with a measurement precision determined by the noise level of plus or minus 0.02 nT. The sample rate was settable to within 0.25 nT per component. The experiment was operated in a high flux bit-rate mode of 3 vector samples per second. The data were obtained from June 19 to July 31, 1975, and for 3 hours on October 25, 1975. The bit-rate data were obtained for the remainder of the experiment's useful lifetime. Quality of data was high except during September 23 to October 1, 1975, when high-rate data were not obtained. NSSDC has all the data from this experiment.

Mariner 2: Van Allen

INVESTIGATION NAME: PARTICLE DETECTOR
NSSDC ID: 62-041A-07
INVESTIGATIVE PROGRAM: CODE E6-4, SCIENCE
INVESTIGATION DISCIPLINE(S): PARTICLES AND FIELDS
PERSONNEL
PI: J.A. Van Allen

U of Iowa

BRIEF DESCRIPTION
A coaxial, bidirectional, flat plate type 213 Geller-Mueller tube (with energy thresholds of 6 keV for electrons and 50 keV for protons) was used to study the charged particles of the magnetically trapped in the vicinity of the planet Venus and the change in the energy and mass balance in the upper atmosphere. The experiment was operated in a high flux bit-rate mode of 3 vector samples per second at 5/4 of the spacecraft's orbit in time. The data were obtained from June 19 to July 31, 1975, and for 3 hours on October 25, 1975. The bit-rate data were obtained for the remainder of the experiment's useful lifetime. Quality of data was high except during September 23 to October 1, 1975, when high-rate data were not obtained. NSSDC has all the data from this experiment.
DRAFT DESCRIPTION

This ion mass spectrometer experiment obtained measurements of the plasma ion composition in the Venus vicinity. The measurements were obtained with a high spatial resolution of 100 km, and the data were analyzed by means of a computer program that identified the plasma ion species. The results were used to test the models of the Venus plasma environment.

INVESTIGATION NAME- GAMMA-RAY BURST DETECTOR

PERSONNEL
PI - V.J. EVANS
OI - J.C. ALEXANDER
OI - R.A. OLSON
OI - M.J. SPALDING

INVESTIGATION DISCIPLINE(S)
GAMMA-RAY ASTROPHYSICS

DRAFT DESCRIPTION

An all-sky scanning gamma-ray burst detector designed for the detection of gamma-ray bursts was installed on the spacecraft. The instrument was sensitive to bursts occurring in the energy range of 10 to 100 keV. The data were analyzed using a computer algorithm that identified the burst characteristics and time of occurrence.

INVESTIGATION NAME- COSMIC-RAY IONIZATION

PERSONNEL
PI - H.R. ANDERSON
OI - J.A. VAN ALLEN
OI - V.H. NEHER

INVESTIGATION DISCIPLINE(S)
COSMIC RAYS

DRAFT DESCRIPTION

The cosmic-ray ionization detector experiment was designed to measure the cosmic-ray ionization rate in the Earth's atmosphere. The detector was sensitive to cosmic rays with energies ranging from 100 MeV to 1 TeV. The data were analyzed using a computer algorithm that identified the cosmic-ray intensity and energy distribution.

INVESTIGATION NAME- MARINER 19 BROADFOOT

INVESTIGATION DISCIPLINE(S)
ULTRAVIOLET

DRAFT DESCRIPTION

An ultraviolet spectrometer experiment was designed to measure the ultraviolet radiation at 100 km altitude. The instrument was sensitive to radiation in the wavelength range of 100 to 300 nm. The data were analyzed using a computer algorithm that identified the radiation intensity and wavelength distribution.

INVESTIGATION NAME- MARINER 19 BROADFOOT

INVESTIGATION DISCIPLINE(S)
ULTRAVIOLET

DRAFT DESCRIPTION

An infrared spectrometer experiment was designed to measure the infrared radiation at 100 km altitude. The instrument was sensitive to radiation in the wavelength range of 1 to 1000 nm. The data were analyzed using a computer algorithm that identified the radiation intensity and wavelength distribution.

INVESTIGATION NAME- INFRARED

INVESTIGATION DISCIPLINE(S)
PLANETARY ATMOSPHERES

DRAFT DESCRIPTION

An infrared spectrometer experiment was designed to measure the infrared radiation at 100 km altitude. The instrument was sensitive to radiation in the wavelength range of 1 to 1000 nm. The data were analyzed using a computer algorithm that identified the radiation intensity and wavelength distribution.

INVESTIGATION NAME- NEUGRAUER

INVESTIGATION DISCIPLINE(S)
PLANETARY ATMOSPHERES

DRAFT DESCRIPTION

An infrared spectrometer experiment was designed to measure the infrared radiation at 100 km altitude. The instrument was sensitive to radiation in the wavelength range of 1 to 1000 nm. The data were analyzed using a computer algorithm that identified the radiation intensity and wavelength distribution.
that in turn split by a dichroic filter into two perpendicular beams that were incident on two theristor bolometer detector cells. The successful measurements were conducted during planetary flyby on December 5th, 1962. The accuracy of the radiation measurements obtained varied from 2 deg for source temperatures near 200 deg K to 10 deg for source temperatures near 500 deg K. A complete description and performance summary for the Mariner 2 radiometer is given in "Mariner-Venus 1962 Final Project Report," NASA SP-59, 1962.  

---- PIONEER VENUS PROBE SRM, SUNDI --------------------------------------------------------------

INVESTIGATION NAME- SATELLITE FLUX RADIOMETER (SRM)  
NSSDC ID- 78-0176--04 INVESTIGATIVE PROGRAM CODE EL-400-4P, SCIENCE  
INVESTIGATION DISCIPLINE(S) PLANETARY ATMOSPHERES AERONOGY  
PERSONNEL  
PI - W.E. SUNDI U OF WISCONSIN  
01 - A. LEMOINE U OF LILLE  
01 - A. SCHMIDT NASA-JPL  
01 - A. PHIL NASA-JPL  
01 - G.E. DANILOV CALIF INST OF TECH  
01 - M. HERMAN U OF LILLE  
BRIEF DESCRIPTION  
The objective were to locate regions of radiative convergence and divergence as a function of altitude and to indicate the height at which solar energy is absorbed by the atmosphere. This experiment used a small net flux radiometer on the Probe targeted to the daytimes of Venus to measure the net solar flux in the 0.2- to 4-micrometer region. The two Probes targeted to the nightside of the planet carried net infrared flux sensors covering the 1- to 25-micrometer region. The instrument weighed about 0.4 kg and used 2.2 W of power.  

---- PIONEER VENUS PROBE SRM, SUNDI --------------------------------------------------------------

INVESTIGATION NAME- SATELLITE FLUX RADIOMETER (SRM)  
NSSDC ID- 78-0176--04 INVESTIGATIVE PROGRAM CODE EL-400-4P, SCIENCE  
INVESTIGATION DISCIPLINE(S) PLANETARY ATMOSPHERES AERONOGY  
PERSONNEL  
PI - W.E. SUNDI U OF WISCONSIN  
01 - A. LEMOINE U OF LILLE  
01 - A. SCHMIDT NASA-JPL  
01 - A. PHIL NASA-JPL  
01 - G.E. DANILOV CALIF INST OF TECH  
01 - M. HERMAN U OF LILLE  
BRIEF DESCRIPTION  
The objective was to locate regions of radiative convergence and divergence as a function of altitude and to indicate the height at which solar energy is absorbed by the atmosphere. This experiment used a small net flux radiometer on the Probe targeted to the daytimes of Venus to measure the net solar flux in the 0.2- to 4-micrometer region. The two Probes targeted to the nightside of the planet carried net infrared flux sensors covering the 1- to 25-micrometer region. The instrument weighed about 0.4 kg and used 2.2 W of power.
INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S) CELESTIAL MECHANICS

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

BRIEF DESCRIPTION
Deep Space Network tracking data on Mariner 5 were used to obtain improved determinations of the masses of Venus and the moon, the astronomical unit, and improved ephemeres of the earth and Venus. The experimenter used the onboard receiver and transmitter equipment in conjunction with the Deep Space Station equipment to obtain Doppler measurements. Data were obtained at 24-hour intervals from January 1 to December 31, 1969, at 12-hour intervals until January 4, 1970.

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-049A-58

BRIEF DESCRIPTION
This experiment used the S-band and X-band radio signals for data measurements. The objectives were: (1) to model the gravity field of Venus, (2) to calculate the direction and magnitude of the Venus spin vector, (3) to bound the amplitude of (and possibly estimate) the polar motion of Venus, (4) to determine the density profile of the upper atmosphere, and (5) to determine a correction between the coordinate system of planetary geophysical and an inertial coordinate system reference to extraterrestrial radio sources.

INVESTIGATION NAME: TWO-FREQUENCY BEACON RECEIVER
NSSEC ID: 67-066A-02

BRIEF DESCRIPTION
Both 423.5-MHz and the 2107 subharmonics of 578.8-MHz signals were transmitted from a 4.5-kW STEerable parabolic antenna at Stanford University to the two-frequency radio receiver in the spacecraft. The high-frequency signal served as a reference signal since its propagation time was not appreciably delayed. The low-frequency signal was delayed in proportion to the total electron content in the propagation path. On the spacecraft, a phase-locked receiver counted the low-frequency zero crossings of the received signals to obtain measurements of phase-path differences. The experiment operated nominally from launch to November 1967. For similar experiments covering other time periods, see Pioneers 9-11 (LO-0095-62, 67-024A-03, 67-053A-04, and 67-059A-05). More detailed descriptions of the experiment can be found in J. Geophys. Res., V. 72, pp. 3325-3327, and in Radio Science, V. 6, pp. 55-63. NSSDC has all the data from this experiment.

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-67

PERSONNEL
PI - J.H. KNAPMAN NASA-JPL

BRIEF DESCRIPTION
This experiment used data obtained from the 3-MHz and X-band radio signals. The objectives were (1) to determine the electron content of the Venusian atmosphere and troposphere, (2) to study the solar wind plasma flow and to explain solar wind scintillations (scale and characteristics of the irregularities in the Venusian ionosphere), and (3) to determine values of the terrestrial variations in the Venusian atmosphere and ionosphere.

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-68

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-67

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-68

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-67

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-68

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-67

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-68

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-67

PERSONNEL
PI - J.A. ANDERSON NASA-JPL

INVESTIGATION NAME: CELESTIAL MECHANICS
NSSEC ID: 67-066A-68

PERSONNEL
PI - J.A. ANDERSON NASA-JPL
**NSDC 19- 78-0514-02**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**GEODESY AND CARTOGRAPHY**  
**PLANETOLOGY**  

**PERSONNEL**  
**PI** - G. PETTENGILL  
**OS** - M.T. BOWEN, JR.  
**OI** - W.M. KAUER  
**OII** - O.J. STEINLE  

**MASS INST. OF TECH**  
**U. OF CALIF., LA**  

**BRIEF DESCRIPTION**  
A radar alimeter was used to obtain information on the orbital altitude, planetary surface temperature, and radar scattering properties in order to infer the surface topography, geology, and the thermal and mechanical properties of the interior of Venus. The weight of the instrument was 20 kg (70 lb), and the power consumption was 25 W.

----- PIONEER VENUS 3. PHILLIPS-----

**INVESTIGATION NAME - INTERNAL DENSITY DISTRIBUTION**  
**NSDC 19- 78-0514-23**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**PLANETOLOGY**  
**PLANETARY PHYSICS**  

**PERSONNEL**  
**PI** - W.J. PHILLIPS  

**LUNAR + PLANETARY INST.**

**BRIEF DESCRIPTION**  
This experiment used the S-band and X-band radio signals for data measurements. The objectives were (1) to determine the internal mass distribution and the physical processes that have operated to produce the distribution, (2) to determine the relationship of the surface morphology to the internal density distribution, (3) to determine the amount of isotopic composition of the Venusian surface and (4) to describe an evolutionary track for Venus that is consistent with the above.

**ATMOSPHERE**

----- PIONEER VENUS 3. BRACE-----

**INVESTIGATION NAME - ELECTRON TEMPERATURE PROBE**  
**NSDC 19- 78-0514-01**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**PLANETARY ATMOSPHERES**  
**PLANETARY IONOSPHERES**  

**PERSONNEL**  
**PI** - L.H. BRACE  
**OS** - K.R. MCCLURE  
**OI** - A. PIERSHEN  
**OII** - A. HART  
**OII** - T.M. DURANCE  

**NASA - GSFC**  
**ESA - ESTES**  
**U. OF MICHIGAN**

**BRIEF DESCRIPTION**  
This experiment consists of a pair of cylindrical Langmuir probes of the type used in the Atmospheric Explorer (AE) series. Two probes were required so that one was always out of the wake of the spacecraft. In flight analyses, 56 measurements were taken at a rate of one per second, providing high spatial resolution for the mean electron number density, which were used both to study the upper atmosphere and to study interaction of the solar wind with the Venusian atmosphere. The experiment produced measurements over the whole region traversed by the satellite, covering a large range of solar aspect angles, to yield more complete configuration of the physical properties of the ionosphere region.

----- PIONEER VENUS 3. NIEMANN-----

**INVESTIGATION NAME - NEUTRAL MASS SPECTROMETER**  
**NSDC 19- 78-0514-19**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**AERONOMY**  
**PLANETARY ATMOSPHERES**  

**PERSONNEL**  
**PI** - H.G. NIEMANN  
**OS** - G.R. CAISERAN  
**OI** - E.D. MELLE  
**OII** - J.R. SPENCER  

**NASA - GSFC**  
**U. OF MICHIGAN**

**BRIEF DESCRIPTION**  
The experiment used a quadrupole mass spectrometer with three ion-source operating modes and three mass-scanning modes. The ion source could be operated alternately in open and closed configurations to increase accuracy. An adaptive mass scan was used to reduce the bit rate required for a given information-return rate. The resolution was 1.E-4 for adjacent masses, and the mass range was 1 to 45 u. Vertical and horizontal density variations of the major neutral constituents of the upper atmosphere of Venus were detected and measured to define the dynamical, chemical, and thermal states of the upper atmosphere. Important constituents measured were He, O, O2, CO, and NO. It was also possible to study H2 and/or H2, C, and N2.

----- PIONEER VENUS 3. VON ZAHN-----

**INVESTIGATION NAME - NEUTRAL MASS SPECTROMETER**  
**NSDC 19- 78-078A-03**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**PLANETARY ATMOSPHERES**  
**AERONOMY**

**PERSONNEL**  
**PI** - H.U. VON ZAHN  
**OS** - J.C. WIBER  
**OI** - R.W. KUNTH  

**U. OF MICHIGAN**  
**U. OF MINNESOTA**

**BRIEF DESCRIPTION**  
This neutral particle mass spectrometer experiment obtained measurements which provide information on the composition and evolution of Venus' atmosphere, the present energy balance and dynamic of the upper atmosphere, and the interaction of the upper atmosphere with solar radiation and the interplanetary medium. A magnetic deflection double-focusing mass spectrometer was flown to measure the upper atmosphere neutral molecules in the mass range 1 to 64 atomic mass units (u).

----- PIONEER VENUS PROBE 4. HOFFMAN-----

**INVESTIGATION NAME - NEUTRAL PARTICLE MASS SPECTROMETER**  
**NSDC 19- 78-078A-06**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**PLANETARY ATMOSPHERES**  
**AERONOMY**

**PERSONNEL**  
**PI** - J.H. HOFFMAN  
**OS** - R.H. RODES, JR.  
**OI** - R.J. SIMMONS  
**OII** - D.J. PETERSEN  

**U. OF TEXAS, DALLAS**  
**U. OF TEXAS, DALLAS**  
**THE SYSTEMS GROUP**

**BRIEF DESCRIPTION**  
The objective of this investigation was to measure the composition of the lower atmosphere of Venus. This experiment used a ceramic micro-teak gas inlet and a double-focusing magnetic deflection mass spectrometer. About 50 analyses of the Venusian atmosphere were planned during the probe's descent to a sample volume of a few cubic feet. The experiment was analyzed for rare gases. The analyzer had a mass range of 1 to 212 u and a dynamic range of 1.E-7. The instrument was based on a design flown previously.

----- PIONEER VENUS 4. KEATING-----

**INVESTIGATION NAME - ATMOSPHERIC DRAG**  
**NSDC 19- 78-0514-19**  
**INVESTIGATIVE PROGRAM**  
**CODE EL-4/S SCIENCE**  
**INVESTIGATION DISCIPLINES**  
**PLANETARY ATMOSPHERES**

**PERSONNEL**  
**PI** - J.R. KEATING  

**NASA - GSFC**

**BRIEF DESCRIPTION**  
This experiment made use of the spacecraft's S-band and X-band radio signals for data measurements. The objectives were (1) to establish the diurnal variation of thermospheric density and density scale height (2) to determine the relationship of solar wind variations to density variations, (3) to determine the relationship of long and short term variation in solar extraneous UV radiation to density variations, (4) to search for phenomena such as a semi-annual variation and super rotation of the thermosphere, and (5) to formulate a thermospheric model for the Venusian atmosphere.
INVESTIGATION NAME: DIFFERENTIAL LONG BASE LINE INTERFEROMETRY (DLIR)

NSSDC 10-78-078A-86 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES, METEOROLOGY

PERSONNEL
PI - C.E. COUNSELMAN
OI - J.J. SHAPIRO
OI - R.H. PRINZ
OI - R..C. PETTIGILL
OI - G. MANCHE
OI - A. TELESCINT
OI - J.R. HALLORAN
OI - J.J. PETTICORN

BRIEF DESCRIPTION
This experiment used the Deep Space Network (DSN) telemetry data. The objective was to measure and study the small-scale turbulence characteristics of the atmosphere of Venus. Information obtained included the variation of intensity of turbulence with altitude, wind velocity transverse to the line-of-sight path, and distribution of scale size in the atmosphere. These measurements contributed to an understanding of the atmosphere’s circulation and dynamics.

INVESTIGATION NAME: ATMOSPHERIC TURBULENCE (MTUR)

NSSDC 10-78-078B-86 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES, CELESTIAL MECHANICS

PERSONNEL
PI - R. WOO
OI - H.E. BLAMON
OI - G. MANCHE
OI - A. TELESCINT
OI - J.R. HALLORAN
OI - J.J. PETTICORN
OI - J.J. PETTICORN
OI - J.J. PETTICORN

BRIEF DESCRIPTION
This experiment used the Deep Space Network (DSN) telemetry data. The objective was to measure and study the small-scale turbulence characteristics of the atmosphere of Venus. Information obtained included the variation of intensity of turbulence with altitude, wind velocity transverse to the line-of-sight path, and distribution of scale size in the atmosphere. These measurements contributed to an understanding of the atmosphere’s circulation and dynamics.

INVESTIGATION NAME: ATMOSPHERIC TURBULENCE (MTUR)

NSSDC 10-78-078C-86 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES, CELESTIAL MECHANICS

PERSONNEL
PI - R. WOO
OI - H.E. BLAMON
OI - G. MANCHE
OI - A. TELESCINT
OI - J.R. HALLORAN
OI - J.J. PETTICORN
OI - J.J. PETTICORN
OI - J.J. PETTICORN

BRIEF DESCRIPTION
This experiment used the Deep Space Network (DSN) telemetry data. The objective was to measure and study the small-scale turbulence characteristics of the atmosphere of Venus. Information obtained included the variation of intensity of turbulence with altitude, wind velocity transverse to the line-of-sight path, and distribution of scale size in the atmosphere. These measurements contributed to an understanding of the atmosphere’s circulation and dynamics.

INVESTIGATION NAME: NEPHELOMETER (NKN)

NSSDC 10-78-078D-86 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES, AERONOMY

PERSONNEL
PI - R. AGENT
OI - J.E. ROGERS
OI - J.E. BLAMONT
OI - G. MANCHE
OI - A. TELESCINT
OI - J.R. HALLORAN
OI - J.J. PETTICORN
OI - J.J. PETTICORN
OI - J.J. PETTICORN

BRIEF DESCRIPTION
This experiment consisted of a nephelometer to measure the energy backscattered from cloud particles. It used a pulsed gallium arsenide laser diode to illuminate the clouds. The altitude history of the backscattered signal indicated the presence and vertical extent of clouds along the trajectory. Comparisons with the measurements from the scale probes indicated the spatial variability of the cloud structure. The laser operated at about 9600 A. The experiment weighed about 6.5 kg and used about 1.3 W of power.

INVESTIGATION NAME: NEPHELOMETER (NKN)

NSSDC 10-78-078E-86 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES, AERONOMY

PERSONNEL
PI - R. AGENT
OI - J.E. ROGERS
OI - J.E. BLAMONT
OI - G. MANCHE
OI - A. TELESCINT
OI - J.R. HALLORAN
OI - J.J. PETTICORN
OI - J.J. PETTICORN
OI - J.J. PETTICORN

BRIEF DESCRIPTION
This experiment consisted of a nephelometer to measure the energy backscattered from cloud particles. It used a pulsed gallium arsenide laser diode to illuminate the clouds. The altitude history of the backscattered signal indicated the presence and vertical extent of clouds along the trajectory. Comparisons with the measurements from the scale probes indicated the spatial variability of the cloud structure. The laser operated at about 9600 A. The experiment weighed about 6.5 kg and used about 1.3 W of power.
This experiment consisted of a nephelometer to measure the energy backscattered from cloud particles. It used a pulsed galium arsenide laser diode to illuminate the clouds. The altitude history of the backscattered signal indicated the presence and vertical extent of clouds along the trajectory. Comparisons with the measurements from the other probes revealed the spatial variability of the cloud structure. The laser operated at about 9000 Å. The experiment weighed about 1.2 kg and used about 1.2 W of power.

**** PIONEER VENUS PROBE S3, SEIFF ********

INVESTIGATION NAME- ATMOSPHERE STRUCTURE

NSSDC ID- 78-078E-03 INVESTIGATIVE PROGRAM CODE EL+4-SCIENCE INVESTIGATION DISCIPLINES) PLANETARY ATMOSPHERES METEOROLOGY AERONOMY

PERSONNEL
PI - R. RAGEN NASA-ARC
PI - J.S. BLANCHARD CHRS-SA
PI - J. J. YOUNG NASA-ARC
PI - J. R. DERR US GEOLOGICAL SURVEY

BRIEF DESCRIPTION

This instrument for the experiment included a three-axis accelerometer, pressure sensors, and temperature sensors. They were based on the technology demonstrated by the PAET rocket vehicle (Planetary Atmosphere Experiment Test R-7160-2803). The measurements were used to construct a profile of atmospheric state properties for the trajectory from the surface to approximately 140 km altitude. They were also used to determine vertical wind velocity, horizontal wind velocity, and turbulence. By comparing atmospheric conditions along this trajectory with those measured by the other probes, circulation models of the atmosphere were determined. The instruments weighed about 1.2 kg and consumed about 1.4 W of power.

**** PIONEER VENUS PROBE LEG, CROFT ********

INVESTIGATION NAME- ATMOSPHERE STRUCTURE

NSSDC ID- 78-078E-01 INVESTIGATIVE PROGRAM CODE EL+4-SCIENCE INVESTIGATION DISCIPLINES) PLANETARY ATMOSPHERES METEOROLOGY AERONOMY

PERSONNEL
PI - A. SEIFF NASA-ARC
PI - S.C. SOMMER NASA-ARC
PI - J.R. BLANCHARD NASA-ARC
PI - J.J. YOUNG NASA-ARC
PI - J.R. DERR NASA-ARC
PI - J. J. YOUNG US GEOLOGICAL SURVEY

BRIEF DESCRIPTION

The objective of this experiment was to determine the atmospheric structure of Venus as affected by the intensity and refection of probes telemetry signals. An investigation of the interference between the direct ray and a surface-reflected component was undertaken to assess communications reliability for the design of future probe missions.
----- PIONEER VENUS PROBE SRJ. CROFT

INVESTIGATION NAME: ATMOSPHERIC PROPAGATION (PROP)

NSSDC ID: 78-078E-07

INVESTIGATIVE PROGRAM

CORE E.4. SCIENCE

INVESTIGATION DISCIPLINES:

PLANETARY ATMOSPHERES

PERSONNEL

PI - T.A. CROFT

SRI INTERNATIONAL

BRIEF DESCRIPTION

This experiment used the Deep Space Network (DSN) telemetry data. The objectives were (1) to determine the atmospheric structure of Venus as it affects the intensity and refraction of Probe telemetry signals and (2) to investigate the interference between the direct ray and a surface-reflected component as a means of assessing communications reliability for the design of future probe missions.

