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DESCRIPTION OF SCIENTIFIC EXPERIMENTS ORBITING GEOPHYSICAL OBSERVATORY MISSION VI

MAY 1969

GSFC — GODDARD SPACE FLIGHT CENTER —
GREENBELT, MARYLAND

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DESCRIPTION OF SCIENTIFIC EXPERIMENTS

ORBITING GEOPHYSICAL OBSERVATORY

MISSION VI

Compiled by

F. J. Liberatore
OGO Experiment Coordinator

May 1969

Experiment Descriptions Supplied by
Principal Investigators

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

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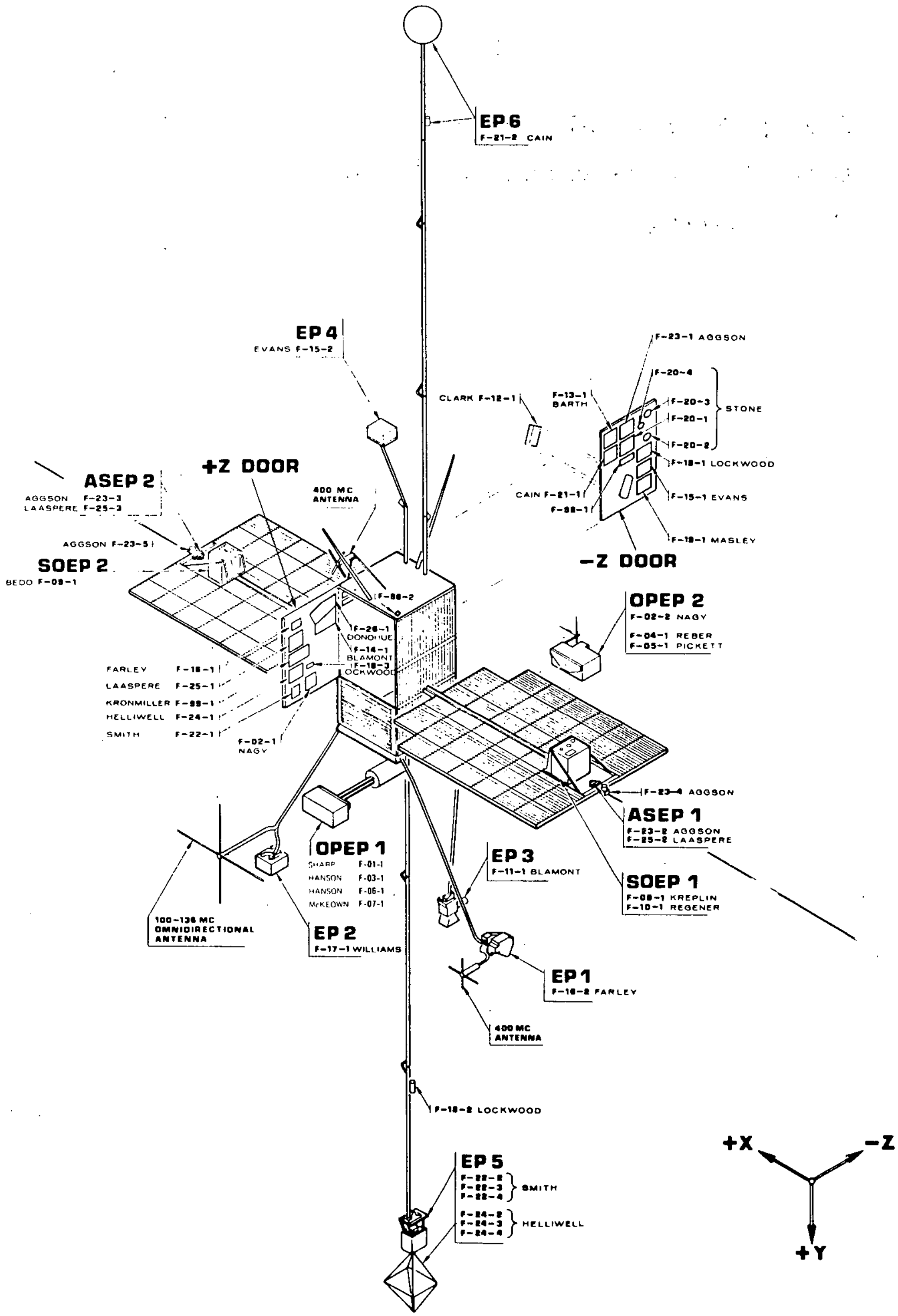

OGO-F Experiment Locations

EXPERIMENT DESCRIPTION

FOR

Microphone Density Gage for OGO-F

(Experiment F-01)

INVESTIGATOR

The principal investigator for the Microphone Density Gage Experiment is Dr. G. W. Sharp; the co-investigator is T. J. Crowther. Both investigators are affiliated with Lockheed Missiles and Space Company.

OBJECTIVES

The experiment's objective is to measure, in situ, the spatial and temporal variations in the neutral atmospheric density around the OGO-F orbit. In particular, latitude variation, day-night variations, and solar activity-correlated variation in the atmospheric density will be the objects of this study.

INSTRUMENTATION

A thin metallic ribbon is suspended between the pole pieces of a permanent magnet and mounted in the orbital-plane experiment package (OPEP) looking along the velocity vector of the vehicle. The atmospheric gas, effectively having the velocity of the vehicle, exerts a pressure on this ribbon. This pressure is proportional to the atmospheric mass density and the square of the velocity of the gas with respect to the ribbon. The gas striking the ribbon is mechanically chopped so that the ribbon is caused to execute a forced oscillation in the magnetic field, the amplitude of which is proportional to the applied pressure. The electrical voltage generated by this ribbon motion through the magnetic field is amplified and rectified to provide a dc signal suitable for telemetry. In-flight calibration is supplied to ensure that the ribbon/electronics sensitivities have not changed. Pressures equivalent to solar radiation pressure in free space can be detected.

OPERATIONAL USE

The experiment is useful around the entire orbit of OGO-F. Presently the instrumental limit of sensitivity is such that a minimum density (ρ) of 1×10^{-16} gm/cm^3 is measurable. For the time of the OGO-F flight, which is near solar maximum, the instrument should measure atmospheric density from perigee up to approximately 850 km. Measurements made at all local times are of interest; and, since one of the primary objectives is to obtain a measure of the latitudinal dependence of density, measurements made at all latitudes are important. The effects of various solar and geomagnetic changes on the neutral density will be of particular interest. Thus, correlation with instruments that measure these phenomena or are affected by such changes will be of great value.

MEASURED DATA

It is expected that atmospheric density values will be obtained over most of the spacecraft orbit whenever the instrumentation for this experiment is in use. These density values can be obtained quickly as a function of system time and be made available for correlations with other measurements on a point-by-point basis. A density value is obtained at every playout of the main frame, i.e., once every 0.25 second for the slowest rate on OGO-F.

REDUCED DATA

The final reduced form of the data will include computed atmospheric density values plotted as a function of latitude, local time, solar activity, and other geophysical parameters that are available or appear to be important. The data will be published in the literature in this form.

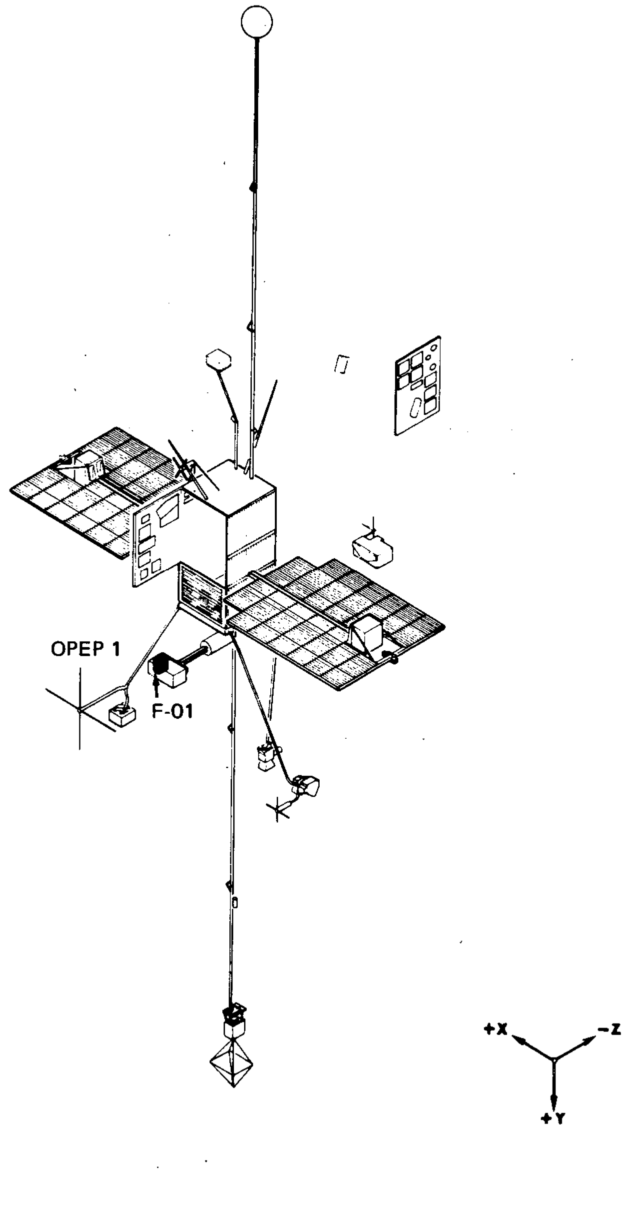

Figure 1. Experiment F-01 Location

EXPERIMENT DESCRIPTION

FOR

Electron Temperature and Density for OGO-F

(Experiment F-02)

INVESTIGATOR

The principal investigator for the Electron Temperature and Density Experiment is Dr. A. F. Nagy, who is affiliated with the University of Michigan. The co-investigator is L. H. Brace, who is affiliated with Goddard Space Flight Center (GSFC).

OBJECTIVES

The objectives of this experiment are to measure the ambient electron temperature and density in the upper atmosphere and to provide information on the equilibrium potential of the spacecraft.

INSTRUMENTATION

The instrumentation uses a small cylindrical probe that is placed outside the spacecraft sheath. The potential of the probe is varied a few volts with respect to the spacecraft. The resulting collected current versus applied voltage characteristics are then used to derive electron temperature and density and spacecraft potential. This OGO-F experiment uses two cylindrical probes placed on OPEP 2 at 90 degrees to each other, with one probe looking into the velocity vector. This arrangement is helpful in experimentally evaluating the orientation effects on the volt-ampere characteristics. The electronics package, to be housed in the main body, contains (1) the voltage generator that drives the probe, (2) the current detector that transforms the collected current into a voltage appropriate for telemetry, and (3) the logic circuits and power supplies.

The Langmuir Probe Experiment requires a constant reference potential for its operation; therefore, it is important that the other experiments do not cause the spacecraft potential to vary. The Langmuir Probe itself will not cause any such interference since the area ratio between the spacecraft and the probe is expected to be large enough to prevent any significant variation in the spacecraft potential.

OPERATIONAL USE

The detector sensitivities have a sufficient dynamic range to permit meaningful measurements to be made at all times during the expected operational life of the satellite. The experiment is planned to operate as continuously as possible.

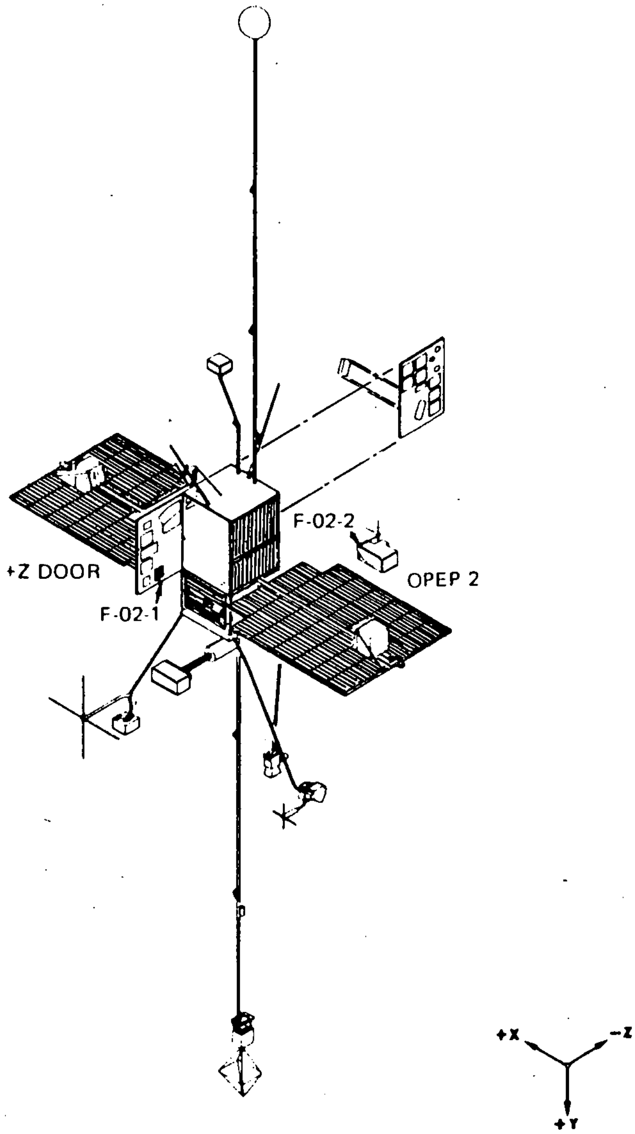

Figure 2. Experiment F-2 Location

EXPERIMENT DESCRIPTION

FOR

Ionospheric Duct Detector for OGO-F

(Experiment F-03)

INVESTIGATOR

The principal investigator for the Ionospheric Duct Detector Experiment is Dr. W. B. Hanson; the co-investigator is T. W. Flowerday. Both investigators are affiliated with the Southwest Center for Advanced Studies.

OBJECTIVES

The objectives of this experiment are to measure ion temperature, ion composition, and ion concentration, and, to identify irregularities in ion concentration.

INSTRUMENTATION

The instrumentation uses a planar ion-trap that points nearly in the direction of vehicle motion. The two modes of operation are as follows:

1. Sweep mode—A current-voltage characteristic curve is obtained from which ion temperature, concentration, and composition can be derived. Electrons with energy normal to the trap face being greater than 9 ev will also be recorded during this mode, provided that the flux is greater than $10^7 cm^{-2} sec^{-1}$.

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2. Duct mode—A differential amplifier is used to detect changes in the "saturated" ion current as the satellite moves across field lines. The system is capable of measuring ion concentrations from 10^2 to 1.7×10^6 ions/cm^3.

OPERATIONAL USE

The experiment is useful around the entire orbit of OGO-F.

MEASURED DATA

The instrument will detect fractional concentration gradients of 6×10^{-3}km; i.e., irregularities with a 300-meter scale length can be detected if the maximum fractional concentration change is in the order of 10^{-3}. The minimum detectable scale size decreases inversely with the bandwidth allotment. The physical significance of concentration gradients smaller than those mentioned above is not immediately obvious unless a scale length greater than 10 km is involved. For scale lengths greater than 10 km, a direct rather than a differential measurement of ion current can be used for detection.

REDUCED DATA

Statistical data analyses will be made with regard to the irregularity scale size and the percentage depression or enhancement of the electron concentration. Correlations of these parameters with latitude, local time, and magnetic activity will also be examined.

Little is known about the mechanisms for generating ionospheric irregularities; therefore, significant direct comparison of the data with theory cannot be made.