------ PIONEER VENUS PROBE S. CROFT

INVESTIGATION NAME: ATMOSPHERIC PROPAGATION (PROP)

NSSDC ID: 78-078E-07

INVESTIGATIVE PROGRAM

CORE E.4. SCIENCE

INVESTIGATION DISCIPLINES:

PLANETARY ATMOSPHERES

PERSONNEL

PI - T.A. CROFT

SRI INTERNATIONAL

BRIEF DESCRIPTION

This experiment used the Deep Space Network (DSN) telemetry data. The objectives were (1) to determine the atmospheric structure of Venus as it affects the intensity and refraction of Probe telemetry signals and (2) to investigate the interference between the direct ray and a surface-reflected component as a means of assessing communications reliability for the design of future probe missions.

------ PIONEER VENUS PROBE S. CROFT

INVESTIGATION NAME: DIFFERENTIAL LONG BASELINE INTERFEROMETER (GLIB)

NSSDC ID: 78-078E-07

INVESTIGATIVE PROGRAM

CORE E.4. SCIENCE

INVESTIGATION DISCIPLINES:

PLANETARY ATMOSPHERES

PERSONNEL

PI - T.A. CROFT

SRI INTERNATIONAL

BRIEF DESCRIPTION

This experiment involved applying differential very-long-baseline interferometry techniques to the radio signals from the entry Probe and Bus techniques to infer or place upper limits on wind speeds in the lower atmosphere. These results were used in modeling the circulation patterns of Venus' atmosphere. Data taken prior to probe entry were used, where feasible, to infer characteristics of Venus' gravity field for use with probe entry operations as well as in later scientific evaluation.

------ PIONEER VENUS PROBE S. CROFT

INVESTIGATION NAME: DIFFERENTIAL LONG BASELINE INTERFEROMETER (GLIB)

NSSDC ID: 78-078E-07

INVESTIGATIVE PROGRAM

CORE E.4. SCIENCE

INVESTIGATION DISCIPLINES:

PLANETARY ATMOSPHERES

PERSONNEL

PI - T.A. CROFT

SRI INTERNATIONAL

BRIEF DESCRIPTION

This experiment involved applying differential very-long-baseline interferometry techniques to the radio signals from the entry Probe and Bus techniques to infer or place upper limits on wind speeds in the lower atmosphere. These results were used in modeling the circulation patterns of Venus' atmosphere. Data taken prior to probe entry were used, where feasible, to infer characteristics of Venus' gravity field for use with probe entry operations as well as in later scientific evaluation.

------ PIONEER VENUS PROBE S. CROFT

INVESTIGATION NAME: CLOUD PARTICLE SIZE SPECTROMETER (CLPS)

NSSDC ID: 78-078E-07

INVESTIGATIVE PROGRAM

CORE E.4. SCIENCE

INVESTIGATION DISCIPLINES:

PLANETARY ATMOSPHERES

PERSONNEL

PI - T.A. CROFT

SRI INTERNATIONAL

BRIEF DESCRIPTION

This experiment involved applying differential very-long-baseline interferometry techniques to the radio signals from the entry Probe and Bus techniques to infer or place upper limits on wind speeds in the lower atmosphere. These results were used in modeling the circulation patterns of Venus' atmosphere. Data taken prior to probe entry were used, where feasible, to infer characteristics of Venus' gravity field for use with probe entry operations as well as in later scientific evaluation.
The objective of this experiment was to measure Venus' cloud particle sizes and concentrations. A laser was used to illuminate cloud particles. Optical lenses imaged the particle shadows on arrays of detectors. The particle shapes were used to determine particle size and concentration. The flight sensor was similar to those flown in aircraft and balloons.

PIONEER VENUS PROBE LRG, OPANA

INVESTIGATION NAME: GAS CHROMATOGRAPH (LGC)
INVESTIGATION DISCIPLINES: PLANETARY ATMOSPHERES
PERSONNEL
PI = V.I.
01 = J.B.
01 = G.
01 = A.

Brief Description
The objective of this experiment was to determine the composition of Venus' lower atmosphere. From these measurements, deductions were made of the gaseous sources of infrared opacity, the degree of differentiation of Venus' interior, the degree of similarity between the solid bodies of Earth and Venus, and evolution of Venus' atmosphere. Two gas chromatograph columns were used to analyze samples of the atmosphere during probe descent.

PIONEER VENUS PROBE LRG, TOMASKO

INVESTIGATION NAME: SOLAR FLUX RADIOMETER (LSFR)
INVESTIGATION DISCIPLINES: PLANETARY ATMOSPHERES
PERSONNEL
PI = M.G.
01 = A.
01 = A.

Brief Description
The objective of this investigation was to determine the regions in Venus' atmosphere where solar energy is deposited. Six narrow-field-of-view detectors were used to measure the intensity of scattered solar light. As the probe descended through the atmosphere, the difference between upward-looking and downward-looking detectors indicated the net downward flux.

POLARIZATION

PIONEER VENUS PROBE LRG, HANSEN

INVESTIGATION NAME: CLOUD PHOTOPOLOMETER
INVESTIGATION DISCIPLINES: PLANETARY ATMOSPHERES
PERSONNEL
PI = M.G.
01 = A.
01 = A.

Brief Description
The objective of this experiment was to determine the regions in Venus' atmosphere where solar energy is deposited. Six narrow-field-of-view detectors were used to measure the intensity of scattered solar light. As the probe descended through the atmosphere, the difference between upward-looking and downward-looking detectors indicated the net downward flux.
Mars
Plate 3. This is a composite of press release photographs from the Mariner 9, Vikings 1 and 2 Orbiter, and Vikings 1 and 2 Lander missions. (A) 211-5050 is a mosaic of Viking Orbiters' medium-resolution photos depicting most of one hemisphere of Mars and showing the Valles Marineris (4000-km-long canyon), the Tharsis bulge's giant volcanoes, and the very large Argyre basin. (B) P12732 is a Mariner 9 high-resolution photo of part of the Valles Marineris, discovered on this mission, showing some of the arroyos, the largest of which resembles our Grand Canyon in size and appearance. (C) 211-5248 is a mosaic from Viking Orbiter photography of Arsia Mons, one of the giant shield volcanoes on Mars. (D) P17002 is a Viking 1 Orbiter mosaic photo of the terrain near the Viking 1 Lander's site showing features that are best explained as the products from flowing water. Conditions in the past must have been different, permitting free water to form in large quantities, which is not possible at present on Mars. (E) 211-5685 is a Viking 1 Lander photo of the immediate surroundings of the spacecraft at its landing site in Chryse Planitia. Note the presence of many loose rocks, rock outcroppings, and dune-like areas. (F) P16848 is a Viking 1 Orbiter photo of Yuti, showing a type of crater unique to Mars which has an enormous, high central peak with a summit crater. The large central peak and large, multi-layered ejecta envelopes do not follow the Schroter rule for impact craters. (G) P12694 is a Mariner 9 photo of Phobos, the larger and closer of the two tiny satellites of Mars. The photo shows the moon to be irregular in shape (only 20 km long) and highly cratered. Mariner 9 was the first to obtain detailed photos of these moons. Viking Orbiter photos later revealed long grooves and crater chains on Phobos and deep dust on Deimos. (H) Viking 2 Lander photo shows the immediate surroundings of the spacecraft in the Utopia region of Mars. Note that most of the rocks have a pocked or vesicular surface and that they are quite different from those at the Lander 1 site in (E). One of the footpads landed on a rock.
INTRODUCTION

Mars is the next planet out from the sun that is treated in this catalog. Six missions have been sent to Mars by the U.S. and several by the U.S.S.R., but since NSSDC has no data from the U.S.S.R. missions, they are omitted in this catalog. The last missions, Vikings 1 and 2, consisted of two spacecraft each: (1) Viking Orbiter and (2) Viking Lander. Each spacecraft is treated separately. On these missions there were 49 investigations for which NSSDC has data or sources from which data may be obtained. These investigations cover eight categories: (1) Imaging, (2) Particles and Fields, (3) Ultraviolet, (4) Infrared, (5) Radio Science and Celestial Mechanics, (6) Atmosphere, (7) Surface Chemistry, and (8) Biology. The last two categories of investigations are unique to Mars. Tables 1 and 2 and Appendix A give more details of these investigations.
### SPACELAB COMMON NAME: MARINER

**SPACECRAFT**

**ALTERNATE NAME:** MARINER 4

**LAUNCH DATE:** 11/28/64

**WEIGHT:** 262.1 KG

**LAUNCH SITE:** CAPE CANAVERAL, UNITED STATES

** LAUNCH VEHICLE:** ATLAS

**SPONSORING COUNTRY/AGENCY:** UNITED STATES

**NASA-CSSA**

**INITIAL ORBIT PARAMETERS**

**ORBIT TYPE:** NA$/$FLY

**PERSONNEL**

PM - J.M. JAMES

PS - R.K. SLOAN (US)

**BRIEF DESCRIPTION**

Mariner 4 was the fourth in a series of spacecraft used for planetary exploration in a flyby mode. It was designed to conduct close-up scientific observations of the planets and return these observations to Earth. It had an orbit stabilizer, and was able to transmit data to Earth without the need for a lander. It was highly successful, returning many pictures and scientific data. It also performed scientific experiments on the interplanetary environment.

**ORBIT TYPE:** AREOCENTRIC

**ORBIT PERIOD:** 1475.7 MIN

**PERIAPSIS:** 153.7 KM ALT

**APOLYPSIS:** 16000.4 KM ALT

**PERSONNEL**

PM - R. SCHNEIDER

PS - R.H. STEINBACHER

**BRIEF DESCRIPTION**

Mariner 4 was the sixth in a series of spacecraft used for planetary exploration in a flyby mode. It was designed to conduct close-up scientific observations of the planets and return these observations to Earth. It had an orbit stabilizer, and was able to transmit data to Earth without the need for a lander. It was highly successful, returning many pictures and scientific data. It also performed scientific experiments on the interplanetary environment.

**ORBIT TYPE:** AREOCENTRIC

**ORBIT PERIOD:** 1370.1 MIN

**PERIAPSIS:** 357.9 KG

**APOLYPSIS:** 947.9 KG

**PERSONNEL**

PM - J.T. MARTIN (US)

PS - E.A. DOFFEN (US)

**BRIEF DESCRIPTION**

The Viking spacecraft consisted of an orbiter and a lander. The lander separated from the orbiter after entering the Martian atmosphere, and the orbiter continued to study the Martian environment. The lander was the first to land on another planet, and was highly successful in returning scientific data on the Martian surface.
72 kg (158 lb). The orbiter was an octagon approximately 2.5 m across. The eight sides of the ring-like structure were 1.37 m high and were alternately 1.4 m and 2.34 m wide. The Viking orbiter operations were terminated on August 7, 1976. For a detailed description of the Viking mission and experiments see "Scientific Results of the Viking Project," J. Geophys. Res., v. 82, n. 28, 1977.

*************** VIKING 2 ORBITER **********************

SPACECRAFT COMMON NAME: VIKING 2 ORBITER
ALTERNATE NAMES: PL-T234, VIKING-II ORBITER

NSSC ID: 75-053A
LAUNCH DATE: 09/09/75
WEIGHT: 1092. KG
LAUNCH SITE: CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE: TITAN

SPONSORING COUNTRY/AGENCY
UNITED STATES

ORBIT PARAMETERS
ORBIT TYPE: AREOCENTRIC
EPOCH DATE: 08/09/76
INCLINATION: 55.2 DEG
PERIAPSIS: 14970. KM ALT
APOAPSIS: 35500. KM ALT

PERSONNEL
PR - J. A. MARTIN(NA) NASA-JPL
PS - G.A. SOFFEN(NA) NASA-LAC

BRIEF DESCRIPTION
The Viking spacecraft consisted of an orbiter and a lander. The lander separated from the orbiter, entered the Martian atmosphere, and soft-landed on September 3, 1976. Scientific experiments were conducted at Earth from the orbiter during entry and while it was on the surface, and beam data before and after surface activity. The orbiter was a solar-electric spacecraft stabilized in three axes using inertial reference. There was a 509-w power capacity for the orbiter. It carried instruments for studying atmospheric water vapor, thermal mapping, and radio science investigations. The scientific and photographic analysis instruments had a mass of approximately 72 kg (158 lb). Because of the low altitude fuel, the transmitters and experiments were turned off July 25, 1975. The orbiter was an octagon approximately 2.5 m across. The eight sides of the ring-like structure were 1.67 m high and were alternately 1.4 m and 2.34 m wide. For a detailed description of the Viking mission and experiments see "Scientific Results of the Viking Project," J. Geophys. Res., v. 82, n. 28, 1977.

*************** VIKING 2 LANDER **********************

SPACECRAFT COMMON NAME: VIKING 2 LANDER
ALTERNATE NAMES: VIKING-II LANDER

NSSC ID: 75-053C
LAUNCH DATE: 09/09/75
WEIGHT: 598. KG
LAUNCH SITE: CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE: TITAN

SPONSORING COUNTRY/AGENCY
UNITED STATES

INVESTIGATION NAME: MARS TV CAMERA
INVESTIGATIVE CODE: PLANETOLOGY
INVESTIGATION DISCIPLINE(S): PLANETOLOGY
PIT - E. L. LEIGHTON

BRIEF DESCRIPTION
The Mars television experiment was designed to obtain photographs of the Martian surface and telemeter these to Earth at the rate of 150 pictures per second with a 20.6-mm effective focal length and a 1.5° field of view. The camera was an image-forming system with a field of view of approximately 12°. The camera was designed to record a sequence of images and store them in a charged-coupled-device (CCD) array. The images were transmitted to Earth by radio relay through an orbiting spacecraft. The spacecraft carried a camera and a television system that allows for the transmission of images to Earth. The images were then turned off July 25, 1975. For a detailed description of the Viking mission and experiments see "Scientific Results of the Viking Project," J. Geophys. Res., v. 82, n. 28, 1977.

*************** VIKING 2 LANDER **********************

SPACECRAFT COMMON NAME: VIKING 2 LANDER
ALTERNATE NAMES: VIKING-II LANDER

NSSC ID: 75-053A
LAUNCH DATE: 09/09/75
WEIGHT: 598. KG
LAUNCH SITE: CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE: TITAN

INVESTIGATION NAME: MARS TV CAMERA
INVESTIGATIVE CODE: PLANETOLOGY
INVESTIGATION DISCIPLINE(S): PLANETOLOGY
PIT - E. L. LEIGHTON

BRIEF DESCRIPTION
The Mars television experiment was designed to obtain photographs of the Martian surface and telemeter these to Earth at the rate of 150 pictures per second with a 20.6-mm effective focal length and a 1.5° field of view. The camera was an image-forming system with a field of view of approximately 12°. The camera was designed to record a sequence of images and store them in a charged-coupled-device (CCD) array. The images were transmitted to Earth by radio relay through an orbiting spacecraft. The spacecraft carried a camera and a television system that allows for the transmission of images to Earth. The images were then turned off July 25, 1975. For a detailed description of the Viking mission and experiments see "Scientific Results of the Viking Project," J. Geophys. Res., v. 82, n. 28, 1977.

*************** VIKING 2 LANDER **********************

SPACECRAFT COMMON NAME: VIKING 2 LANDER
ALTERNATE NAMES: VIKING-II LANDER

NSSC ID: 75-053C
LAUNCH DATE: 09/09/75
WEIGHT: 598. KG
LAUNCH SITE: CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE: TITAN

INVESTIGATION NAME: MARS TV CAMERA
INVESTIGATIVE CODE: PLANETOLOGY
INVESTIGATION DISCIPLINE(S): PLANETOLOGY
PIT - E. L. LEIGHTON

BRIEF DESCRIPTION
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INVESTIGATION NAME- TELEVISION PHOTOGRAPHY

NSSDC ID- 71-051A-04
INVESTIGATIVE PROGRAM
CORE EL-4A: SCIENCE
INVESTIGATIVE DISCIPLINE(S)
PLANETOLOGY

PERSONNEL
PI - W. MAUSER
CALIF INST OF TECH

BRIEF DESCRIPTION

Two television cameras, one of medium resolution (wide angle) and the other of high resolution (narrow angle), were part of the Viking 1 scientific instrumentation. The wide-angle camera, which had a field of view of 11 deg by 14 deg and a focal length of 50.8 cm, encompassed 100 times more surface area than the narrow-angle camera and was used only for near-encounter pictures. The narrow-angle camera, which was used for both near- and far-encounter pictures, had a focal length of 50.8 cm and was provided 10 times the linear resolution of the wide-angle camera. Camera shutters were alternated and timed to provide overlapping of the wide-angle and narrow-angle pictures, providing 75 pictures from the two systems (26 near-encounter and 50 far-encounter). The far-encounter pictures were taken between 12 min 59 sec before encounter and 2 min 55 sec after encounter along a track that crossed the equatorial zones of the planet and included many known light and dark features of the Martian surface. The near-encounter cameras crossed the equatorial zone and did not overlap. Ten pictures were taken in each series of operations. In the first series, 33 pictures were obtained from 12 min before to 2 min 55 sec after closest approach. In the second series, 17 pictures were obtained between 22 h and 7 h from closest approach. TV pictures data were recorded and stored on the onboard television and data storage subsystems. For each picture produced by the camera, three separate encoded versions were transmitted to Earth—an analog video (C4V) picture, a digital video (D4V) picture, and an every twenty-eighth (ETE) digital picture. Video reconstruction consisted of combining the three data streams (C4V, D4V, and ETE). This generated video data as they existed coming out of the camera. Individual recorded video magnetic tapes were displayed on a CTV and photographed on 70 mm film to produce the final images. They were also digitally processed by an IBM 360/75 computer for enhancement and by an IBM 360/75 computer for enhancement and digital processing of the final data. This resulted in a digital processing of the Martians and their environment in the resolution of 360/75. Detailed information on the digital processing procedures can be found in "Digital Processing of the Martian Surface", by J. C. Campbell, 1978, which was issued by JPL.

----- MARINER 9 MAUSER -----

INVESTIGATION NAME- MARS TV CAMERA

NSSDC ID- 69-055A-01
INVESTIGATIVE PROGRAM
CORE EL-4A: SCIENCE

INVESTIGATION DISCIPLINE(S)
PLANETOLOGY

PERSONNEL
PI - R.G. LEIGHTON
CALIF INST OF TECH

BRIEF DESCRIPTION

Television vision camera, one of medium resolution (wide angle) and the other of high resolution (narrow angle), were part of the Viking 1 scientific instrumentation. The wide-angle camera, which had a field of view of 11 deg by 14 deg and a focal length of 50.8 cm, encompassed 100 times more surface area than the narrow-angle camera and was used only for near-encounter pictures. The narrow-angle camera, which was used for both near- and far-encounter pictures, had a focal length of 50.8 cm and was provided 10 times the linear resolution of the wide-angle camera. Camera shutters were alternated and timed to provide overlapping of the wide-angle and narrow-angle pictures, providing 126 pictures from the two systems (53 near-encounter and 73 far-encounter). The far-encounter pictures were taken between 20 min 26 sec before closest approach and 2 min 55 sec after closest approach along a roughly north-south course that intersected the Martian 6 tracks and included the Martian south pole. The near-encounter pictures were taken in three series of operations between 68 h and 5 h before closest approach. Two fractional operations were obtained at the end of the first two series. Each field of view of the camera was encoded and recorded within the 100 television and data storage systems. For each picture produced by the cameras, separate encoded versions were transmitted to Earth: a composite analog video (C4V) picture, a digital video (D4V) picture, and an every twenty-eighth (ETE) digital picture. Video reconstruction consisted of combining the three data streams (C4V, D4V, and ETE). This resulted in digital processing of the Martian surface in the resolution of 360/75. Detailed information on the digital processing procedures can be found in "Digital Processing of the Martian Surface", by J. C. Campbell, 1978, which was issued by JPL.

----- MARINER 9 MAUSER -----

INVESTIGATION NAME- VIKING ORBITER, CARE

NSSDC ID- 75-073B-01
INVESTIGATIVE PROGRAM
CORE EL-4C/DO-P: SCIENCE

INVESTIGATIVE DISCIPLINE(S)
PLANETOLOGY

PERSONNEL
PI - R.A. SMITH
U OF STANFORD

INVESTIGATION DISCIPLINE(S)
PLANETOLOGY

BRIEF DESCRIPTION

The Viking orbital television subsystem (OIV) consisted of twin high-resolution, 500-line television framing cameras mounted on the scan platform of each orbiter with the optical axes offset by 1.38 deg. Each camera was an identical camera on each orbiter had a 475-mm focal length telescope; 57-mm diameter (similar to the central section of which was scanned in a raster format of 1024 lines by 182 samples) and six color filters to restrict the spectral bands of an image to limited portions of the near-visible response characteristics. Each image view was 1.54 deg by 1.69 deg with each picture element (pixel) subtending 25 microradians. The slight offset of the optical axes and the alternate shuttering mode of operation (the interval between frames being 4.48 slo) produced overlapping images of the surface, individual images are identified by picture number (PICN), which is a unique identifier of the location and time of the image. The first three digits denote the revolution (REV) during which the image was observed. The suffix A and B are assigned to the Viking Orbiter 1A and 1B. The first two digits are the frame number. Operation of this experiment was examined on August 7, 1979.
COLORADO IS 2.4 SURVEY. The A.B. LANDER was acquired from the APPL. INC. below.

...below. The use of a single detector to image an entire frame allowed a relative radiometric accuracy of plus or minus 10%. For more information concerning the camera, see Huch et al., Space Science Instrumentation, v. 2, p. 187-214, 1975.

PERSONNEL
TL - T.A. MITCH(Deceased) NASA HEADQUARTERS
TM - T. SAGAN CONNELL U
TM - A.B. BINDER U OF KIEL
TP - E.C. MORGIS US GEOLOGICAL SURVEY
TH - F.D. HUCK NASA-LARC
TH - E.C. LIEBER JR. NUCLEAR REGULATORY COM
TM - J.R. POLLOCK STANFORD U
TH - R.E. ADKISON WASHINGTON U

BRIEF DESCRIPTION
The lander imaging experiment viewed the scence surrounding the lander, the surface sampler, and other parts of the lander, the twin, and Phobos to provide data for operational purposes and for geological and meteorological investigations. Two scanning cameras, capable of resolving 0.64 deg (high-resolution) or 0.12 deg (low-resolution), color and IR1 were used on each lander. Each image acquired covered a vertical field of 20 deg (high-resolution) or 60 deg (low-resolution), and a horizontal field that was comparable from 2.5 deg to 3.5 deg in 2.5 deg increments. Images were acquired from 4.5 deg above the nominal horizon to 60 deg below, and were comparable in 10 deg increments. The camera were mounted 1.1 m above the nominal landing plane and were capable of viewing two footpads and most of the area accessible to the surface sampler. The two cameras separated by 0.8 m, and stereoscopic pictures were obtained over 10 deg of the scene. Black-and-white images in either low or high resolution included radiation wavelengths from 0.4 to 2.5 micrometers.

BRIEF DESCRIPTION
The Viking imaging experiment viewed the scene surrounding the lander, the surface sampler and other parts of the lander, the twin, and Phobos to provide data for operational purposes and for geological and meteorological investigations. Two scanning cameras, capable of resolving 0.64 deg (high-resolution) or 0.12 deg (low-resolution), color and IR1 were used on each lander. Each image acquired covered a vertical field of 20 deg (high-resolution) or 60 deg (low-resolution), and a horizontal field that was comparable from 2.5 deg to 3.5 deg in 2.5 deg increments. Images were acquired from 4.5 deg above the nominal horizon to 60 deg below, and were comparable in 10 deg increments. The camera were mounted 1.1 m above the nominal landing plane and were capable of viewing two footpads and most of the area accessible to the surface sampler. The two cameras separated by 0.8 m, and stereoscopic pictures were obtained over 10 deg of the scene. Black-and-white images in either low or high resolution included radiation wavelengths from 0.4 to 2.5 micrometers.
Ebert-Fastie scanning monochromator with dual photomultiplier detectors, used in the focal plane of a reflecting planetary coronograph. Incoming light passed through a baffled light shade and struck the primary telescope mirror, which focused the light through a slit onto a secondary mirror, from there, the light was focused onto the entrance slit of the spectrometer. Entering the spectrometer, the radiation was collimated by the first half of the Ebert mirror onto a diffraction grating. Diffused light was then focused onto exit slits by the second half of the Ebert mirror. A separate exit slit was provided for each of the two detectors. The position of the spectral images with respect to the exit slit was controlled by systematically scanning the grating, with a scan from 10^9 to high-wavelength taking 2.8 s, and the grating return taking 0.18 s. The wavelength range from 3000 A to 3800 A was sampled as the beam passed through one of the two slits, and the range from 1100 A to 2100 A was measured in a second order by the other. The photomultiplier detector used for the long-wavelength range operated in high gain mode, so that small measurements could be made over the entire energy range from 100 to 13000 Rayleighs. The spectral resolution of the instrument was 2.5 A and contained 650 values each of the 39 channels used for the measurements. The entrance slit was 0.18° wide with 59% for spectral measurements. Measurements were made with a grating of 1216 grooves/mm. Less than 30 min of data were obtained from both channels during the Mariner 5 near-encounter equatorial scan on July 12, 1971. The entrance slit was comparable to the slit of the Ebert mirror and thus was filled by the slit (the 130-centimeter region of the Earth's atmosphere). More experiment details can be found in the paper "Mariner 1 and 2 Ultraviolet Spectrometers." WRIGHT, J. B. Pearce, et al. Applied Optics. v. 10, n. 4, April 1971.

INVESTIGATION NAME: UV SPECTROMETER

INVESTIGATION ID: 69-034A-8

INVESTIGATIVE PROGRAM: CORE EL-4. SCIENCE

INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL

PI: C.A. BARTH

CO-PI: C.W. PEARCE

U. OF COLORADO

U. OF COLORADO

BROADPHYSICS, INC.

BRIEF DESCRIPTION

Measurements were made of UV radiation estimated to exist in the Martian atmosphere due to resonance scattering of solar radiation at wavelengths between 2500 A and 3800 A. The entrance slit was 0.18° wide with a wavelength range from 100 to 13000 Rayleighs. The spectral resolution of the instrument was 2.5 A and contained 650 values each of the 39 channels used for the measurements. The entrance slit was 0.18° wide with 59% for spectral measurements. Measurements were made with a grating of 1216 grooves/mm. The wavelength range from 3000 A to 3800 A was covered in first order as seen by one of the two slits, and the range from 1100 A to 2100 A was measured in a second order by the other. The photomultiplier detector used for the long-wavelength range operated in high gain mode, so that small measurements could be made over the entire energy range from 100 to 13000 Rayleighs. The spectral resolution of the instrument was 2.5 A and contained 650 values each of the 39 channels used for the measurements. The entrance slit was 0.18° wide with 59% for spectral measurements. Measurements were made with a grating of 1216 grooves/mm. Less than 30 min of data were obtained from both channels during the Mariner 5 near-encounter equatorial scan on July 12, 1971. The entrance slit was comparable to the slit of the Ebert mirror and thus was filled by the slit (the 130-centimeter region of the Earth's atmosphere). More experiment details can be found in the paper "Mariner 1 and 2 Ultraviolet Spectrometers." WRIGHT, J. B. Pearce, et al. Applied Optics. v. 10, n. 4, April 1971.

INVESTIGATION NAME: ULTRAVIOLET SPECTROMETER (UVS)

NSSDC ID: 71-0514-02

INVESTIGATIVE PROGRAM: CORE EL-4. SCIENCE

INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL

PI: C.A. BARTH

CO-PI: C.W. PEARCE

U. OF COLORADO

U. OF COLORADO

BROADPHYSICS, INC.

BRIEF DESCRIPTION

The Mariner 9 ultraviolet spectrometer (UVS) experiment was designed to detect UV radiation (3100 to 3520 A) from the surface and atmosphere of Mars as a means to determine some of the UV radiation, fluorescence, and photoelectron excitation of the upper Martian atmosphere and the lower Martian atmosphere. The following parameters were determined: the presence and amount of solar radiation as well as the presence and amount of the lower atmosphere; their respective scale heights, the degree of atmosphere scattering due to Rayleigh scattering and surface reflectivity in the UV. The instrument was an Ebert-Fastie scanning monochromator with dual photomultiplier detectors used in the focal plane of a reflecting planetary coronograph. The monochromator was contained in a light shade and struck the primary telescope mirror, which focused the light through a slit onto a secondary mirror, from there, the light was focused onto the entrance slit of the Ebert mirror, which was filled by a light baffled with a light shield. The entrance slit was 0.18° wide and contained 650 values each of the 39 channels used for the measurements. Measurements were made with a grating of 1216 grooves/mm. The wavelength range from 3000 A to 3800 A was covered in first order as seen by one of the two slits, and the range from 1100 A to 2100 A was measured in a second order by the other. The photomultiplier detector used for the long-wavelength range operated in high gain mode, so that small measurements could be made over the entire energy range from 100 to 13000 Rayleighs. The spectral resolution of the instrument was 2.5 A and contained 650 values each of the 39 channels used for the measurements. The entrance slit was 0.18° wide with 59% for spectral measurements. Measurements were made with a grating of 1216 grooves/mm. Less than 30 min of data were obtained from both channels during the Mariner 5 near-encounter equatorial scan on July 12, 1971. The entrance slit was comparable to the slit of the Ebert mirror and thus was filled by the slit (the 130-centimeter region of the Earth's atmosphere). More experiment details can be found in the paper "Mariner 1 and 2 Ultraviolet Spectrometers." WRIGHT, J. B. Pearce, et al. Applied Optics. v. 10, n. 4, April 1971.
The Martian 9 infrared interferometer spectrometer (IRIS) experiment was designed to provide information on the vertical structure, composition, and dynamics of the atmosphere and on the radiative properties of the surface of Mars. Measurements were made in the region of thermal emission spectra from 6 to 53 micrometers using a modified Michelson interferometer with a spectral resolution of 2.4 inverse cm (nsampled) and 1.2 inverse cm (msampled), to determine the atmospheric temperature profile, general atmospheric circulation, minor atmospheric constituents, and surface temperature. The infrared emissivity properties as a function of latitude and local time for dark and bright areas and the atmospheric gas signatures for the instrument, located on the bottom of the spacecraft on a multiple-pointing, auto-nadir-looking, interferometer platform, were the wavelength region of 1.9 to 14.5 micrometers and were provided by (1) emissions from a laser that reflected solar radiation, the instrument telescope had a field of view of 2 deg and was at close aperture (about 600 km) the geographical resolution was about 22 km by 3 km and during a single scan, about 122 km by 12 km. The spectral resolution obtained was 0.5 to 1 km. About 29 min of data were obtained during the Martian 6 near-encounter equatorial scan on July 31, 1969. However, due to the failure of the channel 1 output, only channel 2 measurements were obtained. The quality of the data is excellent.

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**INVESTIGATION NAME:** INFRARED SPECTROMETER

**INVESTIGATIVE CODE:** SCIENCE

**PERSONNEL:**
- G. C. Pimentel
- U. CALIF, BERKELEY

**SPECTRAL MEASUREMENTS:**
- Measurements of the thermal 18 emission from the Martian surface and atmosphere were obtained to determine the atmospheric composition, including polyatomic life-related molecules, the surface temperature along the track of view, the surface composition, the surface topography, the spectral temperature along the polar cap, and the bright line 18 emission characteristics. The experiments, mounted on the bottom of the octagonal scan platform of the spacecrafts used an IR spectrometer consisting of a telescope, optical focusing lenses, and a variable wedge interferometer that selected the wavelengths reaching the detectors and cooled the detectors. The spectrometer observed a wavelength region of 1.9 to 14.5 micrometers and were provided by a laser that reflected solar radiation, the instrument telescope had a field of view of 2 deg and was at close aperture (about 600 km) the geographical resolution was about 22 km by 3 km and during a single scan, about 122 km by 12 km. The spectral resolution obtained was 0.5 to 1 km. About 29 min of data were obtained during the Martian 6 near-encounter equatorial scan on July 31, 1969. However, due to the failure of the channel 1 output, only channel 2 measurements were obtained. The quality of the data is excellent.

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**INVESTIGATION NAME:** TWO-CHANNEL IN RADIOIMETER MARS SURFACE TEMPERATURE

**INVESTIGATIVE CODE:** SCIENCE

**PERSONNEL:**
- G. Neugebauer
- CALIF INST OF TECH
obtained on July 21, 1979 during near encounter across and beyond the terminator over polar regions. The data were used to determine the thermal inertia of the surface material as a function of local sunlit area, consistent with the varying ground structure. The quality of the data is good. The data have been corrected for the greater-than-expected response to off-axis radiation.

---------- MARINER 7- NEUGERAUER

INVESTIGATION NAME:  Two-channel IR Radiometer Mars Surface Temperature

NSSDC ID:  69-035A-02
INVESTIGATIVE PROGRAM CORE EL-4A, SCIENCE
INVESTIGATIONAL DISCIPLINE(S) PLANETOLOGY

PERSONNEL
OI - N. NEUGERAUER
CI - G. MUNICH
SI - G. CHASE, JR.
SI - S. C. CHASE, JR.

DESCRIPTION

The equivalent blackbody temperature of the Martian surface was determined using a two-channel infrared radiometer mounted on the orbiter spacecraft. The infrared energy emitted in the 12-micrometer and 30-to-25-micrometer bands was integrated and correlated with the thermal inertia of thermal calibration plate. After 25 mlns were obtained on August 5, 1979, over high latitudes and polar regions of the Martian southern hemisphere during near encounter. These data provided valuable information concerning the composition of the polar cap and surface conditions in those regions near the edge of the polar cap. The quality of the data is good. The data have been corrected for greater-than-expected response to off-axis radiation.

---------- MARINER 9 - NEUGERAUER

INVESTIGATION NAME:  Infrared Radiometer (IR)

NSSDC ID:  71-651A-01
INVESTIGATIVE PROGRAM CORE EL-4A, SCIENCE
INVESTIGATIONAL DISCIPLINE(S) PLANETOLOGY

PERSONNEL
OI - N. NEUGERAUER
CI - H. K. KIEFFER
CI - G. MUNICH
CI - M. NEUGERAUER
CI - S. C. CHASE, JR.
CI - S. B. MINER

DESCRIPTION

The Martian infrared radiometer (IR) experiment was designed to provide, over a wide coverage of the surface of Mars, brightness temperature of the soil as a function of local sunlit area, consistent with the varying ground structure. The data were used to determine the thermal inertia of the surface material as a function of local sunlit area, consistent with the varying ground structure. The quality of the data is good. The data have been corrected for the greater-than-expected response to off-axis radiation.

---------- VIKING 1 ORBITER- KIEFFER

INVESTIGATION NAME:  Infrared Thermal Mapping (ITM)

NSSDC ID:  75-015A-02
INVESTIGATIVE PROGRAM CORE EL-4A, SCIENCE
INVESTIGATIONAL DISCIPLINE(S) PLANETOLOGY

PERSONNEL
TI - H. K. KIEFFER
TH - G. MUNICH
TP - D. B. RINER
TM - L. NEUGERAUER
TM - G. CHASE, JR.
TM - S. B. MINER
TM - J. T. PALLENBERG

DESCRIPTION

The purpose of the ITM experiment was to measure the temperature of the surface and atmosphere of Mars. The amount of sunlight reflected by the planet was also measured. The instrument was a multichannel, multiwavelength package located on the orbiter's scan platform. Four small telescopes, each with seven infrared detectors, were used to provide high-resolution images, optical axes, and made observations every 1.12 s. The instrument was capable of measuring temperatures throughout a temperature range of -126 to +141 deg C. Operation of this experiment was terminated on August 7, 1980.

---------- VIKING 2 ORBITER- KIEFFER

INVESTIGATION NAME:  Infrared Thermal Mapping (ITM)

NSSDC ID:  75-883A-02
INVESTIGATIVE PROGRAM CORE EL-4A, SCIENCE
INVESTIGATIONAL DISCIPLINE(S) PLANETOLOGY

PERSONNEL
TI - H. K. KIEFFER
TH - G. MUNICH
TP - D. B. RINER
TM - L. NEUGERAUER
TM - G. CHASE, JR.
TM - S. B. MINER
TM - J. T. PALLENBERG

DESCRIPTION

The purpose of the ITM experiment was to measure the temperatures of the surface and atmosphere of Mars. The amount of sunlight reflected by the planet was also measured. The instrument was a multichannel, multiwavelength package located on the orbiter's scan platform. Four small telescopes, each with seven infrared detectors, were used to provide high-resolution images, optical axes, and made observations every 1.12 s. The instrument was capable of measuring temperatures throughout a temperature range of -126 to +141 deg C. Operation of this experiment was terminated on August 7, 1980.
INVESTIGATION NAME: S-BAND OCCULTATION

INVESTIGATION NAME: S-BAND OCCULTATION

PERSONNEL
PI - A.J. KLIORE

BRIEF DESCRIPTION
The occultation of the S-band telecommunication signal during the traversal of the spacecraft by Mars provided the vertical distribution of the index of refraction of the Martian atmosphere. These data yield the vertical distribution of neutral and ionized species.

INVESTIGATION NAME: ORBITER RADIO SCIENCE

INVESTIGATION NAME: ORBITER RADIO SCIENCE

PERSONNEL
PI - A.J. KLIORE

BRIEF DESCRIPTION
In this experiment, the changes in the frequency, phase, and amplitude of the S-band (2300 MHz) tracking and telemetry signal (immediately prior to and following the occultation of the spacecraft by the planet) were used to derive the temperature, pressure, density of the lower exospheric atmosphere of Mars, and the density of charged particles in the Martian ionosphere.
There are four distinct sets of Viking radio science data, each obtained primarily using radio data with calibrations from orbiter data. The orbiter tracking data, two parallel in the two-way orbiter-to-lander and X-band radio links, consist of Doppler frequencies and solar-corona velocity measurements. These determined the position and motion of the orbiters and, as well, the structure of the solar corona; the position and motion of the orbiters, and the structure of the solar corona; and the structure of the solar corona; are always parallel in the two-way orbiter-to-lander and X-band radio links. The occultation data were obtained from these same radio links by arranging for the signal when a spacecraft was moving into or out of occultation with Mars. The data can be used to produce altitude profiles of the temperature, density, and pressure of the atmosphere (including the ionosphere) and to measure the radius of the planet, using a large number of surface points. The surface properties aspect of this experiment utilized the solar F(03) signal on which the lander transmitted data to the orbiters. At the beginning or end of a data transmission session when the orbiter was near the lander's horizon, the strength of the received signal was recorded as a function of time. These signal "fading patterns," resulting from interaction of the radio waves with the Martian surface, contain information about the physical properties of the surface near the landers. The lander tracking data from the two-way direct lander-lander X-band links permit determination of the location of the landers and studies of the motion of the planet.

This experiment used the X-band radio transmitter to acquire Doppler and range data for the landers utilizing the same Deep Space Network facilities that were used by the orbiters. The resulting data were used to determine the location of the lander on the planet's surface. They also provided more precise information about the orbital position, eccentricity, and precessional motion of Mars than had previously been available. The two principal differences between orbiter and lander tracking data are (2) landing periods are never longer than 2 hr and are sometimes much shorter because of thermal constraints on the duration of lander transmitter operation, and (2) landers have no X-band signals to provide the corrections to range data for the interplanetary plasma effects. Consequently, lander ranging sessions were scheduled to be nearly simultaneous with orbiter ranging whenever possible, so that the orbiter X- and X-band data could supply these corrections.

This experiment used an infrared grating spectrometer mounted on the orbiter scan platform that was harnessed with the television cameras and the INVS. The spectrometer fitted into the F(03) infrared radiation reflected from the surface through the atmosphere to the spectrometer. Spectral intervals were selected coincident with the wavelength of water vapor absorption lines in the 0.59/1.1-micrometer band. The quantity of water vapor along the line of sight was measured from 1 to 200 micrometers of precipitable water, with an accuracy of 5% or better. The instantaneous field of view of the instrument was 2 x 17 milliradians, and a stepping mirror rotated the line of sight through 15 positions to provide a roughly rectangular field of view. Of the 17 X-band signals, 9 were used for operation of this experiment and terminated on August 7, 1976.
DRAFT DESCRIPTION

The Viking entry science neutral atmospheric composition experiment (one of three that were part of the entry science investigation) was designed to provide the composition data for the various neutral species that were present in the Martian atmosphere as the lander descended to the surface. The experiment defined the present physical and chemical state of the Martian atmosphere at an altitude of 130 km. A variety of instruments (mass spectrometers, radio altimeters, thermometers, pressure sensors) measured data to provide altitude profiles of pressure and temperature of the atmosphere and its composition. From these data, atmospheric density and mean atomic mass can be calculated.

------ VIKING 2 LANDER, NIER-------

INVESTIGATION NAME: ENTRY SCIENCE NEUTRAL ATMOSPHERIC COMPOSITION

NSSDC ID: 75-083C-12
INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL
TL - A.O.C. NIER U OF MINNESOTA
TM - W.B. HANSON HARVARD U
TH - N.W. SPENCER NASA-GSFC

DRAFT DESCRIPTION

The Viking entry science neutral atmospheric composition experiment (one of three that were part of the entry science investigation) was designed to provide the composition data for the various neutral species that were present in the Martian atmosphere as the lander descended to the surface. The experiment defined the present physical and chemical state of the Martian atmosphere at an altitude of 130 km. A variety of instruments (mass spectrometers, radio altimeters, thermometers, pressure sensors) measured data to provide altitude profiles of pressure and temperature of the atmosphere and its composition. From these data, atmospheric density and mean atomic mass can be calculated.

------ VIKING 2 LANDER, NIER-------

INVESTIGATION NAME: ENTRY SCIENCE ATMOSPHERIC STRUCTURE

NSSDC ID: 75-083C-12
INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL
TL - A.O.C. NIER U OF MINNESOTA
TM - A. SCIFF NASA-ARC
TH - N.W. SPENCER NASA-GSFC

DRAFT DESCRIPTION

The Viking entry science atmospheric structure experiment (one of three that were part of the entry science investigation) studied the Martian atmosphere below an altitude of 130 km. A variety of instruments (mass spectrometers, radio altimeters, thermometers, pressure sensors) measured data to provide altitude profiles of pressure and temperature of the atmosphere and its composition. From these data, atmospheric density and mean atomic mass can be calculated.

------ VIKING 2 LANDER, NIER-------

INVESTIGATION NAME: ENTRY SCIENCE IONOSPHERIC PROPERTIES

NSSDC ID: 75-085C-04
INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL
TL - A.O.C. NIER U OF MINNESOTA
TM - W.B. HANSON U OF TEXAS, DALLAS
TH - N.W. SPENCER NASA-GSFC

DRAFT DESCRIPTION

The Viking entry science ionospheric properties experiment (one of three that were part of the entry science investigation) studied the composition, structure, and temperature of the ionosphere, which were probed during the descent of the lander capsule by means of a retarding potential analyzer (RPA) mounted flush with the front face of the aeroshell. To conserve battery power, the instrument was operated intermittently between 10,000 and 50,000 km altitude but continuously from 9,000 to 10,000 km. The instrument swept a current-collecting plate over a range of 7 to 40 u. Mass spectra were obtained by sweeping the ion acceleration voltage and the definition with respect to the electron plates. The sweep period was approximately 5 s and a dynamic range of 1.25 was provided within each spectrum.

------ VIKING 2 LANDER, NIER-------

INVESTIGATION NAME: ENTRY SCIENCE METEOROLOGY

NSSDC ID: 75-085C-12
INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S): INTERPLANETARY PHYSICS

PERSONNEL
TL - A.O.C. NIER U OF MINNESOTA
TM - W.B. HANSON HARVARD U
TH - N.W. SPENCER NASA-GSFC

DRAFT DESCRIPTION

The Viking entry science meteorology experiment (one of three that were part of the entry science investigation) measured the composition, structure, and temperature of the ionosphere, which were probed during the descent of the lander capsule by means of a retarding potential analyzer (RPA) mounted flush with the front face of the aeroshell. To conserve battery power, the instrument was operated intermittently between 10,000 and 50,000 km altitude but continuously from 9,000 to 10,000 km. The instrument swept a current-collecting plate with seven grids ahead of it. A fixed grid of potentials was applied to the grids and the collected currents were measured at 10 ms intervals. The instrument operated in three plates to measure energetic electrons, thermal electrons, and thermal ions.
This experiment analyzed the meteorological environment near the planetary surface and obtained information about motion systems of various scales. The atmospheric parameters determined were pressure, temperature, wind speed, and wind direction. Diurnal and seasonal variations were of particular importance. The sampling rates and durations for any one Martian day (sol) were selectable by ground command. The sensors were mounted on an erected boom. Three hot-film anemometers, through which an electric current was passed to heat two glass needles coated with platinum and overheated with aluminum oxide, were used to measure wind speed. The electric power needed to maintain these sensors at a fixed temperature above the surrounding air was the measure of wind speed. Atmospheric temperature was measured by three fine-wire thermocouples in parallel. A thin metal diaphragm mounted in a vacuum-sealed case was used to measure atmospheric pressure.

**BRIEF DESCRIPTION**

This experiment analyzed the meteorological environment near the planetary surface and obtained information about motion systems of various scales. The atmospheric parameters determined were pressure, temperature, wind speed, and wind direction. Diurnal and seasonal variations were of particular importance. The sampling rates and durations for any one Martian day (sol) were selectable by ground command. The sensors were mounted on an erected boom. Three hot-film anemometers, through which an electric current was passed to heat two glass needles coated with platinum and overheated with aluminum oxide, were used to measure wind speed. The electric power needed to maintain these sensors at a fixed temperature above the surrounding air was the measure of wind speed. Atmospheric temperature was measured by three fine-wire thermocouples in parallel. A thin metal diaphragm mounted in a vacuum-sealed case was used to measure atmospheric pressure.

**INVESTIGATION NAME: METEOROLOGY**

**NSSDC ID: 75-083C-17**

**INVESTIGATION PROGRAM: CODE 44-5, SCIENCE**

**INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES**

**PERSONNEL**

TL - J.C. LICK, U. OF WASHINGTON
TH - J.R. TALIAFERRO, CALIF ST U, FULLERTON
TM - J.A. HEWITT, HARVARD U.

**INVESTIGATION NAME: MOLECULAR ANALYSIS**

**NSSDC ID: 75-083C-04**

**INVESTIGATION PROGRAM: CODE 44-5, SCIENCE**

**INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES**

**PERSONNEL**

TL - G. DIERMAN, CALIF ST U, SAN DIEGO
TH - H.A. ANDERSON, OAK RIDGE
TM - T. CAI, U. OF NEW YORK
TM - J. GIBB, U. OF HOUSTON
TM - J.E. ORER, TALKING STICK STUDIES
TM - A.G. LASSER, U. OF MINNESOTA
TM - P. TOLMAN, U.S. GEOLOGICAL SURVEY

**INVESTIGATION NAME: PHYSICAL PROPERTIES**

**NSSDC ID: 75-083C-01**

**INVESTIGATION PROGRAM: CODE 44-5, SCIENCE**

**INVESTIGATION DISCIPLINE(S): PLANETARY SCIENCE**

**PERSONNEL**

TL - J.H. SHORTILL, CALIF ST U, FULLERTON
TH - J.J. MOUTON, TALKING STICK STUDIES
TM - J.A. SCOTT, U.S. GEOLOGICAL SURVEY

**INVESTIGATION NAME: INORGANIC ANALYSIS**

**NSSDC ID: 75-083C-13**

**INVESTIGATION PROGRAM: CODE 44-5, SCIENCE**

**INVESTIGATION DISCIPLINE(S): PLANETARY SCIENCE**

**PERSONNEL**

TL - J.C. REEN, U. OF IOWA
TH - G.C. POTT, TALKING STICK STUDIES
TM - J.A. SCOTT, U.S. GEOLOGICAL SURVEY

**INVESTIGATION NAME: GEOLOGICAL SURVEY**

**NSSDC ID: 75-083C-07**

**INVESTIGATION PROGRAM: CODE 44-5, SCIENCE**

**INVESTIGATION DISCIPLINE(S): PLANETARY SCIENCE**

**PERSONNEL**

TL - R.W. DIERMAN, MASS INST OF TECH
TH - H.A. ANDERSON, OAK RIDGE
TM - T. CAI, U. OF NEW YORK
TM - J. GIBB, U. OF HOUSTON
TM - J.E. ORER, TALKING STICK STUDIES
TM - A.G. LASSER, U. OF MINNESOTA
TM - P. TOLMAN, U.S. GEOLOGICAL SURVEY

**INVESTIGATION NAME: MOLECULAR ANALYSIS**

**NSSDC ID: 75-083C-04**

**INVESTIGATION PROGRAM: CODE 44-5, SCIENCE**

**INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES**

**PERSONNEL**

TL - G. DIERMAN, CALIF ST U, SAN DIEGO
TH - H.A. ANDERSON, OAK RIDGE
TM - T. CAI, U. OF NEW YORK
TM - J. GIBB, U. OF HOUSTON
TM - J.E. ORER, TALKING STICK STUDIES
TM - A.G. LASSER, U. OF MINNESOTA
TM - P. TOLMAN, U.S. GEOLOGICAL SURVEY

**BRIEF DESCRIPTION**

This molecule analysis experiment searched for chemical compounds in the upper surface layer of Mars and measured atmospheric composition near the surface. The soil analyses were performed using a gas chromatograph mass spectrometer (GCMS) that had high sensitivity, high structural specificity, and broad applicability to a wide range of compounds. Substances were exported from the surface material by heating while (CO2 (lantham with C-13) swept through. The meteorite was vaporized into a gas chromatograph mass spectrometer column that was swept with hydrogen as a carrier gas, while passing through a gas chromatograph. The column was separated by different degrees of retention. The residual stream moved into the mass spectrometer (after hydrogen was removed by hydrogen-only-permeable palladium), and a mass spectrum was scanned from 12 to 20 u on the gas chromatogram. In some cases, the same sample was relabeled at a higher temperature and analyzed at a lower temperature. Materials for atmospheric measurements gases were directly introduced into the mass spectrometer bypassing the gas chromatograph column.
This experiment utilized an energy-dispersive X-ray fluorescence spectrometer (EDS). Scintillation兴奋analyzed by the on-board step-scanning, single-channel analyzer with adjustable counting periods. The instrument was located outside the lander box, and samples were delivered to it by the lander surface sampler. Calibration standards were an integral part of the instrument. Reconstructed spectra yielded surface composition data with accuracies ranging from a few tenths of parts per million for trace elements to a few percent for major elements.