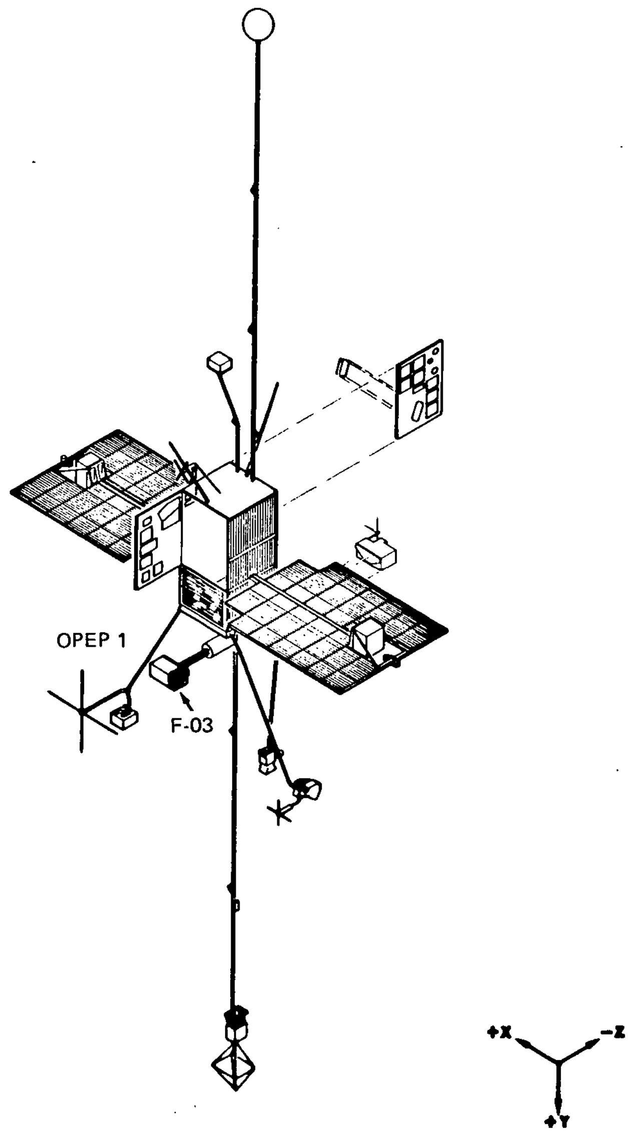

Figure 3. Experiment F-03 Location

EXPERIMENT DESCRIPTION

FOR

Neutral Atmospheric Composition

(Experiment F-04)

INVESTIGATOR

The principal investigator for the Neutral Atmospheric Composition Experiment is C. A. Reber, who is affiliated with GSFC. The co-investigators are G. R. Carignan and D. R. Taeusch, who are affiliated with the University of Michigan, and D. N. Harpold who is affiliated with GSFC.

OBJECTIVES

The primary objective of this experiment is to study the behavior of the concentrations of the major constituents (N_2, O_2, O, He, and H_2) of the earth's neutral atmosphere during varying solar activity and magnetic disturbances, and during diurnal, seasonal, and latitudinal variations. A secondary objective is to obtain accurate measurements of the concentration of trace constituents of the earth's neutral atmosphere.

INSTRUMENTATION

A quadrupole mass spectrometer will be used to obtain the atmospheric composition data. The spectrometer system will consist of a quadrupole analyzer, in which mass separation occurs within a dc and a radio frequency electric field, an enclosed dual-filament electron bombardment ion source, an electron multiplier, supporting electronics for operating the analyzer and source, and a breakoff device for exposing the evacuated mass spectrometer to the atmosphere once in orbit.

OPERATIONAL USE

At the orbital altitudes of OGO-F, the mass spectrometer system can operate safely at all times. Since the upper atmosphere exhibits large variations in structure as a function of altitude, latitude, and local time, it will be necessary to operate over as large a range of these parameters as the operational plan of the satellite will permit. Such maximum usage will also permit coverage of unanticipated solar or magnetic disturbances.

MEASURED DATA

In order to achieve the scientific objectives of this experiment, the analyzer will be operated in three configurations:

1. Configuration A. — This will be the normal operational configuration, the experiment being automatically placed in this mode each time it is turned on. The analyzer will be fixed-tuned sequentially to the masses of principal interest (N_2, O_2, O, He, and H_2) for approximately 1.15 seconds per mass. A complete cycle requiring 368 seconds will consist of 28 stepping sequences (9.2 seconds per sequence) and two sweeping sequences (55.2 seconds per sequence) in which the analyzer will be variably tuned over the mass range of

2 to 1.2, 4 to 2.2, 16 to 9, 28 to 15.5, 32 to 18, and 45 to 25.3 atomic mass units (amu).

2. Configuration B. — The analyzer will be variably tuned over the mass range of 2 to 1.1, 4 to 2.2, 16 to 9, 28 to 15.5, 32 to 18, and 45 to 25.3 amu to verify correct stepping operation and measure trace constituents. A complete cycle requiring 368 seconds will consist of six sweeping sequences (55.2 seconds per sequence) and four stepping sequences (9.2 seconds per sequence).

3. Configuration C. — To provide maximum accuracy and spatial resolution, the analyzer will be fixed-tuned to chosen masses of interest for indefinite periods. This will also be a failure mode of operation in the event of possible malfunction of the logic system.

REDUCED DATA

The quadrupole mass spectrometer system, using the three operational configurations described above, will yield quantitative data reducible to atmospheric neutral particle constituent number densities. From these can be obtained the total density, ρ, mean mass, $\overline{M}$, and scale height temperatures.

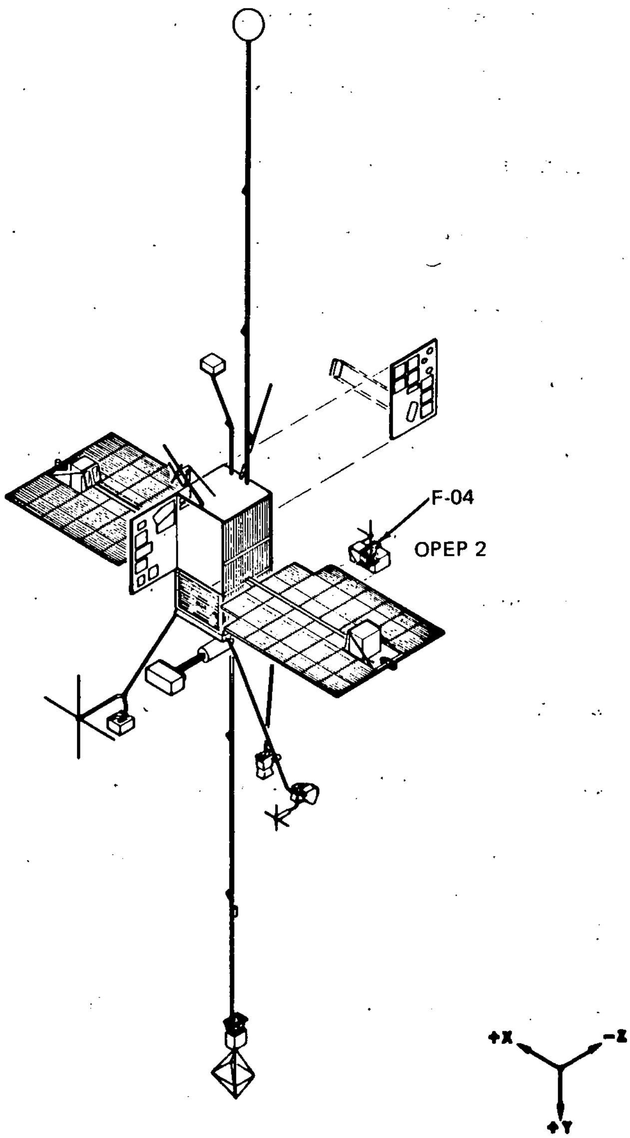

Figure 4. Experiment F-04 Location

EXPERIMENT DESCRIPTION

FOR

Mass Spectrometer for OGO-F

(Experiment F-05)

INVESTIGATOR

The principal investigator for the Mass Spectrometer Experiment is Dr. R. Pickett; the co-investigators are H. A. Taylor and M. Pharo. All investigators are affiliated with GSFC.

OBJECTIVES

The primary objective of this experiment is to study the atmospheric thermal positive ion concentration and mass in the range from 1 to 45 amu. The specific objectives include:

1. Continuing the detailed study of ionic composition as a function of magnetic coordinates (latitude, longitude, time, and McIlwain's L parameter) to investigate the means and degree of magnetic control of the ion distribution
2. Comparing, in magnetic coordinates, low-altitude Polar Orbiting Geophysical Observatory (POGO) data with high-altitude Eccentric Geophysical Observatory (EGO) ion spectrometer results, with special attention given to ionic diffusion along L shells
3. Studying the diurnal, earth-sun relationship effects on the ion composition and concentration in both the chemical and diffusive

equilibrium regions. Of particular interest are the changing scale heights of the dominant ions causing a marked variation in the H+ - O+ transition level.