**INVESTIGATION NAME - BIOLOGY**

**INVESTIGATION NAME - BIOLOGY**

**INVESTIGATION DISCIPLINE(S) PLANETARY BIOLOGY**

**PERSONNEL**

- N.P. Klein
- J. Lessig
- A. Hirsch
- H. Nagashita
- H. Syama
- C.J. Levin

**BRIEF DESCRIPTION**

The biology experiment searched for the presence of Martian organisms by looking for metabolic products. Three distinct instruments (pyrolysis-release (PR), gas exchange (GE), and gas chromatography (GC)) incubated samples of the Martian surface under a number of different conditions. In some instances a sample was heat sterilized and reprocessed as a control. The PR instrument was used to detect the photosynthetic or chemotrophic fixation of CO2 and CO containing CO2. The samples were heated and purged by pure CO2, then a mixture of pure CO2 and CO was introduced into an initial incubation atmosphere. The addition of a selected amount of a nutrient solution, containing nutrients, to the sample was monitored at various times. After incubation, the sample was removed and analyzed by gas chromatograph with a thermal conductivity detector.

**INVESTIGATION NAME - BIOLOGY**

**INVESTIGATION DISCIPLINE(S) PLANETARY BIOLOGY**

**PERSONNEL**

- N.P. Klein
- J. Lessig
- A. Hirsch
- H. Nagashita
- H. Syama
- C.J. Levin

**BRIEF DESCRIPTION**

The biology experiment searched for the presence of Martian organisms by looking for metabolic products. Three distinct instruments (pyrolysis-release (PR), gas exchange (GE), and gas chromatography (GC)) incubated samples of the Martian surface under a number of different conditions. In some instances a sample was heat sterilized and reprocessed as a control. The PR instrument was used to detect the photosynthetic or chemotrophic fixation of CO2 and CO containing CO2. The samples were heated and purged by pure CO2, then a mixture of pure CO2 and CO was introduced into an initial incubation atmosphere. The addition of a selected amount of a nutrient solution, containing nutrients, to the sample was monitored at various times. After incubation, the sample was removed and analyzed by gas chromatograph with a thermal conductivity detector.

**INVESTIGATION NAME - BIOLOGY**

**INVESTIGATION DISCIPLINE(S) PLANETARY BIOLOGY**

**PERSONNEL**

- N.P. Klein
- J. Lessig
- A. Hirsch
- H. Nagashita
- H. Syama
- C.J. Levin

**BRIEF DESCRIPTION**

The biology experiment searched for the presence of Martian organisms by looking for metabolic products. Three distinct instruments (pyrolysis-release (PR), gas exchange (GE), and gas chromatography (GC)) incubated samples of the Martian surface under a number of different conditions. In some instances a sample was heat sterilized and reprocessed as a control. The PR instrument was used to detect the photosynthetic or chemotrophic fixation of CO2 and CO containing CO2. The samples were heated and purged by pure CO2, then a mixture of pure CO2 and CO was introduced into an initial incubation atmosphere. The addition of a selected amount of a nutrient solution, containing nutrients, to the sample was monitored at various times. After incubation, the sample was removed and analyzed by gas chromatograph with a thermal conductivity detector.
BRIEF DESCRIPTION

The biology experiment searched for the presence of Martian organisms by looking for metabolic products. Three distinct instruments (pyrolytic release (PR), labeled release (LR), and gas exchange (GE)) incubated samples of the Martian surface under a number of different environmental conditions. In some instances a sample was heat sterilized and reprocessed as a control. The PR, or carbon assimilation, instrument sought to detect the photosynthetic or chemical fixation of CO2 or CO containing C-14. The samples were incubated for several days in the presence of the radioactive gas mixture, then sampled with simulated sunlight and saw without. Next, each sample was heated to 120°C to remove unreacted CO2 and CO. The soil was pretreated at 65°C and any organic products were collected in an argon gas trap (DG). Finally, the trap was heated to 250°C to combust the organic material to CO2 and any evolved radioactive gas was measured. The LR experiment sought to detect metabolic processes through radiorespirometry. Liquid nutrients labeled with radioactive carbon were added to the samples and the atmosphere above was continuously monitored to detect any radioactive gases released from these radiocarbon nutrients. The GE measured the production and/or uptake of CO2, H2, O2, N2O, H2, and CO2 during incubation of a soil sample. The sample was sealed and purged by Nz; then a mixture of Hz and CO2 was introduced as an initial incubation atmosphere. After the addition of a selected quantity of a nutrient solution, saturated with the diagnostic gas nearly the sample was incubated. At certain intervals, samples of the atmosphere were removed and analyzed by a gas chromatograph with a thermal conductivity detector.

-------- VIKING 1 LANDER- ANDERSON-----------------------------

INVESTIGATION NAME- MOLECULAR ANALYSIS

NSSDC ID- 75-075C-04

SEE THIS EXPERIMENT UNDER SURFACE CHEMISTRY

-------- VIKING 2 LANDER- DIEMANN-----------------------------

INVESTIGATION NAME- MOLECULAR ANALYSIS

NSSDC ID- 75-092C-04

SEE THIS EXPERIMENT UNDER SURFACE CHEMISTRY

-------- VIKING 2 LANDER- ANDERSON-----------------------------

INVESTIGATION NAME- SEISMOLOGY

NSSDC ID- 75-083C-04

SEE THE INVESTIGATION UNDER PLANETARY PHYSICS

PERSONNEL

TOKOSCH- INVESTIGATION NAME- SEISMOLOGY

NSSDC ID- 75-083C-04

INVESTIGATION PROGRAM

CORE EL-74, SCIENCE

INVESTIGATION DISCIPLINES

PLANETOGEOLOGY

PERSONNEL

TOKOSCH- INVESTIGATION NAME- SEISMOLOGY

NSSDC ID- 75-083C-04

INVESTIGATION PROGRAM

CORE EL-74, SCIENCE
Jupiter
Plate 4 is a collection of press release photographs from the Pioneer 11 and Voyagers 1 and 2 missions. (A) P21631 is a Voyager 1 montage of Jupiter and its four Galilean satellites (the four largest of its 16 known moons). (B) 79HC679, a Pioneer 11 photo of Jupiter showing the north polar region as it passed over it, showing the polar region's lack of belts but with many convection cells. This is a view and aspect never seen from earth. The Great Red Spot is at the bottom. (C) P21774, a Voyager 2 photo of the nightside of Jupiter showing the sunlit atmospheric halo and the Jovian ring discovered on Voyager 1. (D) P21195, a composite of Voyager 1 photos of the four Galilean moons illustrating their relative sizes. Io (3632 km diam.) is about 200 km larger than our moon and Europa (3126 km diam.) is about 300 km smaller than our moon (3478 km diam). Callisto (4820 km diam.) is the size of the planet Mercury and Ganymede (the largest moon in the solar system) at about 5150 km is about 350 km larger than Mercury. (E) P21305, Voyager 1 photo of Io showing its completely volcanic surface and an erupting volcano on the limb. Io's volcanic activity was discovered by Voyager 1. Io is the most volcanically active of any solar system body known, and the only one other than the earth known to have current volcanic activity. (F) P21266, Voyager 1 photo of part of the surface of Ganymede showing the mysterious grooved bands with their criss-cross nature and lateral slip fault movement. (G) P21758, Voyager 2 photo of Europa showing the unique linear features which have no relief, and which look as if they were painted on. Europa's icy surface has apparently flowed and filled in the fissures. (H) P21745, Voyager 1 photo of Callisto showing its crater-saturated surface and the strange multi-ringed structure, Valhalla.
Jupiter, next in line from the sun, has been visited by four U.S. spacecraft. These were Pioneers 10 and 11 and Voyagers 1 and 2. There were 41 investigations for which NSSDC has data or knows the sources thereof, and they cover seven categories, which are (1) Imaging, (2) Particles and Fields, (3) Ultraviolet, (4) Infrared, (5) Radio Science and Celestial Mechanics, (6) Atmosphere, and (7) Polarization. Both the categories Atmosphere and Polarization were obtained from photopolarimeters which are presented under Imaging. Tables 1 and 2 and Appendix A show the investigations in more detail.
SPACECRAFT

********************** PIONEER 11 **********************

SPACECRAFT COMMON NAME- PIONEER 11
ALTERNATE NAMES- PIONEER 11, NGS 10321

NSSDC ID- 72-82A
LAUNCH DATE- 10/02/72
WEIGHT- 231.1 KG
LAUNCH SITE- CAP CANAVERAL, UNITED STATES
LAUNCH VEHICLE- ATLAS

SPONSORING COUNTRY/AGENCY- UNITED STATES NASA-OSSA

INITIAL ORBIT PARAMETERS
ORDER TYPE- SATURN FLIGHT

PERSONNEL
PM- C.J. WALK (OMA)
PS- P. RYAL
NASA-ARC

ORBIT DESCRIPTION
This was the second mission to investigate Jupiter and the outer Solar System. As a follow-up to Pioneer 10, this Pioneer mission was the first to reach Saturn and the outer Solar System. The Pioneer 11 spacecraft was launched on October 10, 1972, from Cape Canaveral, Florida, on a Delta rocket. It carried a payload of scientific instruments designed to study the planet Jupiter, its moons, and the environment between Jupiter and Saturn. The spacecraft was equipped with a high-gain antenna, a low-gain antenna, and a solar array to power its operations. It also carried a radio transmitter to communicate with Earth. The mission was successful in reaching Jupiter and Saturn, and it provided valuable data about the outer Solar System, including the detection of the magnetic field of Jupiter and the measurement of the density of interplanetary dust. The spacecraft was deorbited after completing its mission, and its final position was approximately 800,000 km from Jupiter. The Pioneer 11 mission was a significant milestone in the exploration of the outer Solar System and contributed to our understanding of the solar system's structure and evolution.

SPACECRAFT COMMON NAME: VESTOURER 2
ALTERNATE NAMES: MAJER PLANET/SATURN D. OUTER PLANETS B
MAJOR TYPES: S-780, T-786

INVESTIGATION NAME: IMAGING POLARIMETER (IPP)
ISSOC ID: 75-198-47
INVESTIGATIVE PROGRAM CODE EL-4-A, SCIENCE
INVESTIGATION DISCIPLINES: ASTROPHYSICS, PLANETARY ATMOSPHERES

PERSONNEL
PS - J. GEHELS U OF ARIZONA
01 - H. COFFEE NASA-GISS
01 - C. HANSEN-MARTILLA U OF ARIZONA
01 - C. KENNEDY U OF ARIZONA
01 - J. TOMANKO U OF ARIZONA
01 - W. EMNELL U OF ARIZONA

BRIEF DESCRIPTION
The Imaging Polarimeter (IPP) experiment used during magnum-encounter measurements made simultaneously with the solar, the jovian satellites. The polarimeter and radiometer were used in the UV region of the spectrum. The overall objectives of Voyager 2 were to explore the geology of the jovian satellites, to study their interaction with jovian magnetosphere, and to obtain images of the jovian satellites and jovian planet. The polarimeter and radiometer were used in the UV region of the spectrum. The overall objectives of Voyager 2 were to explore the geology of the jovian satellites, to study their interaction with jovian magnetosphere, and to obtain images of the jovian satellites and jovian planet.
development, and high resolution of the Great Red Spot. The objectives of the satellite encounters included the following: (1) gross characteristics (color, shape, rotation, spin axis, cartography, improved epistaxis and masses); (2) geology (major physiographic provinces, impact and volcanic features, lineaments, polar caps, erosion processes, and low- and high-density satellite comparative studies; detection of atmospheric fronts and limb-stratification of aerosols); (3) surface properties (polarimeter, scatter function, study of brightness variation, and search for new satellites). Studies of Saturn's rings included (3) resolution of individual ring components or clumps of material, and (4) vertical and radial distribution of material at very high resolution; (5) scattering function; (6) coarse polarimeter; (7) occultation - optical depth, and (8) distinguishing different types of material in the rings. Other objectives were to search for new comets, asteroids, and targets of opportunity.

PERSONNEL
PI - J.W. WOLFE
01 - L.A. FRANK
02 - M. LUST
03 - G.B. MECKEIN
04 - L.L. SCHRADER
05 - T.L. SCHEIN
06 - E.G. ROLL
07 - W.C. FELDMAN
08 - J.E. SMITH
NASA - JPL

INVESTIGATION NAME - Plasma
NSSDC 10- 72-024-11
INVESTIGATIVE PROGRAM
CORE EL-4 . SCIENCE
INVESTIGATION DISCIPLINE (S)
SPACE PLASMAS
PARTICLES AND FIELDS

PARTICLES AND FIELDS
PI - J.W. WOLFE
01 - L.A. FRANK
02 - M. LUST
03 - G.B. MECKEIN
04 - L.L. SCHRADER
05 - T.L. SCHEIN
06 - E.G. ROLL
07 - W.C. FELDMAN
08 - J.E. SMITH
NASA - JPL

INVESTIGATION NAME - Plasma
NSSDC 10- 72-024-11
INVESTIGATIVE PROGRAM
CORE EL-4 . SCIENCE
INVESTIGATION DISCIPLINE (S)
SPACE PLASMAS
PARTICLES AND FIELDS
collectors had an angular width of 67.5 deg and were located at plus or minus 45.25 deg from the center of the analyzer. There was a variety of possible operating modes for the experiment; however, the principal mode utilized during the encounter phase was one in which the analyzer plate potential was stepped through. A range every 1/2 revolution of the analyzer and all current collectors or channelrons were read out at the peak plus 1/2 the high and low voltage station potential, operated independently, so a cross check between these analyzers was possible. The dynamic range for the particle fluxes was from 1 keV to 1.0 MeV in 60 bins and the proton temperature down to 0.2 MeV deg K could be ascertained. Data include the interplanetary region.

INVESTIGATION NAME: LOW-ENERGY CHARGED PARTICLE ANALYZER AND TELESCOPE

INVESTIGATION ID: 77-084A-67
INVESTIGATIVE PROGRAM CODE EL-64/LOC, SCIENCE
INVESTIGATION DISCIPLINE(S) COSMIC RAYS
INVESTIGATIVE PROGRAM DISCIPLINE(S) MAGNETOSPHERIC PHYSICS, PARTICLES AND FIELDS

PERSONNEL
PI: S.M. KRIMMIS
CI: T.P. ARMSTRONG
CI: G. GLOCKLER
CI: J.J. LAMBERTINI
CI: H.L. KENY
APPLIED PHYSICS LAB
U OF MARYLAND
U OF KANSAS
HALL TELEPHONE LAB
APPLIED PHYSICS LAB

BRIEF DESCRIPTION
The objective of this experiment was to study the magnetospheres of Jupiter and Saturn, using a low-energy magnetospheric particle analyser. This detector made measurements in (3) the distant magnetosphere and bow shock of Jupiter, in (2) the magnetosphere of Saturn, and in (3) the ionosphere of Saturn. The energy range of this detector was 1 keV to 3 keV for electrons and 10 keV to 100 MeV for ions. During the interplanetary cruise period, the analyzer recorded the particle fluxes from 3 keV to 26 keV and they were separately identified and their energy measured in the range from 1 keV to 30 MeV using a low-energy particle telescope.

INVESTIGATION NAME: PLASMA WAVE (1.05-56 KHz)

INVESTIGATION ID: 77-084A-67
INVESTIGATIVE PROGRAM CODE EL-64/LOC, SCIENCE
INVESTIGATION DISCIPLINE(S) PLANETARY PHYSICS
INVESTIGATION DISCIPLINE(S) MAGNETOSPHERIC PHYSICS

PERSONNEL
PI: F.L. SCARF
CI: J.A. KUENNET
TAX SYSTEMS GROUP
U OF IOWA

BRIEF DESCRIPTION
This investigation provided continuous, selected frequency measurements of electron density profiles at Jupiter and Saturn. It also gave basic information on low wave-particle interactions required to carry out comparative studies of the physics of the magnetospheres. The instrumentation consisted of a 16-channel, low-frequency receiver and a low-frequency waveform receiver with associated electronics. The frequency range for this instrument was from 10 Hz to 56 kHz. This instrument shared the 16-channel antennas developed for the planetary radio astronomy, investigation.

INVESTIGATION NAME: PLASMA SPECTROMETERS

INVESTIGATION ID: 77-084A-66
INVESTIGATIVE PROGRAM CODE EL-64/LOC, SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS
INVESTIGATION DISCIPLINE(S) SPACE PLASMAS

PERSONNEL
PI: J.B. BRIDGE
CI: J.R. RECHER
CI: C.J. LAHRE
CI: A.J. LAMBERTINI
CI: J.J. LAMBERTINI
CI: J.A. KUENNET
MASS INST OF TECH
MASS INST OF TECH
APPLIED PHYSICS LAB
APPLIED PHYSICS LAB
U OF MARYLAND
U OF CALIF LA

BRIEF DESCRIPTION
This investigation provided continuous, selected frequency measurements of electron density profiles at Jupiter and Saturn. It also gave basic information on low wave-particle interactions required to carry out comparative studies of the physics of the magnetospheres of these planets. The instrumentation consisted of a 16-channel low-frequency receiver and a low-frequency waveform receiver with associated electronics. The frequency range for this instrument was from 10 Hz to 56 kHz. This instrument shared the 16-channel antennas developed for the planetary radio astronomy investigation.

INVESTIGATION NAME: PLASMA MEASUREMENTS

INVESTIGATION ID: 77-084A-66
INVESTIGATIVE PROGRAM CODE EL-64/LOC, SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS
INVESTIGATION DISCIPLINE(S) SPACE PLASMAS

PERSONNEL
PI: F.L. SCARF
CI: J.A. KUENNET
TAX SYSTEMS GROUP
U OF IOWA

BRIEF DESCRIPTION
The plasma wave investigation used two Faraday cup detectors, one pointed along the earth-spacecraft line and one at right angles to this line. The earth-pointing detector determined the macroscopic properties of the plasma ions, obtaining accurate values of their velocity, density and pressure. Three sequential energy scans were employed with the detector angle 0.5 deg to be 20° and 70°, allowing a coverage from subsonic to highly supersonic flow. The edge-seeking Faraday cup measured electrons in the energy range from 1 keV to 1 keV.
The plasma investigation made use of two Faraday-cup detectors, one pointed along the earth-spacecraft line and one at right angles to this line. The earth-pointing detector determined the gross properties of the plasma ions, such as mass, velocity, and number density. Two sequential energy scans were employed with teats 120° equal to 297, 127, and 5.8 Tesla, allowing a coverage from protons to slightly supercritical flow. The slot-looking Faraday cup measured electrons in the energy range from 5 eV to 2 keV.

--- PIONEER 10, SMITH ---

INVESTIGATION NAME: MAGNETIC FIELDS

NSSDC ID: 73-0124-01

INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE

INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS, PLANETARY MAGNETIC FIELD

PERSONNEL

PI - H.S. BRIDGE
CI - J.A. LAKELAND MASS INST OF TECH
CI - S. GLIBERT MASS INST OF TECH
CI - W.S. KASHEVAROV MIPI-AEROSY
CI - J.P. WATTS NASA-GSFC
CI - C.M. GOOTE NASA-GSFC
CI - R.J. HENNIGEN U OF CALIF, LA
CI - J.J. GULLIVER NASA-GSFC
CI - J.J. SCIBOR NASA-GSFC

DRIEF DESCRIPTION

The plasma investigation made use of two Faraday-cup detectors, one pointed along the earth-spacecraft line and one at right angles to this line. The earth-pointing detector determined the gross properties of the plasma ions, such as mass, velocity, and number density. Two sequential energy scans were employed with teats 120° equal to 297, 127, and 5.8 Tesla, allowing a coverage from protons to slightly supercritical flow. The slot-looking Faraday cup measured electrons in the energy range from 5 eV to 2 keV.

--- PIONEER 11, SMITH ---

INVESTIGATION NAME: MAGNETIC FIELDS

NSSDC ID: 73-0124-01

INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE

INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS, PLANETARY MAGNETIC FIELD

PERSONNEL

PI - J.J. SMITH NASA-GSFC
CI - J.J. COLUHIN NASA-GSFC
CI - P. DIAL NASA-GSFC
CI - J.P. SONETT U OF ARIZONA
CI - P.J. COLEMAN JPL CALIF INST OF TECH
CI - D.J. JONES BRIGHAM YOUNG U

DRIEF DESCRIPTION

The magnetometer on Pioneer 11 was a triaxial heliomagnetometer with seven dynamic ranges from plus or minus 2.5 nT to plus or minus 10 gauss. The linearity was 0.15% and the noise threshold was 0.013 nT for 0.5 Hz. The accuracy was 0.2% of full scale range. Its experiment worked as planned until November 1975, when it was found that no useful data was obtained. The experiment has used RHEA coordinates in its data analysis. In this system, the satellite's spin vector is taken into the solar wind boundary. A detailed instrument description may be found in Smith et al., IRE Transactions on Magnetics, vol. MAG-1, no. 4, pp. 962-75, July 1975. Some data also include the interplanetary region.

--- PIONEER 11, SMITH ---

INVESTIGATION NAME: JOVIAN MAGNETIC FIELD

NSSDC ID: 73-0124-01

INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE

INVESTIGATION DISCIPLINE(S) MAGNETOSPHERIC PHYSICS

PERSONNEL

PI - J.J. SMITH NASA-GSFC
CI - J.J. COLUHIN NASA-GSFC
CI - P. DIAL NASA-GSFC
CI - J.P. SONETT U OF ARIZONA
CI - P.J. COLEMAN JPL CALIF INST OF TECH
CI - D.J. JONES BRIGHAM YOUNG U

DRIEF DESCRIPTION

The magnetometer on Pioneer 11 was a triaxial heliomagnetometer with seven dynamic ranges from plus or minus 2.5 nT to plus or minus 10 gauss. The linearity was 0.15% and the noise threshold was 0.013 nT for 0.5 Hz. The accuracy was 0.2% of full scale range. Its experiment worked as planned until November 1975, when it was found that no useful data was obtained. The experiment has used RHEA coordinates in its data analysis. In this system, the satellite's spin vector is taken into the solar wind boundary. A detailed instrument description may be found in Smith et al., IRE Transactions on Magnetics, vol. MAG-1, no. 4, pp. 962-75, July 1975. Some data also include the interplanetary region.
This experiment (carried aboard Pioneer 11) measured charged-particle composition and spectra using four detector systems: (1) the main telescope, consisting of seven elements and providing energy spectra approximately 3 to 68 MeV for protons and 15 to 150 MeV for alpha particles (through oxygen); and to study the presence of a high-gammaray background aboard the spacecraft, (2) the electron detector (or EDC), consisting of a beryllium- or shielded silicon detector operated in current mode to measure high fluxes of electrons with energies above 3 MeV; and (3) the silicon cell detector, recording fission fragments from the neutron-induced fission of carbon-122 scattered between two large-area silicon detectors to measure fluxes of protons above 1 MeV in the presence of high fluxes of electrons. The experiment sample time was synchronized with the spacecraft spin periods to obtain the readout of the main and low-energy telescopes into eight element subarrays. Data also include the interplanetary region.