4. Studying the magnetic polar transition regions with special detail to inner and outer ionospheric coupling and the low-altitude sharp transitions in ionic composition and density. The effects of other geomagnetic anomalies are also investigated.

5. Investigating the influence of magnetic and solar activity on the above effects

6. Conducting the above studies in an OPEP with experiments to measure the other important aeronomic parameters: ion temperature, electron density and temperature, neutral concentration and mass. Thus, a closely controlled experiment becomes possible by which solar energy deposited in the electrons and its conduction to the ions and neutrals can be investigated. This coordinate group of experiments shares a common environment and thus will share common perturbing factors such as aspect and spacecraft charge. It is hoped that there will be strong correlative ability with other OGO-F experiments, including magnetic field experiments, VLF detectors, the Whistler detector, and the other OGO-F ion spectrometer.

INSTRUMENTATION

The instrumentation uses a Bennett RF ion mass spectrometer oriented into the orbit plane. The spectrometer consists of a tube with a series of plane-parallel knitted grids mounted normal to the axis of the tube. Both ac and dc fields accelerate the ions down the length of the tube toward a collector. To reach the collector the ions must pass through a retarding potential. Only those ions satisfying the velocity and phase conditions established by the fields will receive sufficient energy from the fields to pass the retarding potential and impinge on the collector. The sensitivity range of the experiment is from approximately 10^1 to 10^6 ions/cm^3.

OPERATIONAL USE

The intended operational use of the experiment will be extensive enough to attain the above defined objectives. Thus, wide and continued coverage of magnetic coordinates (latitude, longitude, time, L) is desired especially during periods of solar-magnetic disturbances.

MEASURED DATA

From very limited preliminary OGO-C results, it is expected that the primary ions (atomic hydrogen, helium, atomic nitrogen, and atomic oxygen) will be observed over most of the orbit with sharp transitions in the polar regions. The high mass ions (N^+ and O^+) are expected to show an equatorial depression, while the light ions (H^+ and He^+) will show a general enhancement, which can be greatly perturbed by local time effects.

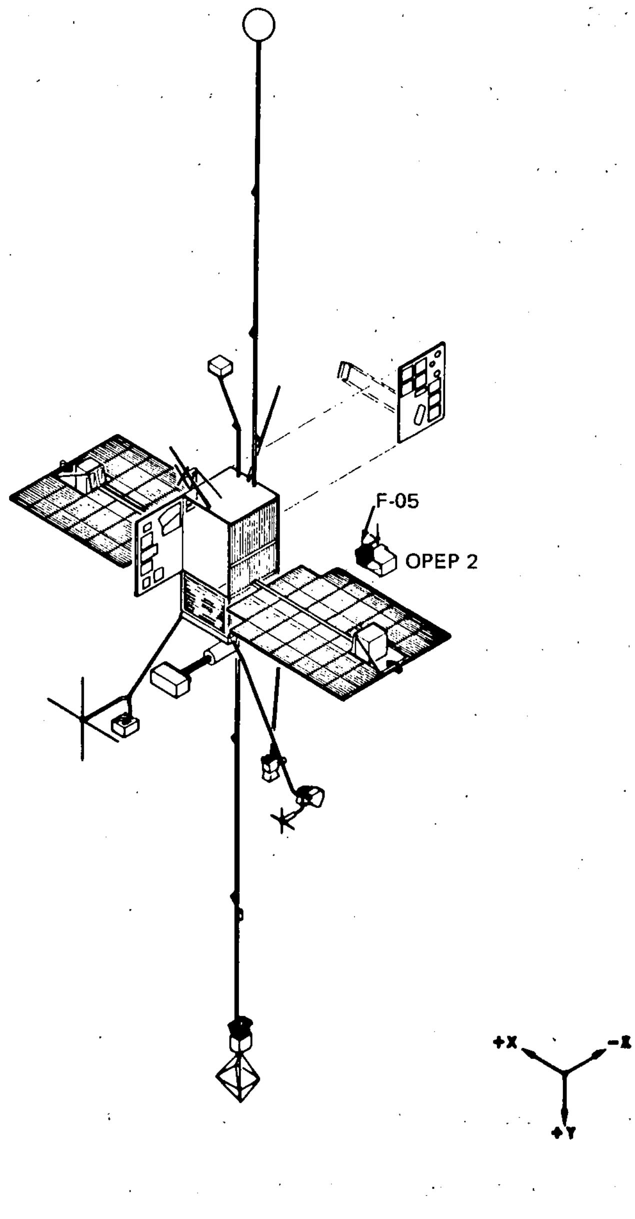

Figure 5. Experiment F-05 Location

EXPERIMENT DESCRIPTION

FOR

Ion Mass Spectrometer for OGO-F

(Experiment F-06)

INVESTIGATOR

The principal investigator for the Ion Mass Spectrometer is Dr. W. B. Hanson; the co-investigator is T. W. Flowerday. Both investigators are affiliated with the Southwest Center for Advanced Studies.

OBJECTIVE

The objective of this experiment is to measure the ambient ion composition along the vehicle path for those positively charged ions in the range from 1 to 40 amu/electronic charge.

INSTRUMENTATION

The instrumentation uses a simple 90-degree sector magnetic-analyzer followed by an electron-multiplier detector and a linear automatic-ranging electrometer. The system is capable of detecting ion concentrations of the order of 10 ions per cm^3. There are three possible modes of operation for the instrument:

1. Sweep mode. — The time duration of the sweep during real time depends on the main-frame data rate (i.e., 21.5 seconds at 64 kbs, 43 seconds at 16 kbs, and 86 seconds at 8 kbs). During storage,

the 86-second sweep will always be chosen.

2. Sampling Mode I. — Eleven previously chosen mass numbers will be sampled in series. They are mass numbers 1, 2, 4, 7, 8, 14, 16, 18, 28, 30, and 32.

3. Sampling Mode II. — This mode is similar to the previous one except that only mass numbers 1, 4, 14, and 16 will be sampled in series.

MEASURED DATA

The measured data will depend on the chosen mode of operation. During real-time readout, only the sweep mode will be used; but, during data storage, any of the three modes may be used. During 8-kbs storage, the time to cover an entire mass range in the sweep mode will be approximately 86 seconds, in Sampling Mode I approximately 13.2 seconds, and in Sampling Mode II approximately 5.5 seconds.

REDUCED DATA

The reduced data will consist of various ion concentrations, and possibly ion concentration ratios, plotted versus appropriate vehicle orbit parameters or other suitable coordinates.

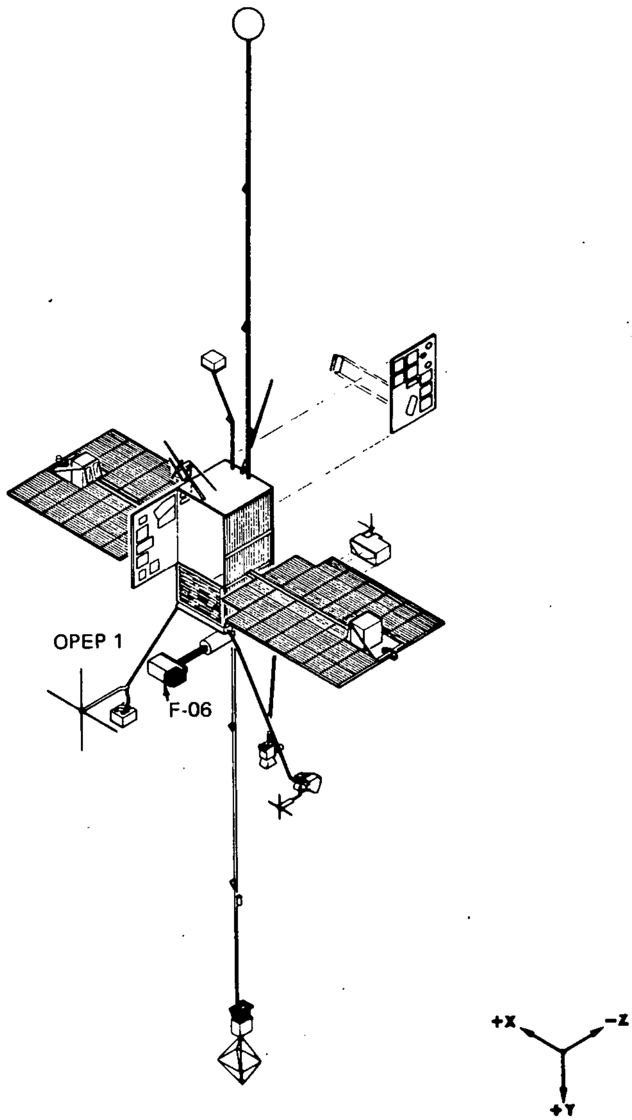

Figure 6. Experiment F-06 Location

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EXPERIMENT DESCRIPTION

FOR

Gas-Surface Energy Transfer Probe for OGO-F

(Experiment F-07)

INVESTIGATOR

The principal investigator for the Gas-Surface Energy Transfer Probe Experiment is Dr. D. McKeown, and the co-investigator is H. R. Poppa. Both investigators are affiliated with Faraday Laboratories.

OBJECTIVES

The experiment measures the kinetic-energy flux of the upper atmosphere relative to the orbiting satellite and what fraction of this energy is transferred at normal incidence to Au and Al surfaces. The primary objective of the experiment is to determine the energy accommodation and drag coefficients for high and low atomic weight metals. A secondary objective is to determine variations in upper atmospheric density occurring diurnally, with latitude and with changes in solar activity by monitoring variations in the kinetic-energy flux of the upper atmosphere.

INSTRUMENTATION

Four energy transfer probes are used to conduct the experiment. Each probe employs a 1.27-cm diameter, 15-MHz, temperature-sensitive quartz crystal to detect energy transfer between 10 $\mu w/cm^2$ and 0.1 w/cm^2. The

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instrumentation for the experiment is 4.5 by 7 by 7.5 in., weighs 4.8 lb, and operates at 28 vdc at 3.5w.

A shutter is positioned in front of the probes to chop the upper atmospheric stream. During the period when the shutter is open, the frequency increase of a probe is proportional to the energy transferred to the crystal sensor. For measurement of the atmospheric kinetic-energy flux, one probe is instrumented with a crystal sensor attached to a wedge-shaped cavity in which atmospheric particles emit energy by multiple collisions. Two probes are instrumented with crystal sensors plated with Au and Al for measurement of energy-accommodation coefficients of surfaces. The fourth probe is a control. The probes are periodically calibrated by dissipating electrical power in each sensor at five different levels between 10 μw and 1.6 Mw.

OPERATIONAL USE

Experimental data will be taken between perigee and approximately 800 km during the day and 600 km during the night. Above these altitudes the atmospheric kinetic-energy flux falls below the 10 $\mu w/cm^2$ threshold of the probe.

The probes are located in the orbital plane experimental package (OPEP) facing forward. During the first month after OGO-F is launched, data should be read out from the probes on each orbit to determine how surface outgassing affects energy transfer. Thereafter, data should be taken about 50 percent of the time so that diurnal variations and changes in solar activity on energy transfer can be observed.

MEASURED DATA

The measured data will consist of four separate output frequencies of the energy transfer probes as a function of time, sensor calibration voltage, shutter position, and the ambient temperature of the probes.

REDUCED DATA

The reduced data will consist of the kinetic-energy flux of the upper atmosphere relative to the orbiting satellite and the amount of energy transfer to Au and Al surfaces. Analysis of this data will yield the energy accommodation and drag coefficients of Au and Al in the upper atmosphere, and variations of the upper atmospheric density with time. By using atmospheric composition measurements from other experimenters, the accommodation and drag coefficients for the surfaces in O and N_2, the absolute value of atmospheric density, and the atmospheric scale height will be determined.

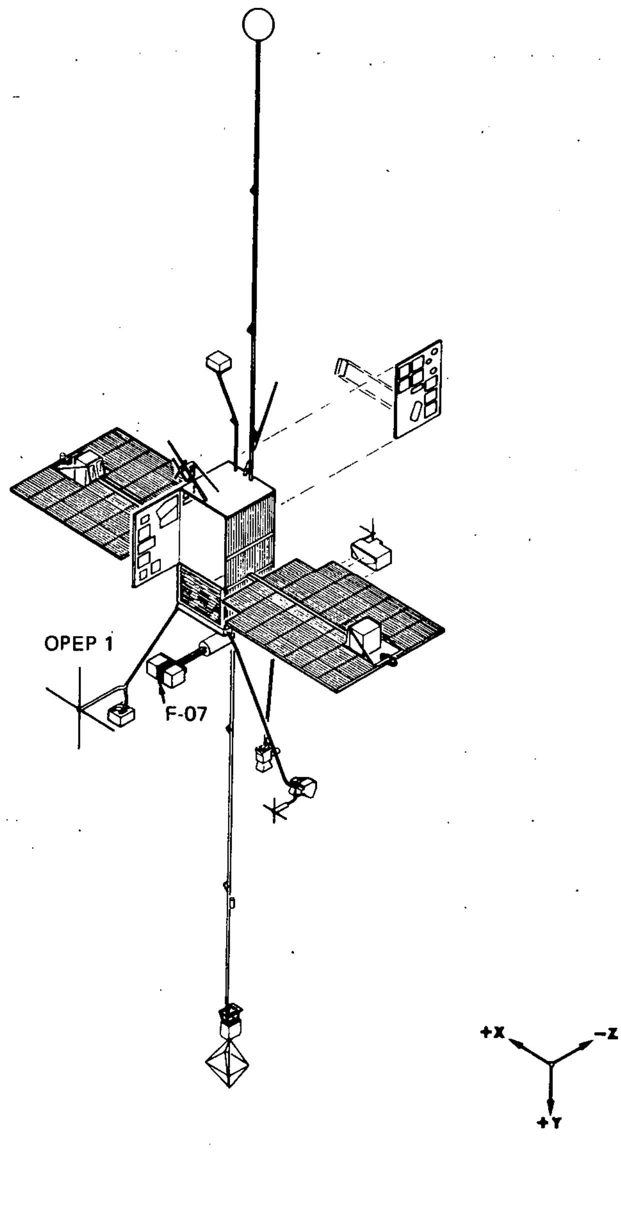

Figure 7. Experiment F-07 Location

EXPERIMENT DESCRIPTION

FOR

Solar X-Ray Emissions for OGO-F

(Experiment F-08)

INVESTIGATOR

The principal investigator for the Solar X-Ray Emissions Experiment is R. W. Kreplin, and the co-investigators are Dr. T. A. Chubb and Dr. H. Friedman. All investigators are affiliated with the U. S. Naval Research Laboratory.

OBJECTIVE

The objective of this experiment is the understanding of the solar flare phenomena through the measurement of their X-ray emissions in the 2- to 150-kev range. The instrumentation is capable of differentiating between thermal and nonthermal processes in the flare mechanism; and, it will obtain X-ray emission history to aid in explaining flare-associated sudden ionospheric disturbance phenomena that affect the D region.

INSTRUMENTATION

The instrument consists of a phoswich photomultiplier detector for the energy range 20 to 150 kev and a proportional counter for the range 2 to 20 kev. These detectors operate into a stacked discriminator pulse-height analyzer which feeds a set of binary accumulators. A digital compression system is employed which generates a 9-bit word. To compensate for drift in the proportional counter detector or power supply, an automatic gain control circuit is employed which uses the 6-kev X-ray from an Fe^{55} source as a reference signal.

With this instrument, solar X-ray flare spectra of moderate resolution can be made in a period of 10 to 20 seconds.

OPERATIONAL USE

Data will be collected continuously when the satellite is in the sunlight. Operation of this experiment at night is unnecessary.

MEASURED DATA

During periods of sunlight the scintillation crystal counter and proportional counter spectrometer will observe energetic solar X-ray emission (0.15 to 6.2Å) and will measure solar X-ray emissions in the 0.6- to 6.0Å region.