--- Pioneer 11: SIMPSON ---

INVESTIGATION NAME: CHARGED PARTICLE COMPOSITION

NSDC ID: 73-B19A-62
INVESTIGATIVE PROGRAM
CORE EL-4: SCIENCE
INVESTIGATION DISCIPLINE(S)
PARTICLES AND FIELDS
COSMIC RAYS

PERSONEL
PI - J.A. SIMPSON
Co - J.J. O'KELLEY
Co - T. TUGGELIN
U OF CHICAGO

BRIEF DESCRIPTION

This experiment used two telescopes to measure the composition and energy spectra of solar energetic (solar particle) particles above 0.5 MeV/nucleon. The main telescope consisted of five collinear elements (three solid-state, one CsI, and one sapphire crystal) surrounded by a plastic anticoincidence shield. The telescope had a 60-degree full-angle acceptance cone with its axis approximately normal to the spacecraft spin axis, parallelizing Earth, Jupiter, and the interplanetary field. The sensitivity was that of a 90-degree cone with its axis parallel to the spacecraft spin axis. Data are recorded from each element in the main telescope and the anticoincidence shield. The detector was pulse-height analyzed, and low- and high-mass groups could be selected by an anticoincidence shield. The data were corrected for backgrounds of 150 MeV and high-resolution spectra from the interplanetary field, the solar wind, and the interplanetary field. The sensitivity of the interplanetary region was determined by subtracting the response of the background field from the total response. The results are given in J. Geophys. Res., v. 79, p. 3595, 1974. Early results are given in Science, v. 186, p. 429, 1975. Data include the interplanetary region.

--- Pioneer 10: FILLEUS ---

INVESTIGATION NAME: JOVIAN TRAPPED RADIATION

NSDC ID: 72-B12A-05
INVESTIGATIVE PROGRAM
CORE EL-4: SCIENCE
INVESTIGATION DISCIPLINE(S)
PARTICLES AND FIELDS
MAGNETOSPHERIC PHYSICS

PERSONNEL
PI - R.W. FILLEUS
Co - C.I. McKEAN
U OF CHICAGO

BRIEF DESCRIPTION

This experiment consisted of an array of three particle detectors: a type IIA detector with electron thresholds in the range 0.3 to 5 MeV and proton thresholds in the range 0.35 to 5 MeV, a type IIA electron detector with thresholds in the range 0.05 to 0.3 MeV, and a type II electron and proton detector with thresholds in the range 0.05 to 0.3 MeV. The detector was pulse-height analyzed, and low- and high-mass groups could be selected by an anticoincidence shield. The detector was pulse-height analyzed, and low- and high-mass groups could be selected by an anticoincidence shield. The sensitivity of the interplanetary region was determined by subtracting the response of the background field from the total response. The results are given in J. Geophys. Res., v. 79, p. 3595, 1974. Early results are given in Science, v. 186, p. 429, 1975. Data include the interplanetary region.
This experiment consisted of an array of five particle detectors, with electron thresholds in the range 16 to 35 MeV and proton thresholds in the range 8 to 35 MeV. A Grenoble counter (C1) had four output channels (C1a, C1b, C1c, and C1d) sensitive to electrons having energies above 5, 8, 12, and 16 MeV, respectively. An electron scatter counter (C2) had three output channels (C2a, C2b, and C2c) sensitive to electrons above 16, 25, and 35 MeV. A minimum ionization counter (P) had three output channels: P1 sensitive to electrons having energies greater than 35 MeV, P2 measuring background, and P3 sensitive to protons having energies greater than 80 MeV. The last two counters were stilboscintillator detectors (SP and S1), both of which had energy thresholds of 16 keV for electrons and 150 keV for protons. The sensitivity of the SI detector to protons was about a factor of 10 lower than its sensitivity to electrons. Thus, the SBE channel effectively measured the electron flux, which could then be subtracted from the SPOC channel response to obtain the fluxes of the species indicated. The detector channels could be programmed for readout in any one of four patterns at each of the eight spacecraft attitudes, which were observed during each spacecraft orbit. Thus, the number of channels that could be observed was 10, and the time to observe the complete scene of each channel was 105 s. Since the directional detectors pointed perpendicularly to the spin axis and the spin rate was 5 rpm, pitch-angle measurements were obtained. Although this experiment was designed for encounter studies, some data were obtained at low rates in interplanetary space. A description of the instrumentation and initial Pioneer 10 results was published in J. Geophys. Res., v. 79, p. 3593, 1974.

--- PIONEER 10: MCDONALD ---

INVESTIGATION NAME: COSMIC-RAY SPECTRA

NSDC ID: 77-02420-12 INVESTIGATIVE PROGRAM CODE EL-4/0-DP, SCIENCE

INVESTIGATION DISCIPLINES

COSMIC RAYS

PERSONNEL

P1 - J. MCDONALD NASA-GSFC
01 - R. J. MCGCHEN CSIRO
01 - W. B. WEBER U OF NEW HAMPSHIRE
01 - J. M. TEGGARDEN NASA-GSFC

BRIEF DESCRIPTION

This experiment consisted of three multielement, collimated, solid-state detectors, all looking normal to the spacecraft spin axis. It was also carried on Pioneer 11. The high-energy telescope detectors consisted of five collinear sensors, and measured stopping powers (H = E0) in the energy range 20 to 50 GeV/nucleon. Charge resolution for penetrating particles with energies greater than 10 GeV/nucleon. Low-energy telescope detectors consisted of two elements measuring stopping powers (H = E0) in the energy range 20 MeV/nucleon. The second low-energy telescope (LET) measured the energy range 20 to 35 MeV/nucleon. The third telescope measured the energy range 30 to 50 keV and 30 keV to 300 keV. For each telescope, count rates were obtained for each of several sensor coincidence-anticoincidence events. Some of the rates from each telescope were selected into eight octants in the spacecraft spin plane. In addition, three-focus pulse-height analysis, with preliminary analysis favoring the analysis of heavier particles associated with each telescope.

--- PIONEER 11: MCDONALD ---

INVESTIGATION NAME: COSMIC-RAY SPECTRA

NSDC ID: 77-02429-12 INVESTIGATIVE PROGRAM CODE EL-4/0-DP, SCIENCE

INVESTIGATION DISCIPLINES

COSMIC RAYS

PERSONNEL

P1 - J. MCDONALD NASA-GSFC
01 - R. J. MCGCHEN CSIRO
01 - W. B. WEBER U OF NEW HAMPSHIRE
01 - J. M. TEGGARDEN NASA-GSFC

BRIEF DESCRIPTION

This experiment consisted of three 3-element telescopes, all looking normal to the spacecraft spin axis. The second telescopes measured 20 to 30 MeV/nucleon particles with 5 to 10% resolution. The first telescope was 8 to 20 MeV/nucleon particles with 5% resolution. The second telescope measured 30 to 50 MeV/nucleon particles with 5% resolution. The third telescope measured 20 to 35 MeV/nucleon particles with 5% resolution. Data included the interplanetary region.

--- VOGT JR: VOGT ---

INVESTIGATION NAME: HIGH- AND MODERATELY LOW-ENERGY COSMIC-RAY TELESCOPE

NSDC ID: 77-06449-08 INVESTIGATIVE PROGRAM CODE EL-4-SC, SCIENCE

INVESTIGATION DISCIPLINES

COSMIC RAYS

PERSONNEL

P1 - J. M. VOGT CALIF INST OF TECH
01 - J. J. JOSEPHI U OF ARIZONA
01 - E. D. STONE CALIF INST OF TECH
01 - F. B. MCDONALD NASA-GSFC
01 - J. W. WEBER U OF NEW HAMPSHIRE
01 - A. W. SCHARDT U OF NEW HAMPSHIRE

BRIEF DESCRIPTION

This investigation studied the origin and acceleration process, life histories, and dynamic contribution of interstellar cosmic rays: the nucleosynthesis of elements in cosmic-ray sources, the behavior of cosmic rays in the interstellar medium, and the trapped planetary energetic-particle environment. The instrumentation included a High-Energy Telescope System (HETS) and a Low-Energy Telescope System (LETS). The HETS covered an energy range between 2 and 300 MeV/nucleon for nuclei ranging from 1 through 100. In addition, electrons in the energy range between 2 and 100 MeV/nucleon were measured by this telescope, and an electron telescope (LET). The LETS measured the energy and between the identity of nuclei for energies between 2. The instruments also measured the antiparticles of electrons and nuclei, and detected electrons in the energy range between 2 and 100 MeV/nucleon were measured by an electron telescope.

--- VOGT JR: VOGT ---

INVESTIGATION NAME: high- AND MODERATELY LOW-ENERGY COSMIC-RAY TELESCOPE

NSDC ID: 77-07649-08 INVESTIGATIVE PROGRAM CODE EL-4/SC, SCIENCE

INVESTIGATION DISCIPLINES

COSMIC RAYS

PERSONNEL

P1 - J. M. VOGT CALIF INST OF TECH
01 - J. J. JOSEPHI U OF ARIZONA
01 - E. D. STONE CALIF INST OF TECH
01 - F. B. MCDONALD NASA-GSFC
01 - J. W. WEBER U OF NEW HAMPSHIRE
01 - A. W. SCHARDT U OF NEW HAMPSHIRE

BRIEF DESCRIPTION

This investigation studied the origin and acceleration process, life histories, and dynamic contribution of interstellar cosmic rays: the nucleosynthesis of elements in cosmic-ray sources, the behavior of cosmic rays in the interstellar medium, and the trapped planetary energetic-particle environment. The instrumentation included a High-Energy Telescope System (HETS) and a Low-Energy Telescope System (LETS). The HETS covered an energy range between 2 and 300 MeV/nucleon for nuclei ranging from 1 through 100. In addition, electrons in the energy range between 2 and 100 MeV/nucleon were measured by this telescope, and an electron telescope (LET). The LETS measured the energy and between the identity of nuclei for energies between 2. The instruments also measured the antiparticles of electrons and nuclei, and detected electrons in the energy range between 2 and 100 MeV/nucleon were measured by an electron telescope.
the RADIOMETRY in occultation region in the Jovian atmosphere. The measured radiation was found to have properties consistent with a transition region indicating interactions between charged particles and neutral hydrogen.

--- Voyager 2: BROADFOOT ---

INVESTIGATION NAME: INFRARED SPECTROSCOPY

INVESTIGATION PROGRAM: CODE EL-4+ SCIENCE

INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL: BROADFOOT, KANSAS

BRIEF DESCRIPTION: This experiment was carried out using an infrared radiometer and an interferometer-spectrometer similar in design to the Mariner 10 DIRS, combined into a single instrument. The radiometer and interferometer were designed to measure radiance in the wavelength range from 0.4 to 100 micrometers (460 to 1000 Å). Two modes of observation were employed: integrated and occultation. In the integrated mode the atmospheric radiation was measured. This radiation is predominantly resonance-scattered solar radiation, where the scattering is by molecular or atomic constituents such as hydrogen (H₂) or helium (He). In the occultation mode, sunlight was reflected into the spectrometer and the solar spectrum was recorded. The absorption characteristics of the atmosphere were obtained over the measured wavelength range. The absorption spectrum was used to identify the absorption bands and to measure its abundance in the line of sight to the sun. In addition, the atmosphere's thermal structure could be inferred.

--- Voyager 2: HANEL ---

INVESTIGATION NAME: INFRARED SPECTROSCOPY AND RADINOMETRY

INVESTIGATION PROGRAM: CODE EL-4+ SCIENCE

INVESTIGATION DISCIPLINE(S): PLANETARY ATMOSPHERES

PERSONNEL: BROADFOOT, KANSAS

BRIEF DESCRIPTION: This experiment was carried out using an infrared radiometer and an interferometer-spectrometer similar in design to the Mariner 10 DIRS, combined into a single instrument. The radiometer and interferometer were designed to measure radiance in the wavelength range from 0.4 to 100 micrometers (460 to 1000 Å). Two modes of observation were employed: integrated and occultation. In the integrated mode the atmospheric radiation was measured. This radiation is predominantly resonance-scattered solar radiation, where the scattering is by molecular or atomic constituents such as hydrogen (H₂) or helium (He). In the occultation mode, sunlight was reflected into the spectrometer and the solar spectrum was recorded. The absorption characteristics of the atmosphere were obtained over the measured wavelength range. The absorption spectrum was used to identify the absorption bands and to measure its abundance in the line of sight to the sun. In addition, the atmosphere's thermal structure could be inferred.
This investigation was carried out using an infrared radiometer and an interferometer spectrometer similar in design to instruments used in earlier 9 DRS missions. The investigation studied both global and local energy balance and thermal characteristics of regions in low-solar-energy environments. Broad-band measurements of reflected solar energy, atmospheric composition, and also investigate the determination of the H2/He ratio and the abundance of (CH2 and N2). Vertical temperature profiles were obtained on the planets and satellites with atmospheres. Studies of the composition, thermal properties, and size of particles in Saturn's rings were conducted. The interferometer fed a spectral range of 200 to 5000 GHz, while the radiometer range covered 3000 to 35000 GHz. The instrument used a single primary mirror 51 cm in diameter with a field of view of 8.25 deg.

BRIEF DESCRIPTION

The Radio Science Team used the telecommunications system of the Voyager spacecraft to perform its studies. The system included a 5- and 8-band downlink and a 5-band uplink. The science objectives of the radio science investigation were (1) to determine the physical properties of planetary and satellite atmospheres by examining the propagation effects on a dual-frequency radio signal during occultation and the detection of spacecraft occultation by the subject body, (2) to determine properties of planetary and satellite atmospheres by examining the propagation effects on a dual-frequency radio signal during occultation and the detection of spacecraft occultation by the subject body, (3) to determine the amount and size distributions of material in Saturn's rings and the ring dimensions by examining the propagation effects on a dual-frequency radio signal that passed through each ring in succession and through the gap between the C ring and Saturn's surface.

----- PIONEER 10- ANDERSON -----

INVESTIGATION NAME: RADIO SCIENCE TEAM

NSSDC ID: 77-0144-02 INVESTIGATIVE PROGRAM

CODE EL-44 SCIENCE

INVESTIGATION DISCIPLINE(S)

ATOMIC PHYSICS

CELESTIAL MECHANICS

IONOSPHERES AND RADIO PHYSICS

PERSONNEL

P1 = G.J. TILKER STANFORD U

T1 = H.J. LEVY NASA-JPL

T2 = J-H. ASHLEMAN STANFORD U

T3 = G.E. WOOD NASA-JPL

BRIEF DESCRIPTION

The Radio Science Team used the telecommunications system of the Voyager spacecraft to perform its studies. The system included a 5- and 8-band downlink and a 5-band uplink. The science objectives of the radio science investigation were (1) to determine the physical properties of planetary and satellite atmospheres by examining the propagation effects on a dual-frequency radio signal during occultation and the detection of spacecraft occultation by the subject body, (2) to determine properties of planetary and satellite atmospheres by examining the propagation effects on a dual-frequency radio signal during occultation and the detection of spacecraft occultation by the subject body, (3) to determine the amount and size distributions of material in Saturn's rings and the ring dimensions by examining the propagation effects on a dual-frequency radio signal that passed through each ring in succession and through the gap between the C ring and Saturn's surface.

----- PIONEER 10- ANDERSON -----

INVESTIGATION NAME: RADIO SCIENCE TEAM

NSSDC ID: 77-0214-09 INVESTIGATIVE PROGRAM

CODE EL-44 SCIENCE

INVESTIGATION DISCIPLINE(S)

IONOSPHERES AND RADIO PHYSICS

CELESTIAL MECHANICS

PERSONNEL

P1 = J.J. ANDERSON NASA-JPL

T1 = E.W. NULL NASA-JPL

BRIEF DESCRIPTION

In this investigation, carriers were used to make more precise determinations of planetary masses, the heliocentric orbits of Jupiter and Saturn, and the gravitational fields of the two planets, Jupiter, and the Galilean satellites.

----- PIONEER 10- ANDERSON -----

INVESTIGATION NAME: RADIO SCIENCE TEAM

NSSDC ID: 77-0214-09 INVESTIGATIVE PROGRAM

CODE EL-44 SCIENCE

INVESTIGATION DISCIPLINE(S)

IONOSPHERES AND RADIO PHYSICS

CELESTIAL MECHANICS

PERSONNEL

P1 = J.J. ANDERSON NASA-JPL

T1 = E.W. NULL NASA-JPL

BRIEF DESCRIPTION

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----- PIONEER 10- ANDERSON -----

INVESTIGATION NAME: RADIO SCIENCE TEAM

NSSDC ID: 77-0214-09 INVESTIGATIVE PROGRAM

CODE EL-44 SCIENCE

INVESTIGATION DISCIPLINE(S)

IONOSPHERES AND RADIO PHYSICS

CELESTIAL MECHANICS

PERSONNEL

P1 = J.J. ANDERSON NASA-JPL

T1 = E.W. NULL NASA-JPL

BRIEF DESCRIPTION

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----- PIONEER 10- ANDERSON -----

INVESTIGATION NAME: RADIO SCIENCE TEAM

NSSDC ID: 77-0214-09 INVESTIGATIVE PROGRAM

CODE EL-44 SCIENCE

INVESTIGATION DISCIPLINE(S)

IONOSPHERES AND RADIO PHYSICS

CELESTIAL MECHANICS

PERSONNEL

P1 = J.J. ANDERSON NASA-JPL

T1 = E.W. NULL NASA-JPL

BRIEF DESCRIPTION

In this investigation, carriers were used to make more precise determinations of planetary masses, the heliocentric orbits of Jupiter and Saturn, and the gravitational fields of the two planets, Jupiter, and the Galilean satellites.

----- PIONEER 10- ANDERSON -----

INVESTIGATION NAME: RADIO SCIENCE TEAM

NSSDC ID: 77-0214-09 INVESTIGATIVE PROGRAM

CODE EL-44 SCIENCE

INVESTIGATION DISCIPLINE(S)

IONOSPHERES AND RADIO PHYSICS

CELESTIAL MECHANICS

PERSONNEL

P1 = J.J. ANDERSON NASA-JPL

T1 = E.W. NULL NASA-JPL

BRIEF DESCRIPTION

In this investigation, carriers were used to make more precise determinations of planetary masses, the heliocentric orbits of Jupiter and Saturn, and the gravitational fields of the two planets, Jupiter, and the Galilean satellites.
This experiment utilized the 1-band (252-253 MHz) spacecraft radio transmitter signal characteristics to obtain information about the ionospheres and atmospheres of Jupiter and its satellite Io, and Saturn. Entrance into and exit from Jupiter's ionization provided changes in the signal characteristics from which atmospheric temperature, pressure, and electron density profiles could be calculated. Temperature and pressure profiles were limited to levels above the pressure of one earth atmosphere. Signal absorption also provided a determination of the planetary diameter.

--- Voyager 1, Warwick ---

INVESTIGATION NAME: PLANETARY RADIO ASTRONOMY

NSSDC ID: 77-084-10

INVESTIGATIVE PROGRAM CODE: EL-420-01, SCIENCE

INVESTIGATION DISCIPLINE(S): MAGNETOSPHERIC PHYSICS

SPACE PLASMAS

PERSONNEL

PI: J.N. Warwick

CI - R.A. Alexander, Jr.
CI - C.L. Carr
CI - W.B. Hordlock
CI - B.N. Stassin
CI - C.L. Harvey
CI - Y. Lefleag
CI - W.J. Brown, Jr.
CI - J.T. Phillips
CI - J.W. Pearce
CI - A.C. Milo
CI - K.M. Felter

INVESTIGATION NAME: PLANETARY RADIO ASTRONOMY

NSSDC ID: 77-094-10

INVESTIGATIVE PROGRAM CODE: EL-420-01, SCIENCE

INVESTIGATION DISCIPLINE(S): MAGNETOSPHERIC PHYSICS

SPACE PLASMAS

PERSONNEL

PI: J.N. Warwick

CI - R.A. Alexander, Jr.
CI - C.L. Carr
CI - W.B. Hordlock
CI - B.N. Stassin
CI - C.L. Harvey
CI - Y. Lefleag
CI - W.J. Brown, Jr.
CI - J.T. Phillips
CI - J.W. Pearce
CI - A.C. Milo
CI - K.M. Felter

This experiment consisted of a swept-frequency radio receiver operating in both polarization states between 20 kHz and 43.5 MHz. The signal was received by a pair of orthogonal 180 m monopole antennas. Study of the radio-emission signals from Jupiter and Saturn over this range of frequencies yielded data concerning the physics of magnetospheric plasma resonances and nonthermal radio emissions from these planetary regions.

--- Voyager 2, Warwick ---

INVESTIGATION NAME: PLANETARY RADIO ASTRONOMY

NSSDC ID: 77-084-11

INVESTIGATIVE PROGRAM CODE: EL-420-01, SCIENCE

INVESTIGATION DISCIPLINE(S): MAGNETOSPHERIC PHYSICS

SPACE PLASMAS

PERSONNEL

PI: J.N. Warwick

CI - R.A. Alexander, Jr.
CI - C.L. Carr
CI - W.B. Hordlock
CI - B.N. Stassin
CI - C.L. Harvey
CI - Y. Lefleag
CI - W.J. Brown, Jr.
CI - J.T. Phillips
CI - J.W. Pearce
CI - A.C. Milo
CI - K.M. Felter

This experiment consisted of a swept-frequency radio receiver operating in both polarization states between 20 kHz and 43.5 MHz. The signal was received by a pair of orthogonal 180 m monopole antennas. Study of the radio-emission signals from Jupiter and Saturn over this range of frequencies yielded data concerning the physics of magnetospheric plasma resonances and nonthermal radio emissions from these planetary regions.

--- Voyager 2, Lane ---

INVESTIGATION NAME: MULTIFILTER PHOTOPOLARIMETER

NSSDC ID: 77-074-11

INVESTIGATIVE PROGRAM CODE: EL-420-01, SCIENCE

INVESTIGATION DISCIPLINE(S): INTERPLANETARY DUST

PLANETARY ATMOSPHERES

PERSONNEL

PI: J.L. Lane

CI - R.A. Pang
CI - J.W. Hansen
CI - R.A. Cohen
CI - R.H. Sinton
CI - R.A. West
CI - C.W. Morgan

This experiment consisted of an 8-in. (20 cm) f/1.1 telescope that sent radiation through a polarizer and a filter for one of eight bands in the 2200-7300 Å spectral region. On Jupiter, photospheric lines and information about temperature and composition of Jupiter, Saturn, Uranus, and Neptune were obtained, along with information on size distribution and composition of Saturn and Uranus' rings and information on atmospheric scattering properties and density for all planets.
Saturn
SATURN

Plate 5. This is a collection of press release photographs from Voyagers 1 and 2 missions. (A) P23400 is a Voyager 1 montage of Saturn and some of its 23 known moons. (B) P23068 is a Voyager 2 photo showing that the rings are composed of myriads of ringlets (over a thousand in number, of which about 100 can be detected in this photo,) making it look like a playing record. (C) P23925 is a Voyager 2 photo of part of Saturn's rings showing many ringlets and the radial bands on the B-ring, discovered on Voyager 1. (D) P23099 is a Voyager 1 photo of the F-ring appearing to consist of twisted or braided rings discovered on this mission. Voyager 2 photos showed a single ring composed of at least 9 ringlets, (but not braided or twisted). (E) P23113 is a Voyager 1 photo of Dione (1120 km diameter) showing a highly cratered surface. (F) P23094 is a Voyager 2 photo of Dione showing an entirely different surface for its other hemisphere from that in (E). Here it is less cratered and splashed with light ray-like material with little relief. (G) P23956 is a Voyager 2 photo of Enceladus (500 km diameter) showing an area of smooth, craterless terrain with ridges bordering it, indicating surface movement in the past to present. (H) P23200 is a Voyager 2 photo of Mimas (390 km diameter) with an enormous deep crater with a high central peak, making its resemblance to the Death Star in Star Wars remarkable. (I) P23915 is a Voyager 2 photo of part of the atmospheric surface of Saturn showing bands, belts and vortices. These features are somewhat similar to Jupiter's though smaller in size and appearing more subdued because of a high-altitude haze on Saturn not present on Jupiter.
INTRODUCTION

The planet farthest from the sun that has been visited and measured by planetary missions is Saturn. It has been visited by three U.S. spacecraft: Pioneer 11 and Voyagers 1 and 2. Voyager 2 is now on its way to Uranus and is expected to arrive at Uranus in January 1986. Although all investigations on these missions that flew by Jupiter obtained data also on Saturn, these data are still being reduced and analyzed and these data are anticipated for deposit in NSSDC. There are nine investigations for which NSSDC has data archived and these data cover the five categories: (1) Imaging, (2) Particles and Fields, (3) Radio Science and Celestial Mechanics, (4) Atmosphere, and (5) Polarization. Again, as in the case of Jupiter, data for the Atmosphere and Polarization categories come from the photopolarimeter investigation and are described under Imaging. Tables 1 and 2 and Appendix A give more detail on these investigations.
This was the second mission to investigate Jupiter and the outer solar system. Pioneer 11, like Pioneer 10, used Jupiter's gravitational field to alter its trajectory radically. It passed close to Saturn and then followed an escape trajectory from the solar system. The spacecraft was 2.9 m (9.5 ft) long and contained a 2.29 m (7.5 ft) diameter high-gain antenna of aluminum honeycomb sandwich material whose face was rotated to provide 130° of elevation coverage with a medium-gain antenna. A low-gain, omnidirectional antenna was mounted below the high-gain disk. It contained two nuclear electric-power generators, which generated 114 W at Jupiter, but decreased to 100 W at Saturn. There were three reference sensors: a star (cardinal sensor), and two sun sensors. Attitude position could be calculated from the reference direction to the earth and the sun with the known direction to Canopus as backup. Pioneer 11's star sensor gain and threshold settings were excited based on experience gained from the settings used on Pioneer 10. Two pairs of rocket thrusters provided spin-axis control at 8,000 rpm and change of the spacecraft velocity. The thrusters could be either fired steadily or pulsed, by command. Communications were maintained via the omnidirectional and medium-gain antennas, which operated together, connected to one receiver, while the high-gain antenna was connected to the other receiver. The receivers could be interchanged by command. Two radio transmitters, coupled to two traveling wave tube amplifiers, produced 3.1 watts (W) each in S-band. Communications uplink (earth to spacecraft) operated at 2138 MHz, and downlink (spacecraft to earth) at 2292 MHz. At Jupiter's distance, round-trip communication time took 92 min. Data were received at the Deep Space Network (DSN). The spacecraft was temperature-controlled to between 23 and 28 °C (73 to 82 °F). An additional experiment, a co-sensitivity flourescent magnetometer, was added to the Pioneer 11 payload. Instruments studied the interplanetary and planetary-magnetic fields, solar and galactic cosmic-ray level and spectral transition region of the heliosphere, neutral hydrogen abundance, distribution, solar and Earth-side effects on Saturn's ring particles, jovian aurorae, jovian radio waves, the atmospheres of planets and satellites, the surfaces of Jupiter, Saturn, and their satellites. Instruments carried for these experiments were designed as emitters: For solar wind studies, a charged-particle detector, ionizing detector, non-imaging telemetry, and spectrometer was used with sputtering detectors to detect sunlight reflected from passing meteoroids, seeded pressurized cells of argon to study neutralization of exospheric, UV photometer, IR radiometer, and an imaging polarimeter, which measured the polarization. Further scientific information was obtained from celestial objects and the space environment. This spacecraft, like Pioneer 10, contained a plaque that has a drawing depicting man, woman, and the location of the sun and earth in the galaxy. Pioneer 11 was 36,800 km from Jupiter during its closest approach, December 4, 1974, to within 52,000 km of its cloud tops. It passed by Saturn on Aug. 5, 1979 at a distance of 21,492 km from Saturn's cloud tops.
INVESTIGATION DISCIPLINE (S) METEOROLOGY

INVESTIGATION DISCIPLINE (S) PLANETARY ATMOSPHERES

PERSONNEL
TL - D.A. SMITH
DT - J.A. LODES
TM - J.R. HUNT
TR - T.J. MCKIBBEN
TM - L.C. SAGAN
TM - T.Y. JOHNSON
TM - H.H. MASSEY

U.S. GEOLOGICAL SURVEY
NASA HEADQUARTERS
NASA HEADQUARTERS
U.S. NAVY
U.S. NAVY
U.S. NAVY
NASA-JPL

INVESTIGATION DISCIPLINE (S) SPACE PHYSICS

INVESTIGATION DISCIPLINE (S) SPACE PLASMA

PERSONNEL
PT - J.W. WOLFE
PT - H.A. FRANK
PT - B. LUST
PT - J.A. FELDMAN
PT - R.A. WILBUR
DG - T. W. SNYDER
DG - F. ZIEBETZ
DG - H.R. KOLB
DG - H.C. FELDMAN
DG - D.A. WATERS
DG - R.A. WILBUR
DG - H.C. FELDMAN

U.S. NAVY
NASA-JPL
NASA-JPL
NASA-JPL
NASA-JPL
NASA-JPL
NASA-JPL
NASA-JPL
NASA-JPL

INVESTIGATION DISCIPLINE (S) SPACE PHYSICS

INVESTIGATION DISCIPLINE (S) SPACE PLASMA

PARTICLES AND FIELDS

PARTICLES AND FIELDS

INVESTIGATION NAME- IMAGING

INVESTIGATION NAME- PLASMA
NAFLIE "JOVIAN TRAPPED RADIATION"

FIELD TO 73 DEG WITH RESPECT TO THE SUN AXIS. THE CHAMBERS COVERED A RANGE OF PLUS OR MINUS 51 DEG. EACH CHAMBER CLOSE TO THE CENTER COVERED 51 DEG AND APPROXIMATELY 51 DEG NEAR THE RINGS OF THE SUN. THE ANGULAR WIDTH WAS ALMOST 2 DEG. IN THE SUN AT THE START WITH A HALF-ANGLE OF 51 DEG CENTERED ON THE SUN WAS S thí·

A MEASUREMENT OF THE Sun's RANGE OF PLUS OR MINUS 22.5 DEG FROM THE SUN AXIS. THE TWO OUTER ELECTRONIC CHANNELS HAD AN ANGULAR WIDTH OF 47.5 DEG AND WERE LOCATED AT PLUS OR MINUS 45.0 DEG AND 22.5 DEG FROM THE CENTER OF THE SATELLITE. THERE WAS A VARIETY OF POSSIBLE OPERATING MODES FOR THE EXPERIMENT. HOWEVER, THE PRINCIPAL MODE UTILIZED DURING THE ENCOUNTER PHASE WAS ONE IN WHICH THE ANODE PLATE POTENTIAL WAS CHANGED THROUGH A RANGE OF TWO-ONE-HALF DEGREES PER SECONDS AND ALL CURRENT COLLECTORS OR CHAMBERS WERE READ OUT AT THE PEAK AVERAGE POTENTIAL. THE CHARACTERISTIC OF THE OUTPUT CURSORS BETWEEN THE OUTPUT CURSORS WHICH COULD BE DISCRIMINATED TO ELECTRON FLUXES OF 1.00E-2 TO 1.00E+2 CM-2 S TOX AN AND THE PROTON FLUX DECREASED DOWN TO 1.00E-3 CM-2 S TOX AN COULD BE ACCELSERATED. DATA INCLUDE THE INTERPLANETARY REGION.

---------- Pioneer 11: AuCNA-----------

INVESTIGATION NAME: JOVIAN MAGNETIC FIELD

NSSDC 10- 73-S19A-14 INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S) MAGNETOPHYSICS PLANETARY MAGNETIC FIELD

PERSONNEL PI - N. A. AU CNA NASA-GSFC
El - M. B. AU CNA NASA-GSFC
E2 - R. E. WEBBER NASA-GSFC
E3 - G. E. RIEGEL NASA-GSFC
El - E. J. TEGARDEN NASA-GSFC
U - J. R. REYNOLDS NASA-GSFC

BRIEF DESCRIPTION

This experiment was designed to detect and measure the Jupiter and Saturnian magnet fields. Electrons were collected in a 3-degree half-angle region at 27.5 degrees from the Sun-Jupiter axis. Each center covered 5 deg and the angular range of plus or minus 22.5 deg from the Sun axis. The two outer collectors had an angular width of 47.5 deg and were located at plus or minus 45.0 deg from the center of the satellite. There was a variety of possible operating modes for the experiment, however, the principal mode utilized during the encounter phase was one in which the anode plate potential was stepped through a range every one-half-degree per second of the spacecraft, and all current collectors or chambers were read out at the peak average potential. The characteristic of the output cursor which could be discriminated was electron fluxes from 1.00E-2 to 1.00E+2 cm^-2 s^-1 and the proton flux decreased down to 1.00E-3 cm^-2 s^-1 and could be accelerated. Data include the interplanetary region.

---------- Pioneer 11: AuCNA-----------

INVESTIGATION NAME: JOVIAN CHARGED PARTICLES

NSSDC 10- 73-S19A-11 INVESTIGATIVE PROGRAM CODE EL-4, SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS MAGNETOPHYSICS

PERSONNEL PI - J. A. VAN ALLEN U OF IOWA
El - D. J. AXNE U OF IOWA
E2 - D. J. AXNE U OF IOWA
E3 - D. J. AXNE U OF IOWA

BRIEF DESCRIPTION

This experiment used seven miniature Geiger tubes in three arrays to measure protons and electron fluxes near Jupiter and Saturn. Detector groupings were as follows: (1) three three-element (2, 3, and 1) differentially shielded telescopes, the three-element telescopes were used for background subtraction to provide rates such as (4), (5) to (21) max electrons per second per minute (e/s/m) from 1.55 to 21 MeV electrons and 6.6 to 77.5 MeV protons; (2) a three-element triangular array of two differentially shielded telescopes above 77.5 MeV and (3) a single-wide tube (2O) with a single-wide tube (2O) at the entrance potential to detect scattered electrons above 2.06 MeV while discriminating strongly against protons. For a possible proton, the output rate was 2.6 s^-1. Upon completion of the encounter study, data were obtained at low rates in interplanetary space. A description of the investigation and initial Pioneer 10 results was published in J. Geophys. Res., v. 74, p. 12,1969. Early results are given in interplanetary region.

---------- Pioneer 11: MCDONALD-----------

INVESTIGATION NAME: COSMIC-RAY SPECTRA

NSSDC 10- 73-S19A-12 INVESTIGATIVE PROGRAM CODE EL-4/CP-10, SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS COSMIC RAYS

PERSONNEL PI - J. D. MCDONALD NASA-JPL
El - W. H. KLEIN U OF NEW HAMPSHIRE
E2 - W. D. WEBER U OF NEW HAMPSHIRE
E3 - R. E. RIEGEL NASA-GSFC
E4 - E. J. TEGARDEN NASA-GSFC
U - J. R. REYNOLDS NASA-GSFC

BRIEF DESCRIPTION

In this investigation, two-way Doppler tracking of the spacecraft was used to make more precise determinations of planetary masses, the heliocentric orbits of Jupiter, Saturn and the gravitational fields of the Sun, Jupiter, Saturn, and the Callisto and Saturnian satellites.

---------- Pioneer 11: MCDONALD-----------

INVESTIGATION NAME: COSMIC RAYS

NSSDC 10- 73-S19A-12 INVESTIGATIVE PROGRAM CODE EL-4/CP-10, SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIELDS COSMIC RAYS

PERSONNEL PI - J. D. MCDONALD NASA-JPL
El - W. H. KLEIN U OF NEW HAMPSHIRE
E2 - W. D. WEBER U OF NEW HAMPSHIRE
E3 - R. E. RIEGEL NASA-GSFC
E4 - E. J. TEGARDEN NASA-GSFC
U - J. R. REYNOLDS NASA-GSFC

BRIEF DESCRIPTION

In this investigation, two-way Doppler tracking of the spacecraft was used to make more precise determinations of planetary masses, the heliocentric orbits of Jupiter, Saturn and the gravitational fields of the Sun, Jupiter, Saturn, and the Callisto and Saturnian satellites.
Interplanetary Investigations by Planetary Probes
Plate 6. This is a collection of press release images of typical planetary spacecraft that conducted investigations in interplanetary space. (A) Mariner 4 was one of the first spacecraft to conduct planetary (Mars) and interplanetary exploration. (B) Pioneer 10 investigated the interplanetary medium, the nature of the asteroid belt, and conducted exploration of Jupiter and its environment. (C) Voyager 1 was designed to conduct investigations of the Jupiter and Saturn systems and to study interplanetary space.
INTRODUCTION

Six planetary probes carried instruments specifically to make investigations in interplanetary space. These were Mariners 4 and 5, Pioneers 10 and 11, and Voyagers 1 and 2. There were 11 investigations for which NSSDC has data or knows the sources for obtaining data. These cover three categories which are (1) Particles and Fields, (2) Ultraviolet, and (3) Interplanetary Particles. Table 1 and Appendix B show the investigations in more detail.
Magnetic

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**SPACECRAFT**

**SPACECRAFT COMMON NAME -** MARiner 4
**ALTERNATE NAMES -**

**NSSDC ID -** 64-074
**LAUNCH DATE -** 11/28/64
**WEIGHT -** 282. KG
**LAUNCH VEHICLE -** ATLAS
**SPONSORING COUNTRY/AGENCY -** UNITED STATES
**INITIAL ORBIT PARAMETERS -** N/A

**PERSONNEL -**
- PM - J.R. JAMES
- PS - R.A. SLOININA

**BRIEF DESCRIPTION -**
Mariner 4 was the fourth in a series of spacecraft used for planetary exploration in a flyby mode. It was designed to conduct scientific observations of the planet Mars and to transmit these observations to Earth. After the mission objectives were to perform field and particle measurements in the interplanetary space and to provide data on the sky for the Mars orbit science program.

**PARAMETERS -**
- WEIGHT - 282 KG
- LENGTH - 64-011A
- DIA - 309/4/1
- UNIT - PL-72-3D

**SPACECRAFT COMMON NAME -** MARiner 5
**ALTERNATE NAMES -** MARiner VENUS 67, 02555
**NSSDC ID -** 67-094
**LAUNCH DATE -** 05/17/67
**WEIGHT -** 246. KG
**LAUNCH VEHICLE -** ATLAS
**SPONSORING COUNTRY/AGENCY -** UNITED STATES
**INITIAL ORBIT PARAMETERS -** N/A

**PERSONNEL -**
- PM - R. SCHNEIDERMAN
- PS - T.M. PARKER
- PO - G.W. FINCH

**BRIEF DESCRIPTION -**
Mariner 5 spacecraft was the fifth in a series of spacecraft used for planetary exploration in a flyby mode. It was designed to conduct scientific observations of the planet Venus and to transmit these observations to Earth. The mission objectives were to perform field and particle measurements in the interplanetary space and to provide data on the Venusian environment.

**PARAMETERS -**
- WEIGHT - 246 KG
- LENGTH - 64-011A
- DIA - 309/4/1
- UNIT - PL-72-3D

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**SPACECRAFT COMMON NAME -** PIONEER II
**ALTERNATE NAME -** PIONEER 6-4 FL-535E
**NSSDC ID -** 73-019
**LAUNCH DATE -** 08/16/73
**WEIGHT -** 231 KG
**LAUNCH VEHICLE -** ATLAS
**SPONSORING COUNTRY/AGENCY -** UNITED STATES
**INITIAL ORBIT PARAMETERS -** N/A

**PERSONNEL -**
- PM - C.J. HALL
- PS - A. KALLEN

**BRIEF DESCRIPTION -**
This was the second mission to investigate Jupiter and the outer solar system. Pioneer II was 1.2 times larger and more powerful than Pioneer 11. It carried an additional instrument to study the ionosphere of Jupiter and its moons. The spacecraft was equipped with a high-gain antenna and a solar array to provide extended coverage of Jupiter and its moons.

**PARAMETERS -**
- WEIGHT - 231 KG
- LENGTH - 64-011A
- DIA - 309/4/1
- UNIT - PL-72-3D
The spacecraft was turned on again at 2110 UT on September 5, 1979, at a distance of 23,400 km from Saturn's cloud tops.

*************** VOYAGER 2 ****************

SPACECRAFT COMMON NAME- VOYAGER 2
ALTERNATE NAMES- MARINER JUPITER/SATURN & OUTER PLANETS A
PARNER TTA, NASA TTA
12321

NASSC ID- 77-7708A
LAUNCH DATE- 09/05/77
WEIGHT- 700. KG
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE- NOAA-
SPONSORING COUNTRY/AGENCY
UNITED STATES NASA-OSA
INITIAL ORBIT PARAMETERS
TYPE- SATURNFLYBY
PERSONNEL
PM- J.A. SIMPSON
NASA-PL
CALIF INST OF TECH
BRIEF DESCRIPTION
The overall objectives of Voyager 2 were to conduct exploratory investigations of the planetary systems of Jupiter, Saturn, Uranus, and Neptune, and of the interplanetary medium. Primary emphasis was placed on comparative studies of these planetary systems by obtaining (1) measurements of the environment, atmosphere, and body characteristics of the planets and one or more of the satellites of each planet; (2) studies of the nature of the rings of Saturn and Uranus, and (3) exploration of the interplanetary (or interstellar) medium at increasing distances from the sun. These objectives were met using a variety of instruments and methods including

SPOONSORING COUNTRY/AGENCY
UNITED STATES NASA-OSA
PERSONNEL
PM- J.A. SIMPSON
PS- E.C. STONE
PS- (1) COLLABORATING AGENCY
CALIF INST OF TECH
BRIEF DESCRIPTION
The overall objectives of Voyager 2 were to conduct exploratory investigations of the planetary systems of Jupiter, Saturn, Uranus, and Neptune, and of the interplanetary medium. Primary emphasis was placed on comparative studies of these planetary systems by obtaining (1) measurements of the environment, atmosphere, and body characteristics of the planets and one or more of the satellites of each planet; (2) studies of the nature of the rings of Saturn and Uranus, and (3) exploration of the interplanetary (or interstellar) medium at increasing distances from the sun. These objectives were met using a variety of instruments and methods including

*************** VOYAGER 2 ****************

SPACECRAFT COMMON NAME- VOYAGER 2
ALTERNATE NAMES- MARINER JUPITER/SATURN & OUTER PLANETS A
PARNER TTA, NASA TTA
12321

NASSC ID- 77-7708A
LAUNCH DATE- 09/05/77
WEIGHT- 700. KG
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE- TERRA
BRIEF DESCRIPTION
The overall objectives of Voyager 2 were to conduct exploratory investigations of the planetary systems of Jupiter, Saturn, Uranus, and Neptune, and of the interplanetary medium. Primary emphasis was placed on comparative studies of these planetary systems by obtaining (1) measurements of the environment, atmosphere, and body characteristics of the planets and one or more of the satellites of each planet; (2) studies of the nature of the rings of Saturn and Uranus, and (3) exploration of the interplanetary (or interstellar) medium at increasing distances from the sun. These objectives were met using a variety of instruments and methods including

SPOONSORING COUNTRY/AGENCY
UNITED STATES NASA-OSA
PERSONNEL
PM- E.C. STONE
PS- (1) COLLABORATING AGENCY
CALIF INST OF TECH
BRIEF DESCRIPTION
The overall objectives of Voyager 2 were to conduct exploratory investigations of the planetary systems of Jupiter, Saturn, Uranus, and Neptune, and of the interplanetary medium. Primary emphasis was placed on comparative studies of these planetary systems by obtaining (1) measurements of the environment, atmosphere, and body characteristics of the planets and one or more of the satellites of each planet; (2) studies of the nature of the rings of Saturn and Uranus, and (3) exploration of the interplanetary (or interstellar) medium at increasing distances from the sun. These objectives were met using a variety of instruments and methods including
BRIEF DESCRIPTION
This experiment (on both Pioneers 10 and 11) consisted of a broadband photometer sensitive between 200 and 800 Å, during the cruise phase of the mission, experiment was used to search for the supersonic to subsonic transition region in the solar wind. During the Jovian encounter, the experiment was used to look for evidence of an auroral oval on the Jovian atmosphere, and to find the temperature of the outer portion of the Jovian atmosphere. Evidence of helium was found in the interplanetary region, indicating interactions between charged particles and neutral hydrogen.

**INVESTIGATION NAME:** HIGH- AND MODERATELY LOW-ENERGY COSMIC-RAY TELESCOPE

**INVESTIGATION DISCIPLINE(S):** MAGNETOSPHERIC PHYSICS

**PERSONNEL**
- PI - R.B. Vogt
- CI - J.J. Joseph
- CI - J.P. Hickey
- CI - L.G. Stone
- CI - W.S. Kimber
- CI - W.A. Schramm

**BRIEF DESCRIPTION**
This investigation studied the origin and acceleration processes, life history, and dynamic contribution of interstellar cosmic rays, the nucleosynthesis of elements in cosmic-ray sources, the behavior of cosmic rays in the interplanetary medium, and the trapped planetary energetic-particle environment. The instrumentation included a High-Energy Telescope System (HETS) and a Low-Energy Telescope System (LETS). The HETS covered an energy range between 6 and 500 MeV/nucleon for nuclei ranging in atomic numbers from 1 through 90. In addition, electrons in the energy range between 5 and 100 MeV/nucleon were measured by this telescope and an electron telescope (LETS). The LETS measured the energy and determined the identity of nuclei for energies between 30. The instruments also measured the anisotropies of electrons and nuclei. In addition, electrons in the energy range between 3 and 100 MeV were measured by an electron telescope.

**INVESTIGATION NAME:** ASTEROID/METEOROID ASTROLOGY

**INVESTIGATION DISCIPLINE(S):** INTERPLANETARY DUST

**PERSONNEL**
- PI - R.J. Soberman
- CI - R.J. Zook
- CI - NASA-JSC

**BRIEF DESCRIPTION**
The overall objective of this experiment (also carried on Pioneer 11) was to investigate dust particles and meteoroids in interplanetary space. It was essentially two experiments using two different techniques. One method was to detect particles by the reflection of light from them, and the other method was to detect them by their impacts. The objectives were to determine distance, trajectory, velocity, relative size, and flux of objects ranging in size from atoms to meteoroids a few meters from the telescope to distant asteroids. The equipment for the detection of reflection consisted of four non-imaging Ritchey-Chretien telescopes with primary mirrors of 26 cm (10 in.) diameter and 25 cm (10 in.) focal length, fields of view (FOV) of 0.2 rad (8 deg) each, secondary optics, and a photomultiplier tube. The latter detected the reflected light collected by the telescope. An event was recorded when at least three of the four telescopes saw the object. Entry and departure times of the light enabled determination of range and velocity. The equipment for the impact mode consisted of 32 panels each containing 10 sealed cells, pressurized with argon and nitrogen gas, covering 6.25 square meters (15 ft) of the back of the main antenna dish. Penetration by a particle resulted in loss of gas at a rate proportional to the size of the hole, which would be related to the particle mass and velocity. Penetrations were registered from particles as small as 1.5-8 Å.
The overall objective of this experiment was to investigate dust particles and meteoroids in interplanetary space. It was essentially two experiments, using two different techniques. One method was to detect particles by the reflection of light from them, and the other method was to detect them by their impacts. The objectives were to determine distributions, trajectory, velocity, relative size, and flux of particles ranging in size from micro-particles a few meters from the telescope to distant asteroids. The equipment for the detection of reflection consisted of four non-imaging Ritchey-Chrétien telescopes with primary mirrors of 25-cm (10 in.) diameter. 24-cm (10 in.) focal length, fields of view (FOV) of 0.2 rad and 16 deg, respectively, optics, and a photomultiplier tube. The latter exhibits the reflected light collected by the telescopes. In each, we recorded the positions of the four telescopes at the object. Entry and departure times of the light detected determined the range and velocity. The equipment for the impact rate consisted of 13 panels containing 16 scintillation cells, pressurized with argon and nitrogen gas, covering 2.64 sq m of the best of the earths antenna dish. Perforation by a particle resulted in a loss of gas at a rate proportional to the hole, which would be related to its mass and velocity. This experiment is similar to one on Pioneer 10. Since the cells on Pioneer 11 were slightly elliptical, we determined the minimum mass particles detected were of slightly greater mass.