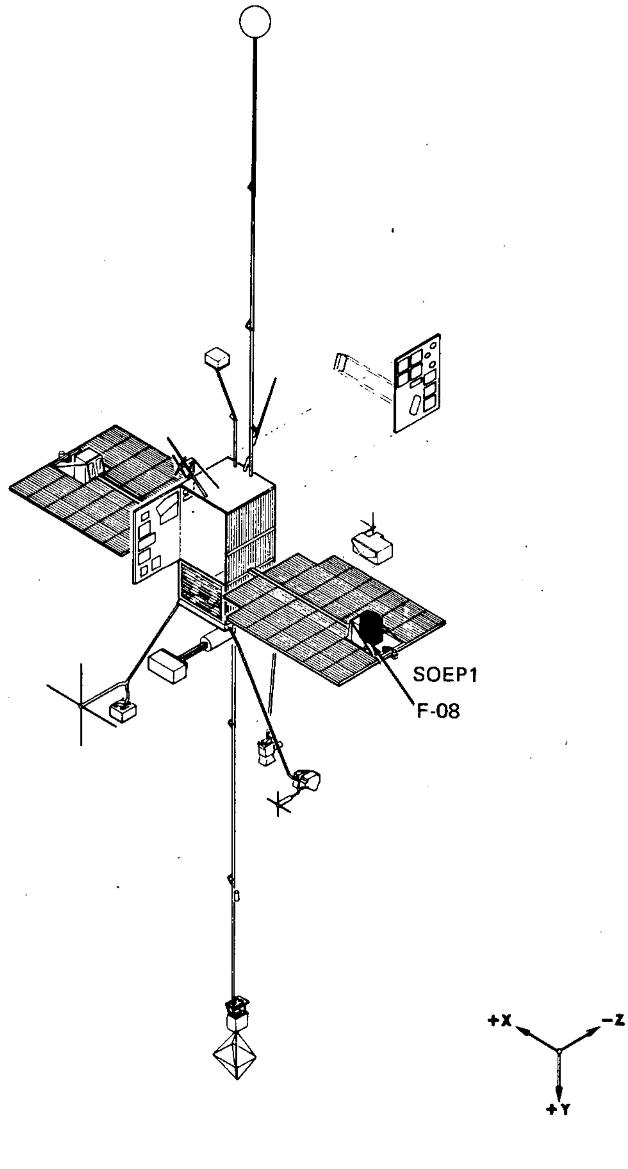

Figure 8. Experiment F-08 Location

EXPERIMENT DESCRIPTION

FOR

Solar Extreme Ultraviolet Emissions for OGO-F

(Experiment F-09)

INVESTIGATOR

The principal investigator for the Solar Extreme Ultraviolet Emissions Experiment is Dr. D. E. Bedo; the co-investigator is Dr. H. E. Hinteregger. Both investigators are affiliated with the Air Force Cambridge Research Laboratory (AFCRL).

OBJECTIVE

The objective of this experiment is to monitor radiation intensities in the ultraviolet portion (160 Å to 1600 Å) of the solar spectrum.

INSTRUMENTATION

The instrumentation uses six collimator-plane grating spectrometers to scan the wavelength range from 160 to 1600 angstroms with an effective overall resolving power of about 100. The spectrometers cover independent but overlapping spectral ranges to give complete redundancy except at the spectral extremes. The wavelength scan is accomplished in 512 steps with each spectrometer output sampled at every step. In addition to the 512-step scan that covers the entire spectral range, the experiment can be commanded to any of 16 short scans of 64 steps each. This will provide improved time resolution for restricted spectral ranges. The scan period is 9 minutes for the long scan. The sample time per step can also be increased by a factor of 4 by ground command to provide better intensity information in the weaker portions of the spectrum. An aspect system will measure the departure of the experiment axis from the mean solar vector with an angular resolution of 1/16 degree about two axes (array and yaw). Aspect information will be available on an alternate frame-main commutator basis.

OPERATIONAL USE

Data will be collected continuously when the satellite is in the sunlight. Operation of this experiment at night is not required.

MEASURED DATA

Raw data from the experiment will consist of totalized counts detected in a sample period (283.5 or 1147.5 msec) at a given step position (wavelength) with a particular spacecraft attitude relative to the sun (aspect system) for each of the six spectrometers. Laboratory calibration with ultraviolet radiation will permit a conversion from total count (or rate) to number of photons per cm^2-sec with a calibration accuracy of 10 to 30 percent depending upon wavelength. Since the spectral sub-ranges overlap for the six spectrometers, many strong solar lines are observed on from two to five spectrometer channels allowing checks for internal consistency which may help understand long-term drifts in spectrometer efficiency. If the experiment attitude relative to the mean solar vector should be stable (i.e., array corrections not occurring with high frequency), it will be possible to observe atmospheric absorption effects near satellite dawn and dusk.

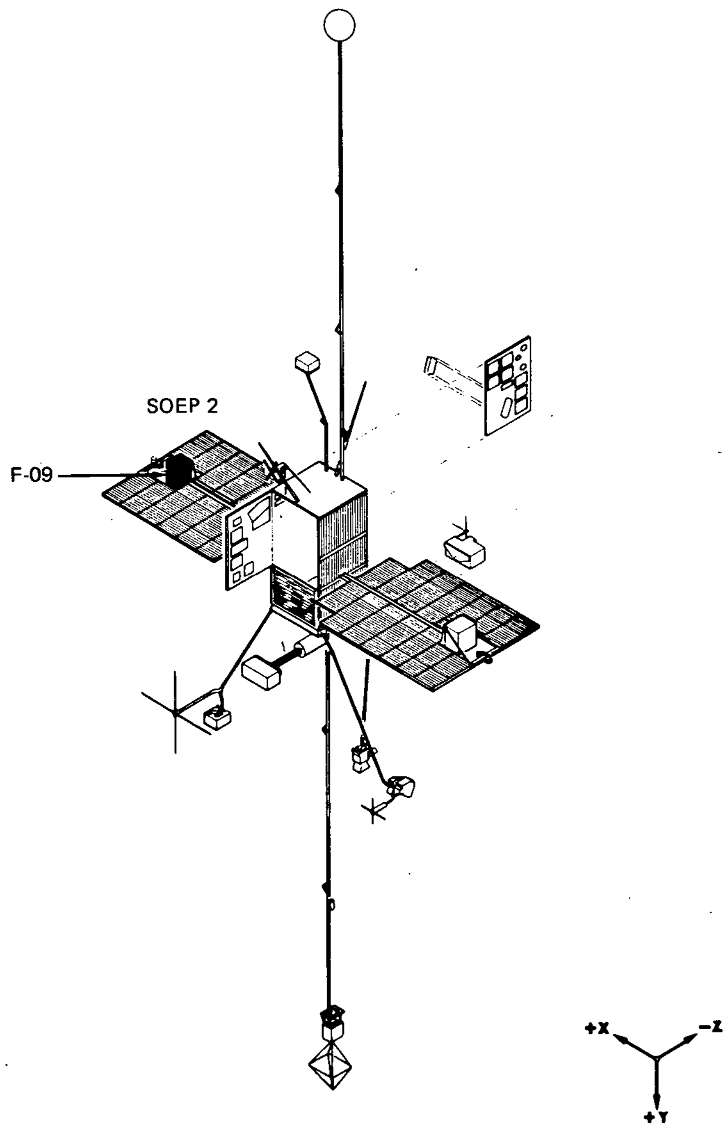

Figure 9. Experiment F-09 Location

EXPERIMENT DESCRIPTION

FOR

Solar Ultraviolet Energy Survey for OGO-F

(Experiment F-10)

INVESTIGATOR

The principal investigator for the Solar Ultraviolet Energy Survey Experiment is Dr. V. H. Regener, who is affiliated with the University of New Mexico.

OBJECTIVE

The primary objective of this experiment is to monitor continuously the intensity of solar radiation in the ultraviolet region of the spectrum over the wavelength range from 1850 to 3500 angstroms. Solar radiation at these wavelengths is largely responsible for the dissociation of oxygen in the upper atmosphere, for the existence and the vertical distribution of atmospheric ozone, and for the temperature distribution in the upper atmosphere.