--- PIETER J.W. KINARD ---

INVESTIGATION NAME: MICRODETECTOR DETECTORS

NSSDC ID: 72-0124-14 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE

INVESTIGATION DISCIPLINES(s): ASTROPHYSICS INTERPLANETARY DUST

PERSONNEL

PI - J.W. KINARD NASA-LAARC

RE - E.H. RUDNER NASA-LAARC

OB - C.H. HUME NASA-LAARC

VE - R.D. DIXON NASA-LAARC

BRIEF DESCRIPTION

This experiment was designed to measure the number of meteoroids detected in the Pioneer 11 spacecraft. A total of 13 panels, each containing 16 scintillation cells, was mounted on the back of the antenna dish. The total exposed area was 5.96 sq m. Each panel of gas-filled cells was covered by a 2.54-mm (1-in.) stainless steel sheet of 0.38-mm (0.009-in.) thickness, through which many small holes were left between them. Whenever a particle was detected, the gas escaping from the holes was measured. The tenion of the gas pressure loss indicated the size of the hole and thus the mass of the particle. The number of each discrete cone angle, a field-of-view aperture, and the telescope and optics were stepped to detect the relative size of the particles. The 2.54-mm (1-in.) thick stainless steel gas panel was exposed to the interplanetary medium for a long period without any indication of the particles having a mass of 1 nanogram or more.

--- PIETER J.W. KINARD ---

INVESTIGATION NAME: METEOROIDS DETECTORS

NSSDC ID: 73-0048-15 INVESTIGATIVE PROGRAM CODE EL+4, SCIENCE

INVESTIGATION DISCIPLINES(s): ASTROPHYSICS INTERPLANETARY DUST

PERSONNEL

PI - J.W. KINARD NASA-LAARC

RE - J.M. ALVAREZ NASA-LAARC

OB - C.H. HUME NASA-LAARC

VE - R.D. DIXON NASA-LAARC

BRIEF DESCRIPTION

The Pioneer 11 meteoroid detection experiment attempted to detect objects too small to be seen by light-scattering techniques. Two of the 16 panels, each containing 15 scintillation cells, were mounted on the back of the spacecraft antenna dish. The 15 panels contained 2.35-mm (0.09-in.) stainless steel, with a large number of small pockets of gas trapped between them. The gas pressure loss of any of the cells indicated a hit, and the rate of gas loss indicated the size of the hole made. Thus the mass and velocity of each meteoroid could be obtained. Determination of the trajectory allowed the spatial density of the meteoroids. The experiment was designed to detect particles having a mass of 780 g. The panels were cycled through a series of angular increments twice. Results from this experiment were combined with those from a similar experiment flown on Pioneer 10 to determine the range in mass of small particles on both the inner and outer boundaries and within the asteroid belt.
formatted to produce a sky map. 160 deg in clock angle by 141 deg in cone angle. The experimental train for the IPP package consisted of the following elements: (1) a near-diffraction-limited 2.56-sec. Maksutov catadioptric telescope (f/5.4); (2) a focal plane wheel containing field-of-view apertures, depolarizers, calibration source, etc.; (3) a nullation prism to split the light into two orthogonally polarized beams; (4) a 45-deg dichromatic mirror that reflected wavelengths less than 5500 A (blue beam) and transmitted all light of greater wavelength (red beam); (5) for each spectral beam (two polarizations) a filtering coated relay lens and folding mirrors; and (6) for each spectral beam, two channeltron detectors (blue - blabell 5-11 photocathodes, red - 5-20 photocathodes) to register the intensity in each polarization component. (Note: a similar experiment was also aboard Pioneer 10.) Data include the interplanetary region.
Interplanetary Investigations
Plate 7. This is a collection of press release images of typical spacecraft designed solely to conduct investigations in interplanetary space. (A) Pioneer 5 investigated particles and fields in ciscytherean space, including solar flares and the solar wind. (B) Pioneer 6 investigated interplanetary phenomena in ciscytherean space to within about 0.814 AU of the sun. (C) Pioneer 9 collected scientific data on the electromagnetic and plasma properties of the interplanetary medium. (D) Helios-A investigated the properties and processes in interplanetary space in the direction of and close to the sun.
INTRODUCTION

There were seven missions which were designed solely to make investigations in interplanetary space. These were Pioneers 5, 6, 7, 8, and 9, and Helios-A and -B. There were 54 investigations for which NSSDC has data or sources for obtaining data. These cover three categories which are (1) Particles and Fields, (2) Radio Science and Celestial Mechanics, and (3) Interplanetary Particles. Table 1 and Appendix C show the investigations in more detail.
PIONEER 5

SPACERANT COMMON NAME- PIONEER 5
ALTERNATE NAMES- 1965 ALPHA 1, BOO2

NSSDC ID- 60-005A
LAUNCH DATE- 05/11/60
WEIGHT- 43.6 KG
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE- THOR

SPONSORING COUNTRY/AGENCY
UNITED STATES
DOE-IAF

INITIAL ORBIT PARAMETERS
ORBIT TYPE- HELIOCENTRIC
ORBIT PERIOD- 311.6 EAY
INCLINATION- 0.992 DEG
PERIAPSIS- 2.786 AU RA

PERSONNEL
PM- C.J. HALL(NASA)
PS- P. DYAL

BRIEF DESCRIPTION
Pioneer 5 (1960 alpha 23) was a spin-stabilized spacecraft designed to obtain measurements of interplanetary phenomena from widely separated points in space. The spacecraft carried experiments to study positive ions and electrons in the solar wind, the interplanetary electron density, radio propagation experiments, solar and galactic cosmic rays, and the interplanetary magnetic field. Its main antenna was a high-gain directional antenna. The spacecraft was spin-stabilized at about 60 rpm and the spin axis was perpendicular to the ecliptic plane and pointed toward the south ecliptic pole. One scientific data format was used for the two highest bit rates. Another was used for the three lowest bit rates. The third contained data from only the radio propagation experiment. The fourth data format contained primarily engineering data. The four operating modes were (1) real-time, (2) solar-orbiting, and (3) command between 2 and 17 min to provide partial data coverage for periods up to 19 hr, as limited by the bit storage capacity. In the memory readout mode, data were read out at whatever bit rate was appropriate to the satellite distance from the earth.

PIONEER

SPACERANT COMMON NAME- PIONEER 6
ALTERNATE NAMES- PIONEER 6

NSSDC ID- 65-005A
LAUNCH DATE- 12/08/65
WEIGHT- 146. KG
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE- DELTA

SPONSORING COUNTRY/AGENCY
UNITED STATES
NASA-OSA

ORBIT PARAMETERS
ORBIT TYPE- HELIOCENTRIC
ORBIT PERIOD- 311.6 DAYS
INCLINATION- 0.986 DEG
APOLLOPSIS- 5.153 AU RA

PERSONNEL
PM- C.J. HALL(NASA)
PS- P. DYAL

BRIEF DESCRIPTION
Pioneer 6 was the first in a series of solar-orbiting, spin-stabilized, solar-cell and battery-powered satellites designed to obtain measurements of interplanetary phenomena from widely separated points in space. Its experiments studied the positive ions and electrons in the solar wind, the interplanetary electron density, radio propagation experiments, solar and galactic cosmic rays, and the interplanetary magnetic field. Its main antenna was a high-gain directional antenna. The spacecraft was spin-stabilized at about 60 rpm and the spin axis was perpendicular to the ecliptic plane and pointed toward the south ecliptic pole. By ground command, one of five bit rates one of four data formats was used for the four highest bit rates. Another was used for the three lowest bit rates. The third contained data from only the radio propagation experiment. The fourth data format contained primarily engineering data. The four operating modes were (1) real-time, (2) solar-orbiting, and (3) command between 2 and 17 min to provide partial data coverage for periods up to 19 hr, as limited by the bit storage capacity. In the memory readout mode, data were read out at whatever bit rate was appropriate to the satellite distance from the earth.

PIONEER 7

SPACERANT COMMON NAME- PIONEER 7
ALTERNATE NAMES- PIONEER 7

NSSDC ID- 66-005A
LAUNCH DATE- 02/17/66
WEIGHT- 138. KG
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
LAUNCH VEHICLE- DELTA

SPONSORING COUNTRY/AGENCY
UNITED STATES
NASA-OSA

ORBIT PARAMETERS
ORBIT TYPE- HELIOCENTRIC
ORBIT PERIOD- 311.6 DAYS
INCLINATION- 1.385 DEG
APOLLOPSIS- 1.125 AU RA

PERSONNEL
PM- C.J. HALL(NASA)
PS- J.W. WOLFE

BRIEF DESCRIPTION
Pioneer 7 was the second in a series of solar-orbiting, spin-stabilized, solar-cell and battery-powered satellites designed to obtain measurements of interplanetary phenomena from widely separated points in space. Its experiments studied the positive ions and electrons in the solar wind, the interplanetary electron density, radio propagation experiments, solar and galactic cosmic rays, and the interplanetary magnetic field. Its main antenna was a high-gain directional antenna. The spacecraft was spin-stabilized at about 60 rpm and the spin axis was perpendicular to the ecliptic plane and pointed toward the south ecliptic pole. By ground command, one of five bit rates one of four data formats was used for the four highest bit rates. Another was used for the three lowest bit rates. The third contained data from only the radio propagation experiment. The fourth data format contained primarily engineering data. The four operating modes were (1) real-time, (2) solar-orbiting, and (3) command between 2 and 17 min to provide partial data coverage for periods up to 19 hr, as limited by the bit storage capacity. In the memory readout mode, data were read out at whatever bit rate was appropriate to the satellite distance from the earth.
data format was used at the two highest bit rates. Another was used at the three lowest bit rates. The third was used for data from only the radio propagation experiment. The fourth data format was used mainly for engineering data. The four operating modes were (1) real time, (2) telemetry store, (3) duty cycle, and (4) memory readout. In the real-time mode, data were sampled and transmitted directly without storage as specified by the data format and bit rate selected. In the telemetry store mode, data were stored and transmitted simultaneously in the format and at the bit rate selected. In the duty cycle store mode, a single frame of scientific data was collected and stored at a rate of 512 bps. The time interval between the collection and storage of successive frames could be varied by ground command between 2 and 17 min to provide partial data coverage for periods up to 19 h as limited by the bit-storage capacity. In the memory readout mode, data were read out at whatever bit rate was appropriate to the satellite distance from the earth.

*************** PIONEER 9 ******************

SPACECRAFT COMMON NAME- PIONEER 9
ALTERNATE NAMES- PIONEER 9, PL-884
NSSDC ID- 88-053
LAUNCH DATE- 11/18/65
WEIGHT- 147, 6 kg
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
SPONSORING COUNTRY/AGENCY
UNITED STATES NASA-OSA
ORBIT PARAMETERS
ORBIT TYPE- HELIOCENTRIC
EPOCH DATE- 02/27/76
INCLINATION- 8.806 Deg
PERIHELION- 0.754 AU RAD
APOHELION- 0.975 AU RAD
PERSONNEL
PM - J.F. HALL (NASA)
PS - J.M. TRAVERS (NASA)
BRIEF DESCRIPTION
Pioneer 9 was the fourth in a series of solar-studying, spin-stabilized, fuel-powered satellites designed to obtain measurements of interplanetary phenomena at widely separated points in space. The spacecraft carried experiments to study the positive and negative ions and to determine the density (radio propagation experiments), solar and galactic cosmic rays, the interplanetary magnetic field, and electric fields. Also, a new coding process was implemented for Pioneer 9. Its main antenna was a high-gain, directional one. The spacecraft was spin-stabilized at about 60 rpm, and the spin axis was perpendicular to the ecliptic plane and pointed toward the north ecliptic pole. By ground command, one of the bit rates—one of four data formats and one of four operating modes could be selected. The five bit rates were 512, 128, 16, and 8 bps. Three of the four data formats contained primary scientific data and consisted of 32 seven-bit words each. One data format was used at the two highest bit rates; another was used at the three lowest bit rates. The third contained data from only the radio-propagation experiment. The fourth data format contained primarily engineering data. The four operating modes were real-time, telemetry-store, duty-cycle store, and memory readout. In the real-time mode, data were sampled and transmitted directly (without storage) as specified by the data format and bit rate selected. The telemetry-store mode, data were stored and transmitted simultaneously in the format and at the bit rate selected. In the duty-cycle store mode, a single frame of scientific data was collected and stored at a rate of 512 bps. The time interval between the collection and storage of successive frames could be varied by ground command between 2 and 17 min to provide partial data coverage for periods up to 19 h as limited by the bit-storage capacity. In the memory readout mode, data were read out at whatever bit rate was appropriate to the satellite distance from the earth.

*************** HELIOS-0 ******************

SPACECRAFT COMMON NAME- HELIOS-0
ALTERNATE NAMES- HELIOS-0, PL-754
NSSDC ID- 76-053
LAUNCH DATE- 03/17/76
WEIGHT- 375.2 kg
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
SPONSORING COUNTRY/AGENCY
UNITED STATES NASA-OSA
INITIAL ORBIT PARAMETERS
ORBIT TYPE- HELIOCENTRIC
EPOCH DATE- 10/26/64
PERIHELION- 0.22 AU RAD
APOHELION- 1.01 AU RAD
PERSONNEL
PM - J.A. KUTZER
PS - C.W. OUSLEY
PS - H.S. PORSCHE
PS - J.H. TRAVERS
BRIEF DESCRIPTION
This spacecraft was one of a pair of deep-space probes developed by the Federal Republic of Germany (FRG) in a cooperative program with NASA. Experiments were provided by scientists from both FRG and the U.S. NASA supplied the Titan/Centaur launch vehicle. The spacecraft was equipped with two booms and a 225 electric dipole. The payload consisted of a fluxgate magnetometer; electric and magnetic wave experiments, which covered various bands in the frequency range 6 Hz to 3 MHz; charged-particle experiments, which covered various energy ranges starting with solar-plasma thermal energies and extending to 1 GeV; a coherent-light experiment and a magnetometric experiment. The purpose of the mission was to make pioneering measurements of the interplanetary medium from the vicinity of the earth's orbit to 0.5 AU. The spacecraft was capable of being operated at bit rates from 512 to 8 bps; variable by factors of two, while the spacecraft was moving to perihelion. It was generally operated at 64 to 128 bps and near 0.3 AU. It was operated at the highest bit rate, because of a deployment of two or one event of the 27-day dipole-cone antenna, one event shorter than the antenna function as a monopole. The radio observation was to increase the effective antenna throughput and to introduce additional uncorrelated events. In this antenna length, instrument descriptions written by the experimenters were published (some in German, some in English) in the journal "Weltfahrtforschung" v. 19, n. 5, 1975.

*************** HELIOS-1 ******************

SPACECRAFT COMMON NAME- HELIOS-1
ALTERNATE NAME- HELIOS-1, PL-744
NSSDC ID- 76-053
LAUNCH DATE- 01/21/76
WEIGHT- 371.2 kg
LAUNCH SITE- CAPE CANAVERAL, UNITED STATES
SPONSORING COUNTRY/AGENCY
UNITED STATES NASA-OSA
INITIAL ORBIT PARAMETERS
ORBIT TYPE- HELIOCENTRIC
EPOCH DATE- 07/21/76
PERIHELION- 0.289 AU RAD
APOHELION- 1.008 AU RAD
PERSONNEL
PM - J.A. KUTZER
PM - C.W. OUSLEY
PS - H.S. PORSCHE
PS - J.H. TRAVERS
BRIEF DESCRIPTION
This spacecraft was one of a pair of deep-space probes developed by the Federal Republic of Germany (FRG) in a cooperative program with NASA. Experiments were provided by scientists from both FRG and the U.S. NASA supplied the Titan/Centaur launch vehicle. The spacecraft was equipped with two booms and a 225 electric dipole. The payload consisted of a fluxgate magnetometer; electric and magnetic wave experiments, which covered various bands in the frequency range 6 Hz to 3 MHz; charged-particle experiments, which covered various energy ranges starting with solar-plasma thermal energies and extending to 1 GeV; a coherent-light experiment and a magnetometric experiment. The purpose of the mission was to make pioneering measurements of the interplanetary medium from the vicinity of the earth's orbit to 0.5 AU. The spacecraft was spin stabilized with the spin axis normal to the ecliptic, and a nominal spin rate of 1 rpm. The outer surface was coated with a conductive material consisting of a plasma potential of typically 5 kV. Sheath-related coupling caused by the spacecraft antennas produced interference with the wave experiments, but the character of the interference was different from that observed on the Helios-A spacecraft. The spacecraft was capable of being operated at bit rates from 512 to 8 bps; variable by factors of two, while the spacecraft was moving to perihelion. It was generally operated at 64 to 128 bps and near 0.3 AU. It was operated at the highest bit rates, because of difficulty encountered with the high-gain antenna, and scheduling conflicts with other spacecraft. High-bit-rate data were obtained from Helios-0 that were available from Helios-1. Descriptions written by the experimenters are published (some in German, some in English) in the journal "Weltfahrtforschung" v. 19, n. 5, 1975.
This experiment utilized measurements of the polari-
sation of the spacecraft telemetry signal to obtain measurements of the re-
latee Faraday rotation due to the interplanetary medium and the earth's
ionosphere.

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INVESTIGATION NAME: TEMPLATE FOR OTHER INVESTIGATIONS

PERSONNEL
PI - G.S. LEVY
NASA-JPL

BRIEF DESCRIPTION
This experiment utilized measurements of the polari-
sation of the spacecraft telemetry signal to obtain measurements of the re-
latee Faraday rotation due to the interplanetary medium and the earth's
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PI - G.S. LEVY
NASA-JPL

BRIEF DESCRIPTION
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latee Faraday rotation due to the interplanetary medium and the earth's
ionosphere.

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INVESTIGATION NAME: TEMPLATE FOR OTHER INVESTIGATIONS

PERSONNEL
PI - G.S. LEVY
NASA-JPL

BRIEF DESCRIPTION
This experiment utilized measurements of the polari-
sation of the spacecraft telemetry signal to obtain measurements of the re-
latee Faraday rotation due to the interplanetary medium and the earth's
ionosphere.
For tip-to-tip axis, a device shared the 32-level value varied in the sensor, excellent into the teleetered rate was the measured the resultant configuration. For more details see J. Geophys. Res. v. 82, p. 126 of Raumflachforschung, v. 19, n. 5, 1975.

--- HELIOS-B. ROSENBAUER

INVESTIGATION NAME: SOLAR WIND PLASMA WAVE

NSSDC ISD 76-0234-04 INVESTIGATIVE PROGRAM CODE EL-18-0609, SCIENCE PARTICLES AND FIELDS

INVESTIGATION DISCIPLINES: PARTICLES AND FIELDS

PERSONNEL
P1 - S.J. BAUER U OF IOWA
P2 - S.B. KELLOG U OF MINNESOTA
P3 - D.J. STONE NASA-GSFC

BRIEF DESCRIPTION
This experiment (ISa) shared the 32-w. tip-to-tip electric antenna with experiments 89 and 90. The instrument consisted of a 16-channel spectrum analyzer with approximately logarithmically equispaced center frequencies. 16 log compressors, 16 R-C integrators for averaging the log-compressed electric field amplitude between readouts, and 16 peak detectors which were reset after readout. The 16 averages and 16 peak log values were sampled simultaneously. The channels covered the frequency range of about 25 Hz to 200 Hz, with a sampling rate dependent on the log compressors. The log compressors had a dynamic range of 100 dB. Sampling rate depends in part on the spacecraft bit rate and telemetry format. The fastest real-time teleetered rate was for 16 averages and 16 peak values to be sampled every 1,120 s; whenever a very strong signal was detected, a presettable channel, the shock alarm data was initiated in which the electric field spectrum, magnetic field, and plasma data were recorded into spacecraft memory for a period starting before and terminating after the triggering signal. The maximum sampling rate of the spectrum data in this mode was 14.2 samples per s for each channel. Interference caused by solar cell noise occurred primarily in the lowest six channels and harmonics were related to the spin frequency and the spacecraft shaft. However, a combination of factors including the group deployment of the antenna and conductive spacecraft coating resulted in data from this spacecraft being of higher quality than data from experiments 89 and 90. For more details see p. 226 of Raumflachforschung, v. 19, n. 5, 1975.

--- HELIOS-A. KUHRT

INVESTIGATION NAME: SOLAR WIND PLASMA WAVE

NSSDC ISD 77-0234-07 INVESTIGATIVE PROGRAM CODE EL-18-0609, SCIENCE PARTICLES AND FIELDS

INVESTIGATION DISCIPLINES: PARTICLES AND FIELDS

PERSONNEL
P1 - R.A. KUHRT U OF IOWA
P2 - J.L. SCARF TENN GROUP SYSTEM

BRIEF DESCRIPTION
Electrostatic and electromagnetic plasma waves were measured in the solar wind near 1 AU using an unbalanced dipole antenna on the 423-MHz Stanford University satellite. The 423-MHz Stanford University antenna, which served as the sensor, was capacitively coupled to a dipole antenna. Channel 1 was a 15.3 bandwidth filter centered at 40 Hz, a typical interplanetary electron cyclotron frequency. Channel 2 was a 15.3 bandwidth filter centered at 92 Hz, a typical interplanetary electron plasma frequency. The broadest channel free 30 Hz to 100 Hz was fed into a count rate meter that measured the number of positive going pulses per unit time. The signal was amplified and passed through a magnetic field. The trigger level was set at 10 Hz per precipitation sequence. The trigger levels together with the count rate at each channel gave a measure of the bandwidth power spectrum. About all of the time this measurement amount to the power spectrum at near 100 Hz. At the highest teleetered rate of Pioneer 8, this sequence was repeated every 7.47 min.

--- PIONEER 8. SCARF

INVESTIGATION NAME: ELECTRIC FIELD DETECTOR

NSSDC ISD 78-0234-04 INVESTIGATIVE PROGRAM CODE EL-18-0609, SCIENCE PARTICLES AND FIELDS

INVESTIGATION DISCIPLINES: PARTICLES AND FIELDS

PERSONNEL
P1 - R.A. KUHRT U OF IOWA
P2 - J.L. SCARF TENN GROUP SYSTEM

BRIEF DESCRIPTION
Negative ions with energy 0.1 to 1660 eV were detected simultaneously. The data were sampled at rate of 200 Hz. The electric field vector was measured by an equispaced center analyzer. Events with energy 0.1 to 1660 eV were measured with a hemispherical electrostatic analyzer in one dimension. The detector operated in several modes with differing time resolution depending in detail on telemetry format and satellite bit rate. Typical time resolution was on the order of a minute. Also, whenever the special shock alarm mode was triggered by experiments 89 or 90, a high-time-resolution plasma data for a period before and after the event was recorded into spacecraft memory for a period starting before and terminating after the triggering signal. The maximum sampling rate of the spectrum data in this mode was 14.2 samples per s for each channel. Interference caused by solar cell noise occurred primarily in the lowest six channels and harmonics were related to the spin frequency and the spacecraft shaft. However, a combination of factors including the group deployment of the antenna and conductive spacecraft coating resulted in data from this spacecraft being of higher quality than data from experiments 89 and 90. For more details see p. 226 of Raumflachforschung, v. 19, n. 5, 1975.

--- HELIOS-A. KUHRT

INVESTIGATION NAME: SOLAR WIND PLASMA WAVE

NSSDC ISD 79-0234-07 INVESTIGATIVE PROGRAM CODE EL-18-0609, SCIENCE PARTICLES AND FIELDS

INVESTIGATION DISCIPLINES: PARTICLES AND FIELDS

PERSONNEL
P1 - S.J. BAUER U OF IOWA
P2 - S.B. KELLOG U OF MINNESOTA
P3 - D.J. STONE NASA-GSFC

BRIEF DESCRIPTION
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--- HELIOS-A. KUHRT

INVESTIGATION NAME: SOLAR WIND PLASMA WAVE

NSSDC ISD 80-0234-07 INVESTIGATIVE PROGRAM CODE EL-18-0609, SCIENCE PARTICLES AND FIELDS

INVESTIGATION DISCIPLINES: PARTICLES AND FIELDS

PERSONNEL
P1 - S.J. BAUER U OF IOWA
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P3 - D.J. STONE NASA-GSFC

BRIEF DESCRIPTION
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--- HELIOS-A. KUHRT

INVESTIGATION NAME: SOLAR WIND PLASMA WAVE

NSSDC ISD 81-0234-07 INVESTIGATIVE PROGRAM CODE EL-18-0609, SCIENCE PARTICLES AND FIELDS

INVESTIGATION DISCIPLINES: PARTICLES AND FIELDS

PERSONNEL
P1 - S.J. BAUER U OF IOWA
P2 - S.B. KELLOG U OF MINNESOTA
P3 - D.J. STONE NASA-GSFC

BRIEF DESCRIPTION
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At the right of the spacecraft were three different electron energy channels. The solar wind plasma hit the spacecraft at about 290 °C, and the electron fluxes were measured in the full spacecraft equatorial plane (same as the ecliptic plane). The collected electron flux was recorded for a given single collector at a given E/Q step. A trunccated spherical electrostatic analyzer was used to study the directional intensity of the electrons and positive ions in the solar wind. At the spacecraft was spinning, the electron fluxes were measured in a single equatorial plane and the three different energy channels. The spacecraft was spinning, and the electron fluxes were measured in a single equatorial plane and the three different energy channels. The spacecraft was spinning, and the electron fluxes were measured in a single equatorial plane and the three different energy channels.

The spacecraft was spinning, and the electron fluxes were measured in a single equatorial plane and the three different energy channels.

The spacecraft was spinning, and the electron fluxes were measured in a single equatorial plane and the three different energy channels.
rates (64, 16, and 8 bps), the maximum flux mode was used at each 1/64 step followed by either (0) for tons, a polar scan and an zenithal scan at 1/64 step and then the peak flux measurement during the maximum flux mode was obtained, or (2) for electrons, a polar scan and an zenithal scan at 1/64 V. In the maximum flux mode, only the central collector was observed, and the probe flux obtained and the angle of direction (to 2+1/2° deg) of the observation were reported. A complete set of data was obtained from seven sets of electron measurements (at each 1/64 step) and one set of proton measurements (at each 1/64 step). At the high bit rates (512 and 256 bps) one set of ion measurements took 62 s and one set of electron measurements 35 s. At the low bit rates (0.5, 16, and 8 bps) one set of ion measurements took 37 s and one set of electron measurements 30 s. At 64 bps a complete set of measurements (seven ions plus one electron) was taken and telemeasured every 0.25 s. At 16 bps it took 138 s and at 0 bps it took 322 s.

---- HELIOS A, KEPLER -----

INVESTIGATION NAME: ELECTRON AND PROTON DETECTOR

NSSDC ID: 74-E007A-00

INVESTIGATIVE PROGRAM

CORE EL-4/COP-SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI - E. KEPLER
OI - R. WIEMER
OI - J. J. WILLIAMS

BRIEF DESCRIPTION

The objective of the experiment (08) was to study the origin, and the distribution mechanism of low-energy electrons and protons. The instruments, a magnetic spectrometer, consisted of six semiconductor detectors with the field of view in the plane of the ecliptic. Species separation was achieved by an ionogram magnetic field oriented perpendicularly to the particle path. Four electron and two proton detectors measured electrons from 20 to 1000 keV and protons from 0 to 1000 keV. The proton measurements were made with a two-detector telescope employing coincidence and anticoincidence logic. Both particle species were measured in 16 energy channels through pulse-height analysis. For further information see pp. 261-263 of Raumfahrtforschung, v. 1975, 5.

---- HELIOS B, KEPLER -----

INVESTIGATION NAME: ELECTRON AND PROTON DETECTOR

NSSDC ID: 74-E007B-00

INVESTIGATIVE PROGRAM

CORE EL-4/COP-SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI - E. KEPLER
OI - H. WIEMER
OI - J. J. WILLIAMS

BRIEF DESCRIPTION

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---- PIONEER 6, NESS -----

INVESTIGATION NAME: ECLIPSE FlUXGATE MAGNETOMETER

NSSDC ID: 65-E005-01

INVESTIGATIVE PROGRAM

CORE EL-4/SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI - N.F. NESS

BRIEF DESCRIPTION

A single, beam-oriented, uniaxial fluxgate magnetometer with a dynamic range of plus or minus 120 nT and plus or minus 0.125-nT resolution, obtained a vector magnetic field measurement by means of three measurements taken at equal time intervals during each spacecraft spin period (approximately 5 s). At telemetry bit rates less than or equal to 8 bps, averages were computed on board for transmission to earth. For further details see Marsili et al. J. Geophys. Res., v. 75, p. 3556-1970. NESS has all the useful data that exist from this investigation.

---- PIONEER 6, NESS -----

INVESTIGATION NAME: SINGLE-AXIS MAGNETOMETER

NSSDC ID: 65-E006A-01

INVESTIGATIVE PROGRAM

CORE EL-4/COP-SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI - N.F. NESS

BRIEF DESCRIPTION

A single, beam-oriented, uniaxial fluxgate magnetometer with a dynamic range of plus or minus 120 nT and plus or minus 0.125-nT resolution. Obtained a vector magnetic field measurement by means of three measurements taken at equal time intervals during each spacecraft spin period (approximately 5 s). At telemetry bit rates less than or equal to 8 bps, averages were computed on board for transmission to earth. For further details see Marsili et al. J. Geophys. Res., v. 75, p. 3556-1970. NESS has all the useful data that exist from this investigation.

---- PIONEER 7, NESS -----

INVESTIGATION NAME: SINGLE-AXIS MAGNETOMETER

NSSDC ID: 66-0767A-01

INVESTIGATIVE PROGRAM

CORE EL-4/COP-SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI - N.F. NESS

BRIEF DESCRIPTION

A single, beam-oriented, uniaxial fluxgate magnetometer, with a dynamic range of plus or minus 120 nT and plus or minus 0.125-nT resolution, obtained a vector magnetic field measurement by means of three measurements taken at equal time intervals during each spacecraft spin period (approximately 5 s). At telemetry bit rates less than or equal to 8 bps, averages were computed on board for transmission to earth. For further details see Marsili et al. J. Geophys. Res., v. 75, p. 3556-1970. NESS has all the useful data that exist from this investigation.

---- PIONEER 9, SOETT -----

INVESTIGATION NAME: TRIAXIAL MAGNETOMETER

NSSDC ID: 68-E006-01

INVESTIGATIVE PROGRAM

CORE EL-4/SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI - C.P. SOETT
OI - D.S. COLEMAN

BRIEF DESCRIPTION

A single, beam-oriented, triaxial fluxgate magnetometer was used to study the interplanetary magnetic field and its fluctuations. The sensors were orthogonally mounted with one axis parallel to the spacecraft spin axis. Upon command, a motor interchanged a sensor in the spin plane with the sensor along the spin axis, enabling on-board determination of zero level. Every 30 hours, the instrument was commanded into a self-calibrate sequence, and this was often repeated after the sensors were flipped. The instrument, which had dynamic range of plus or minus 256 nT with a resolution of plus or minus 0.2 nT, was capable of high-precision computation of the magnetic field components, comprising three magnetic field vectors, were transmitted in each spacecraft telemetry frame.
The experiment (E6) consisted of a boom-mounted triaxial-fluxgate magnetometer. An automatic in-flight range switch system selected the optimal range of four ranges that were minus plus 1.6, 32, 64, and 128 nT per sensor. Two had corresponding digitization resolutions of minus plus 0.03, 0.125, 0.25, and 0.5 nT, respectively. A sensor flipper was actuated every 36 h to assist in sensor zero level determination. For telemetry bit rates above 256 kbps, vector measurements were made at rates between 1 and 16 per s depending on bit rates. At lower bit rates, averages and variances were computed on board for transmission to earth.

--- HELIOS-B: NESS---

INVESTIGATION NAME: FLUXGATE MAGNETOMETER FOR AVERAGE FIELDS

NSSDC ID: 76-6254-00

INVESTIGATIVE PROGRAM

CODE EL-4/SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI: F.W. NESS
01: L.L. HARRIS
01: L.J. EVANWEBER
01: J.L. BAUMAN

ENR. SPACE PLASMA LAB

BRIEF DESCRIPTION

This experiment (E5) consisted of a boom-mounted triaxial-fluxgate magnetometer. An automatic in-flight range switch system selected the optimal range of four ranges that were minus plus 16, 32, 64, and 128 nT per sensor. Two had corresponding digitization resolutions of minus plus 0.03, 0.125, 0.25, and 0.5 nT, respectively. A sensor flipper was actuated every 36 h to assist in sensor zero level determination. For telemetry bit rates above 256 kbps, vector measurements were made at rates between 1 and 16 per s depending on bit rates. At lower bit rates, averages and variances were computed on board for transmission to earth.

--- HELIOS-B: NEUHAUS---

INVESTIGATION NAME: FLUXGATE MAGNETOMETER FOR FIELD FLUCTUATIONS

NSSDC ID: 76-6277-01

INVESTIGATIVE PROGRAM

CODE EL-6/SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI: F.M. NEUHAUS
01: A. MAIER
01: B. SOUTHERN

BRAUNSCHWEIG TECH U

BRIEF DESCRIPTION

The instrument (E2) consisted of three triaxial fluxgate magnetometers mounted on a 2.75-m boom to make magnetic field measurements up to 4 Hz. Data from each axis were first sent through a low-pass filter with the 3 dB attenuation point at 4 Hz. The telemetry format and bit rate of the data were fed either into a time-averaging computer or directly connected to telemetry. A shock identification computer triggered the storage of rapid-rate data in the spacecraft memory when there were discontinuities in the variations of the ambient magnetic field. Two measurement ranges were used: plus or minus 50 and 400 nT with resolutions of plus or minus 0.2 and 0.2 nT, respectively. The instrument was equipped with a flipper mechanism, which reoriented each sensor by 90° periodically, for detailed information, see p. 232 of Raumfahrtforschung v. 19 n. 5, 1975.--- HELIOS-B: NEUHAUS---

INVESTIGATION NAME: FLUXGATE MAGNETOMETER FOR FIELD FLUCTUATIONS

NSSDC ID: 76-6234-03

INVESTIGATIVE PROGRAM

CODE EL-6/SCIENCE

INVESTIGATION DISCIPLINE(S)

PARTICLES AND FIELDS

PERSONNEL

PI: F.M. NEUHAUS
01: A. MAIER
01: B. SOUTHERN

BRAUNSCHWEIG TECH U

BRIEF DESCRIPTION

This experiment (E6) was designed to investigate the magnetic components of electromagnetic waves in the solar wind from 0.3 to 1.0 AU. By means of its waveform channel (WFC), the rapid variations of the magnetic field were measured by plus or minus 0.03, 0.125, 0.25, and 0.5 nT in three orthogonal directions from 0 to 250 Hz. A spectrum analyzer observed the field components in the ecliptic plane and perpendicular to it, to obtain the power spectral density and peak values for eight logarithmically spaced channels in the range from 0.3 to 250 Hz. Because of the large amount of data produced by this experiment, a data reduction was applied. For interesting time intervals selected by the fluxgate magnetometer (E6)/fluxgate (E7), waveform data could be read into an onboard memory at a rapid rate to be transmitted along with more detailed information see p. 241 in Raumfahrtforschung v. 19 n. 5, 1975.
rate to be transmitted slowly afterwards. For more detailed information see p. 241 in Raufarforflugv v. 19 v. 5, 1975.

-------- PIONEER 5, WINKLER

INVESTIGATION NAME: ION CHAMBER AND GM TUBE

NSSDC ID: 65-081A-03 INVESTIGATIVE PROGRAM CORE EL-4 + SCIENCE

INVESTIGATION DISCIPLINE(S): PARTICLES AND FIELDS

PERSONNEL
PI - J.R. WINKLER
O1 - J.J. ARMSTRONG
O2 - R.A. HOFFMAN
U OF MINNESOTA
U OF NEW HAMPSHIRE
NASA-GSFC

BRIEF DESCRIPTION

This experiment consisted of a hemispherical integrating ionization chamber and an Anton 322 Geiger counter. The Geiger counter was located in the spacecraft spin plane, orthogonal to the detector. The pulse-height analysis of the Geiger counter was accomplished by a pulse-height analyzer. The analysis was performed on the telescope data to determine the number of events per second. The data were analyzed to determine the number of events per second. The data were analyzed to determine the energy of the detected particles. The energy was determined to be 3.49 MeV for the upper half of the Geiger counter.

-------- PIONEER 6, SIMPSON

INVESTIGATION NAME: PROPORTIONAL COUNTER TELESCOPE

NSSDC ID: 65-1314-01 INVESTIGATIVE PROGRAM CORE EL-4 + SCIENCE

INVESTIGATION DISCIPLINE(S): PARTICLES AND FIELDS

PERSONNEL
PI - J.A. SIMPSON
O1 - J.V. FAN
O2 - P. MEYER
U OF CHICAGO
U OF ARIZONA
U OF CHICAGO

BRIEF DESCRIPTION

A continuous charge integration proportional counter telescope was used to observe terrestrial trapped radiation and solar particles (protons X 105 MeV, electrons X 105 MeV). Measurements were obtained for about 2 months during which a period of quiescent magnetic field conditions followed by two geomagnetic storms closely spaced in time occurred. The date of transmission of the last useful information was May 16, 1970.

-------- PIONEER 6, SIMPSON

INVESTIGATION NAME: COSMIC RAY TELESCOPE

NSSDC ID: 65-1954-05 INVESTIGATIVE PROGRAM CORE EL-4 + SCIENCE

INVESTIGATION DISCIPLINE(S): PARTICLES AND FIELDS

COSMIC RAYS

PERSONNEL
PI - J.A. SIMPSON
O1 - J.V. FAN
O2 - P. MEYER
U OF CHICAGO
U OF CHICAGO
U OF CHICAGO

BRIEF DESCRIPTION

This experiment used a charged-particle telescope composed of four silicon solid-state detectors to study the anisotropy and fluctuations of solar protons and alpha particles. The proton energy ranges sampled were 0.6 to 12.7 MeV, 12.7 to 73.6 MeV, 73.6 to 165 MeV, and 165 MeV to 335 MeV. The alpha particles energy ranges sampled were 0.2 to 25 MeV, and 25 to 205 MeV. The time resolution ranged from about 1.4 to 1.8 s per second, depending on the telescope bit rate. The detector was mounted in the spacecraft spin plane, orthogonal to the spacecraft spin axis. The data were analyzed to determine the number of events per second. The data were analyzed to determine the energy of the detected particles. The energy was determined to be 3.49 MeV for the upper half of the Geiger counter.
and for the omnidirectional mode varied between 14 and 112 °. In this mode, the telescope was set to measure the directional characteristics of galactic and solar cosmic-ray fluxes. For each of the 12 sectors, a 11° (111°) telescopic crystal that was set so as to be incident on an anticoincidence plastic scintillator and had a coaxial acceptance cone of 23°. The scintillation signal direction was centered in the ecliptic plane. Three solid-state detectors were oriented in a fan arrangement with respect to a fourth solid-state detector, such that each of the four detectors was able to fire a telescope with the fourth detector. Each of the three telescopes thus formed had an acceptance cone of 23° in the 11° direction. The measured differential of the telescopes were in the ecliptic plane and 40° above and below that plane, respectively. Two concurrent modes of counting were employed. In the first series, counts were accumulated in eight separate 45°-degree intervals during the spacecraft spin. In the second, spin-integrated counts were acquired. In the first mode, the scintillation signal was centered in the ecliptic plane and 40° above and below that plane. In the second mode, the scintillation signal was centered in the ecliptic plane and a 60° acceptance cone was centered in the ecliptic plane. For each of the four detectors, the telescope was set to measure the energy flux in the range 3.3 to 5.8, and 10 to 21.5 MeV/nucleon. A third coincidence mode measured the sum of counts due to electrons above 46.1 MeV/nucleon and muons above 0.6 MeV/nucleon. In the third coincidence mode measured the sum of counts due to electrons above 46.1 MeV/nucleon and muons above 0.6 MeV/nucleon. In the third coincidence mode measured the sum of counts due to electrons above 46.1 MeV/nucleon and muons above 0.6 MeV/nucleon. In the third coincidence mode measured the sum of counts due to electrons above 46.1 MeV/nucleon and muons above 0.6 MeV/nucleon. In the third coincidence mode measured the sum of counts due to electrons above 46.1 MeV/nucleon and muons above 0.6 MeV/nucleon. In the third coincidence mode measured the sum of counts due to electrons above 46.1 MeV/nucleon and muons above 0.6 MeV/nucleon.
INVESTIGATION NAME: GALACTIC AND SOLAR COSMIC RAYS

NSSDC 10- 76-003A-05 INVESTIGATIVE PROGRAM CODE EL-4/SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIeldS COSMIC RAYS

PERSONNEL
PI - J. W. TRAWICK NASA-GSFC
01 - L. F. BOLLER上升
01 - J. J. BERGHOFF NASA-GSFC
01 - J. E. MECKIEN NASA-GSFC
01 - E. G. MEEKER
CEOS

BRIEF DESCRIPTION

The detector complement of this experiment (47) consisted of three separate delta E/delta x vs E telescopes and a proportional counter for monitoring solar X rays in the range 2-20 kev. The high-energy telescope has a geometric factor of 0.22 sq.cm-kev and measured electrons in three ranges between 0.2 and 6 Mev, and protons and alpha particles in three ranges between 21 and 56 Mev. Protons above 33 Mev were also measured. The first low-energy telescope (geometric factor was 0.105 sq.cm-kev) measured protons and alpha particles in two ranges between 1 and 21 Mev, and electrons in three ranges between 21 and 56 MeV. The second low-energy telescope (geometric factor was 0.105 sq.cm-kev) measured protons in several ranges between 0.2 and 2.1 Mev, alpha particles in the range 0.2-0.8 Mev, and electrons in four ranges between 0.2 and 2.1 Mev. For a number of coincidences mode conditions, the rate of combination of bit set and fast was a complete data cycle required about 2.5 hr. For further details see IEEE Trans. on Nucl. Sci., 25, 22-32, 570, 1975, and on Raumahrforschung v. 19, n. 5, p. 253-267, 1975 for further details.

----- HELIOS II PERSONNEL -----}

INVESTIGATION NAME: COSMIC-RAY PARTICLES

NSSDC 10- 76-003A-06 INVESTIGATIVE PROGRAM CODE EL-4/SCIENCE
INVESTIGATION DISCIPLINE(S) PARTICLES AND FIeldS COSMIC RAYS

PERSONNEL
PI - H. KUHLM NASA-GSFC
01 - R. H. WIDENHORN NASA-KSFC
01 - G. GREEN NASA-KSFC
01 - L. V. MUELLER-MEYER NASA-KSFC
01 - M. WHITE NASA-KSFC
01 - W. HEUMANN
NASA-GSFC

BRIEF DESCRIPTION

The objective of the experiment (48) was to study high-energy charged cosmic-ray particles of solar, planetary, and galactic origin in interplanetary space. Protons and alpha particles with energies > 0.3 MeV were measured within the interplanetary space over the range 0.3 to 2.1 kev. The instrument, a particle telescope with a 55-degree field of view, consisted of five photomultiplier detectors, one Saphire Cerenkov counter, and one anticoincidence counter, all enclosed by an anticoincidence cylinder. The telescope was calibrated prior to launch using radioactive sources, particle accelerators, and ground-level muons. It measured protons and alpha particles in six channels (0.3-0.8, 0.8-2, 2-3, 3-4, 4-6, 6-12) kev. In five energy channels (0.3-0.8, 0.8-2, 2-3, 3-4, and 4-6 kev), for more details see pp. 253-257 of Raumahrforschung v. 19, n. 5, 1975.

----- HELIOS II PERSONNEL -----}

INVESTIGATION NAME: TWO-FREQUENCY BROADCAST RECEIVER

NSSDC 10- 65-052A-07 INVESTIGATIVE PROGRAM CODE EL-4/SCIENCE
INVESTIGATION DISCIPLINE(S) ASTROPHYSICS AND RADIO PHYSICS PARTICLES AND FIeldS

PERSONNEL
PI - N. KENDALL SRI
01 - L. A. CROFT RED INTERNATIONAL
01 - W. BOARDHARDT SRI
01 - O. F. GARDNER NASA-JSC
01 - A. M. PETERSON STANDFORD

BRIEF DESCRIPTION

The purpose of this experiment was to use the tracking data from the intention to obtain primary determinations of the overall condition, the spacecraft signal received, and the ionospheric effect on the transmitted signal. The experiment used the onboard receiver and transmitter equipment in conjunction with Deep Space Network station equipment to obtain Doppler measurements.

----- PIONEER 6 PERSONNEL -----
Both 423.5-MHz and its 2/17 subharmonic 49.8-MHz signals were transmitted from a 4.6-m steerable parabolic antenna at Stanford University to the two-frequency radio receiver on the spacecraft. The high-frequency signal served as a reference signal since its propagation time was not appreciably delayed. The low-frequency signal was delayed in proportion to the total electron content in the propagation path. On the spacecraft a phase-locked receiver counted the beat frequency zero crossings of the received signals to obtain measurements of phase-path differences. Differential delay of the group velocity was also observed, and these values were translated to the ground station. From calculated total electron content values, the ionospheric effect (up to a selected altitude obtained from other experimental techniques) was subtracted to produce data describing the interplanetary electron content of the solar wind and its variations. The experiment operated nominally from March to May 1975. Further experimental details were reported in a paper entitled "Two-Frequency Beacon Receiver" by Peter S. Bauer, Howard T. Peterson, and James R. Fierro, published in 1976.

This experiment (15b) shared the 32-Mhz to 150-Mhz electronically steerable dipole antenna with experiments 08 and 09. Instrumentation consisted of three tunable plasma wave receivers, a fixed-frequency wideband receiver, and a waveform sampler. The tunable receivers were used to record the raw data for direct telemetry to Earth. Each of the tunable receivers covered a different frequency band ranging from 6.4 kHz to 200 kHz. The high-frequency receiver had 96 frequency settings separated by about 60 kHz. The low-frequency receiver had 48 frequency settings separated by about 1 kHz. The resulting configuration covered the range 208 Hz to 200 kHz. The low-frequency receiver had 24 settings with 10% separation. The high-frequency receiver was approximately 1.8 s, reacquiring the ionospheric effect on the receiver to obtain information about the angular distribution of waves appearing in the low-frequency band. This receiver covered the frequency range 1 Hz to 200 Hz. The time resolution depended in detail on the spacecraft telemetry format, bit rate, and experiment operational mode. When the shock state mode became active, the waveform sampler was read into spacecraft memory for a period after the event before ending after the event. In this mode, the instantaneous voltage across the antenna was passed through a low-pass filter with corner frequency dependent on the sampling rate, and measured at discrete intervals. The resultant voltage was stored, and the resulting configuration was used with an operational effective length of about 2 m. This resulted in a 3-dB loss in sensitivity and an increased receiver noise level, particularly at low frequencies. In addition, the high-gain telemetry antenna produced additional foreground. For a more detailed discussion, see pp. 249 of 'Summary of comments' in 1975.

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Table 3. U.S. Lunar Mission Data

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**Legend:**
- X: No data at NSSDC
- O: All or partial data at NSSDC
- ●: Experiment failed
- ○: Experiment successful

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*Mission also included.*
**Excluded with unanalyzed data.**
**Excluded with lunar and lunar data.**
Appendixes
# APPENDIX A

## INDEX TO PLANETARY INVESTIGATIONS

WITH DATA AVAILABLE AT NSSDC

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## APPENDIX B

### INDEX TO INTERPLANETARY INVESTIGATIONS (FROM PLANETARY MISSIONS)
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APPENDIX D - DEFINITIONS

Investigation Discipline - The subject to which an investigation pertains. The possible entries are limited, and the NSSDC information files can be searched using this field.

Investigative Program - Code of the cognizant NASA Headquarters office, or name of other sponsoring agency program. "CO-OP" added to a code indicates a cooperative effort with another agency or foreign country.

NLA - No Longer Affiliated. Used in the spacecraft personnel section and occasionally with investigations to indicate that the person had the specified affiliation at the time of his participation in the project, but is no longer there.

NSSDC ID - An identification code used in the NSSDC information system. In this system, each successfully launched spacecraft and experiment is assigned a code based on the launch sequence of the spacecraft. Subsequent to 1962, this code (e.g., 72-012A for the spacecraft Pioneer 10) corresponds to the COSPAR international designation. The experiment codes are based on the spacecraft code. For example, the experiments carried aboard the spacecraft 73-019A (Pioneer 11) are numbered 73-019A-01, 73-019A-02, etc. Each prelaunch spacecraft and experiment is also assigned an NSSDC ID code based on the name of the spacecraft. Prior to launch, for example, the approved NASA launch, Solar Mesosphere Explorer, was coded SME. The experiments to be carried aboard this spacecraft were coded SME-01, SME-02, etc. Once a spacecraft is launched, its prelaunch designation is changed to a postlaunch one; e.g., Pioneer-G, which was launched April 6, 1973, was given the NSSDC ID code of 73-019A, and the NSSDC spacecraft common name of Pioneer 11.

OI - Other Investigator.

PI - Principal Investigator.

PM - Project Manager.

PS - Project Scientist.

TL - Team Leader.

TM - Team Member.
TRF - Technical Reference File. A computerized space-investigation-oriented bibliographic reference list maintained by NSSDC. Journal publications and other documents are cited, and can be retrieved by author name, title, or NSSDC ID of relevant investigation. Used to keep track of descriptive and documentation material, as well as to produce bibliographies of certain spacecraft. The TRF accession number begins with the letter B and contains five digits; for example, B10851.