INSTRUMENTATION

The instrumentation consists of a quartz prism spectrograph that is programmed to scan the ultraviolet spectrum in six ranges, most of them approximately 300 angstroms wide. In addition, there will be two ranges in the visible spectrum, one affected by ozone absorption in the yellow-orange region, the other in the range from 3500 to 5000 angstroms where ozone does not absorb. The simultaneous monitoring of the visible radiation is intended to serve as a check on the equipment. One of the visible ranges may permit a determination of the vertical distribution of ozone from its absorption in the yellow-orange part of the spectrum. Some of the ultraviolet ranges are similarly suited to a determination of the vertical ozone distribution during sunset. Knowledge of the vertical distribution of molecular oxygen in the high atmosphere may also be gained from observations in the shortest wavelength region.

To aid in obtaining a quantitative response of the instrument, in-flight calibration with at least two artificial light sources will be provided at regular intervals.

OPERATIONAL USE

It is intended that the instrument be in continuous operation from the time the sun is acquired until sunset. Principally, the data readout will be accomplished via subcommutator words, to ensure continuity of the record, and at a slow rate suited to the design of the experiment.

MEASURED DATA

Data will be tabulated as a function of time in each of the eight spectral intervals listed in Table 1. Special attention will be paid to the degree of constancy of the solar output, especially during periods of variable solar activity.

Table 1

Wavelengths of Spectral Regions to be Monitored*

Region Number	Wavelength Range (angstroms)
1	1850 to 2000
2	2000 to 2300
3	2300 to 2600
4	2600 to 2900
5	2900 to 3200
6	3200 to 3500
7	3500 to 5000
8	5000 to 6000

*Tentative

REDUCED DATA

Data will be presented in raw form (uncalibrated) and calibrated (through the use of in-flight calibration data) to compensate for possible changes in performance of the instrument.

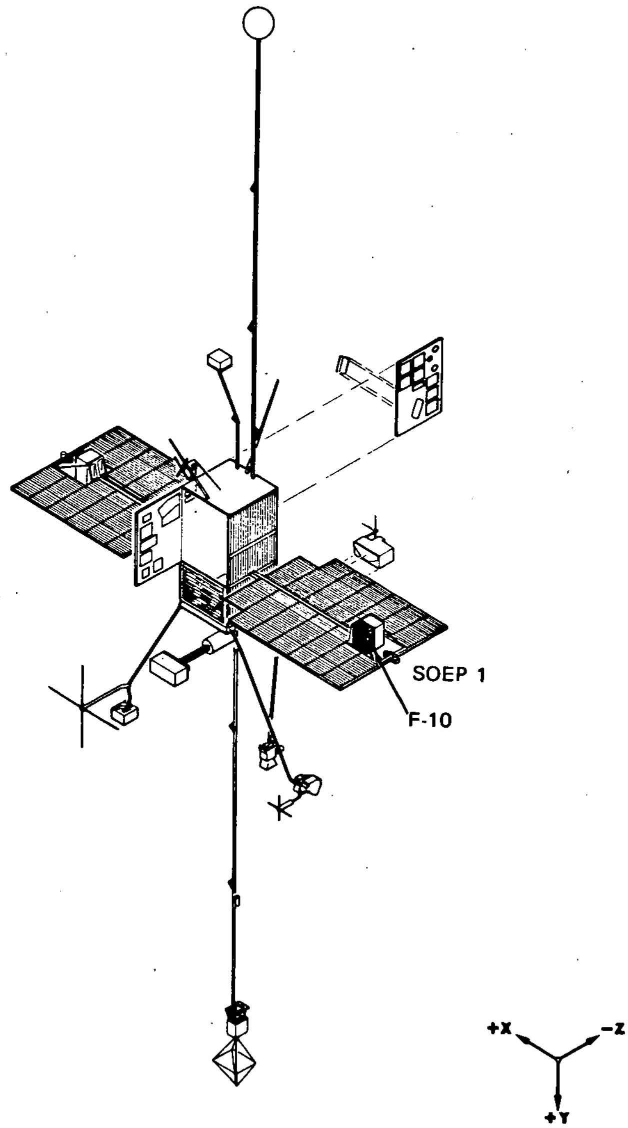

Figure 10. Experiment F-10 Location

EXPERIMENT DESCRIPTION

FOR

Airglow and Auroral Emissions for OGO-F

(Experiment F-11)

INVESTIGATOR

The principal investigator for the Airglow and Auroral Emissions Experiment is Professor J. E. Blamont, who is affiliated with the University of Paris.

OBJECTIVE

During airglow and auroral phenomena, this experiment will study the emitting regions at 6300 angstroms (red line of atomic oxygen) and 3914 angstroms (0-0 band of the first negative system of nitrogen, N_2^+). The general airglow study will consist of the following areas:

1. Altitude distribution of the emitting layer of the red line of atomic oxygen (OI) with consideration of Schuman Runge dissociation of O_2 by solar ultraviolet radiations, dissociative recombination of ions with electrons in the ionosphere, and direct excitation of O by thermal electrons

2. Altitude distribution of the emitting layer of the 3914-angstrom band of the ionized molecular nitrogen with consideration of optical

resonance of the solar 3914-angstrom radiation by N_2^+ ions and, simultaneous ionization and excitation of N_2 by solar X-ray ultraviolet radiations

In the event of an aurora with different excitation mechanisms, the general airglow study will consist of the following areas:

(1) Spatial distribution of the emitting regions of the red line, where the principal excitation process is the energetic particles bombardment; other possible excitation mechanisms are dissociative recombination with energetic electrons (≥ 10 kev) and fast protons collisions.

(2) Spatial distribution of the emitting regions of the 3914-angstrom band with energetic particles bombardment of the molecular nitrogen, and optical resonance of the solar 3914-angstroms radiation by N_2^+ ions (sunlit aurora at high altitudes) as the likely excitation mechanisms.

INSTRUMENTATION

The photometer that measures the altitude distribution of these emissions is similar to that used on the 5012 OPEP experiment in OGO-C and OGO-D satellites. The 3914-angstrom region of the spectrum is observed by using a second interference filter in front of the photometer.

The photometer is mounted on the end of a boom; and the incident light arrives on a stepping mirror. The overall optical look angle is from the XY plane to 30 degrees in the +Z direction, scanned in 60 0.5-degree increments. For each increment the look angle is 6 degrees parallel to the XY plane and 0.5 degree perpendicular to the XY plane. A scan cycle from and back to the XY plane is completed with one filter; another cycle is then completed with the second filter. A complete cycle period is approximatively 34 seconds for each interference filter.

OPERATIONAL USE

Except for experimental limitations, there will be no restriction on operational use for latitudes or solar and geomagnetic conditions. A 300 to 1000 km altitude range for the photometer will be satisfactory.

MEASURED DATA

Generally, only emitting regions above 100 km will be considered because of the unknown contribution of the earth's albedo light and the scattered skylight below this altitude. However, it will be possible to observe the red emitting layer of the night glow (OH and continuum) at 85 km, and the emitting layer of 3914 angstroms during nocturnal aurora around 110 km.

For the 6300-angstrom red line, the correlations that will be of particular interest are: (1) night evolution of the airglow intensity in connection with F-layer displacement, (2) relation between the enhancement of this intensity at dawn and the change of the electron temperature at 200 and 300 km, (c) comparison of airglow intensity variation with the Schuman Runge region of the solar spectrum. For the 3914-angstrom band the correlations of particular interest are: (1) altitude distribution of N_2^+ concentration if the resonance scattering is the main dayglow process, (2) importance of the trapped electrons in the fluctuations of the twilight glow enhancement observed at 3914 angstroms, and (3) correlative study of the twilight glow and sunlit aurora with solar ultraviolet spectrum and N_2 concentration in the F region for the 3914-angstrom band.

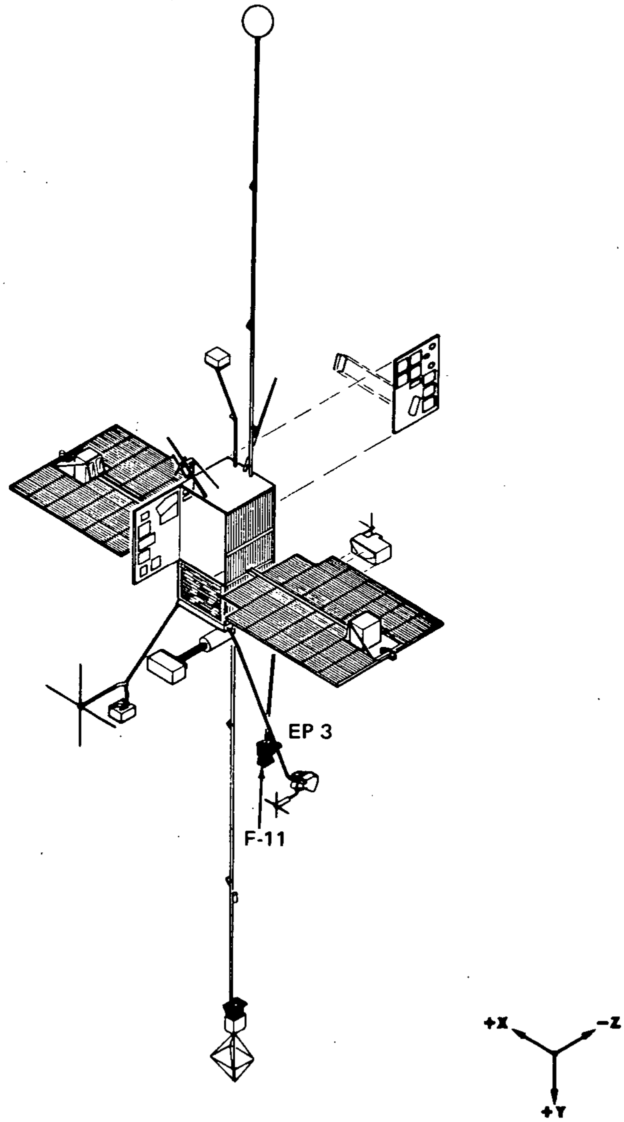

Figure 11. Experiment F-11 Location

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EXPERIMENT DESCRIPTION

FOR

Celestial Lyman-Alpha Measurement for OGO-F

(Experiment F-12)

INVESTIGATOR

The principal investigator for the Celestial Lyman-Alpha Measurement Experiment is Dr. M A. Clark, who is affiliated with the Aerospace Corporation. The co-investigators are G. Munch and Dr. D. D. Elliott, who are affiliated with the Aerospace Corporation, and P. H. Metzger, who is affiliated with Packard Bell.

OBJECTIVE

The objective of this experiment is to measure the zenith angle distribution of Lyman-alpha radiation on a global basis. The primary source of the radiation is the sun, and the distribution occurs by resonant scattering from the neutral hydrogen geocorona. From such measurements it should be possible to deduce the density variation and extent of the hydrogen atmosphere. Measurements of the distribution of radiation within 0.1 angstrom of resonance should give information regarding the hydrogen temperature. It may be possible to make some observation of Lyman-alpha from interplanetary neutral hydrogen.

INSTRUMENTATION

The instrumentation used is a 3-angstrom bandwidth photometer at 1216 angstroms with 5-degree field of view, which employs a rotating 45-degree mirror to make a circular scan of the sky once each 40 seconds. Its location on the -Z door allows observation of only the upper half circle, and the plane of the circular scan, rotated about the Z axis at 20 degrees to the Y direction, allows most of the sky to be observed once each orbit. The instrument contains an atomic hydrogen absorption cell for analysis of the radiation distribution very close to resonance. Three different absorption profiles are employed. There is also an SrF_2 filter periodically inserted into the optical path for measurement of interfering signals (scattered near-visible light and particle radiation effects on the photomultiplier detector). In-flight calibration uses a Lyman-alpha source whose strength is monitored by the photoemission of a titanium surface. The major data are pulse counts caused by individual 1216-angstrom photons. The counts are accumulated and delivered to the telemetry from a shift register in the usual manner.

OPERATIONAL USE

The entire duration of the OGO-F mission is of interest, since the hydrogen atmosphere is very sensitive to the atmospheric temperature and hence to solar cycle effects. Some considerable change in a year might be expected if variation in solar activity is marked. Understanding the hydrogen distribution requires data around complete orbits because of varying solar angle and altitude motion from perigee through apogee. The atmospheric response to rapid solar changes is not likely to be sufficient to show changes in the intensities; therefore, few unusual operations associated with solar flares, etc., are needed except for exploratory observations at times of extreme solar eruption (e.g., class 4 or greater flares).

MEASURED DATA

The measured data will consist of zenith angle intensity distributions for the four conditions of hydrogen filter (0 and 3 absorption profiles) measured as a function of position around the orbit, for both full sunlight and "eclipsed" conditions.

REDUCED DATA

Reduced and analyzed data are expected to include the hydrogen content above satellite altitude, temperature information, and correlation with solar activity on a slow time scale.

Correlation of the results with those of several other OGO-F experiments are of interest. Among the OGO-F experiments with which this experiment should be correlated are F-01, F-02, F-04, F-05, F-06, F-07, F-08, F-09, F-11, F-13, F-14, F-15, F-16, F-17, F-22, and F-26.

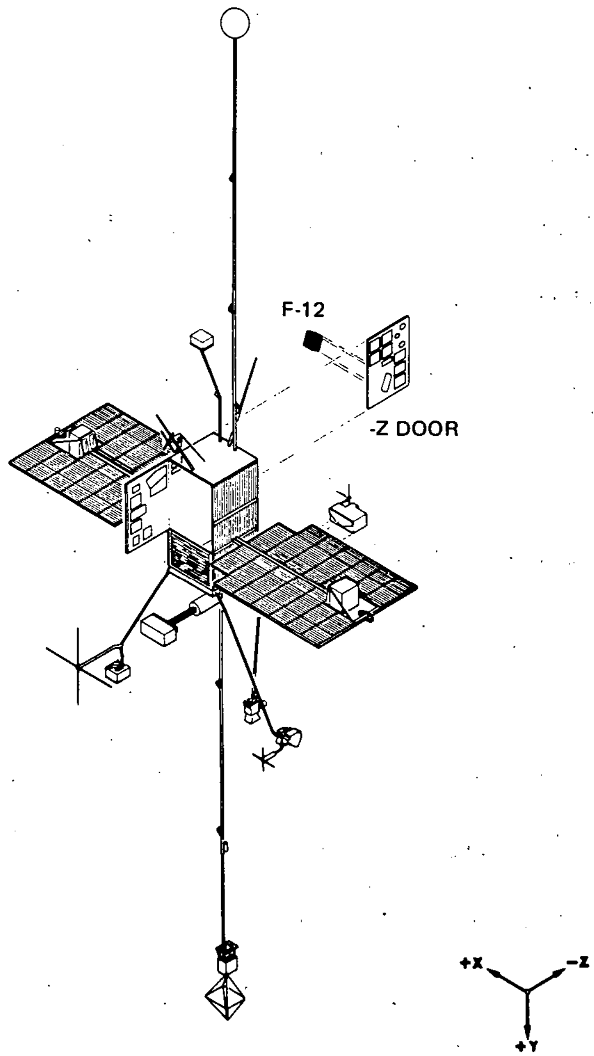

Figure 12. Experiment F-12 Location

EXPERIMENT DESCRIPTION

FOR

Ultraviolet Photometer for OGO-F

(Experiment F-13)

INVESTIGATOR

The principal investigator for the Ultraviolet Photometer Experiment is Dr. C. A. Barth who is affiliated with the University of Colorado. The co-investigators are Dr. J. B. Pearce and Dr. G. E. Thomas, who are affiliated with the University of Colorado, and E. F. Mackey, who is affiliated with Packard Bell.

OBJECTIVES

The objectives of this experiment are (1) to measure the intensities of hydrogen (1216A) and oxygen (1304A) in airglow, (2) to measure the densities of atomic hydrogen and atomic oxygen above orbit, (3) to measure the intensity of the ultraviolet electron-excited and ultraviolet proton-excited aurora, and (4) to measure the spatial distribution (in local time and latitude) and the temporal changes (with solar and geophysical activity) of objectives (1) through (3).

INSTRUMENTATION

The instrumentation consists of photomultipliers with photocathodes and windows to detect 1216A and 1304A.

OPERATIONAL USE

To measure the spatial distribution successfully, the instrument must be operational for more than 50 percent of the duty cycle. To measure the temporal changes, the instrument must be operational during solar events. This experiment must be closely correlated with OGO-F experiments F-01, F-02, F-05, F-06, F-07, F-08, F-09, F-10, F-11, F-12, F-14 (optical), F-15,and F-26, and F-04 (atom density).

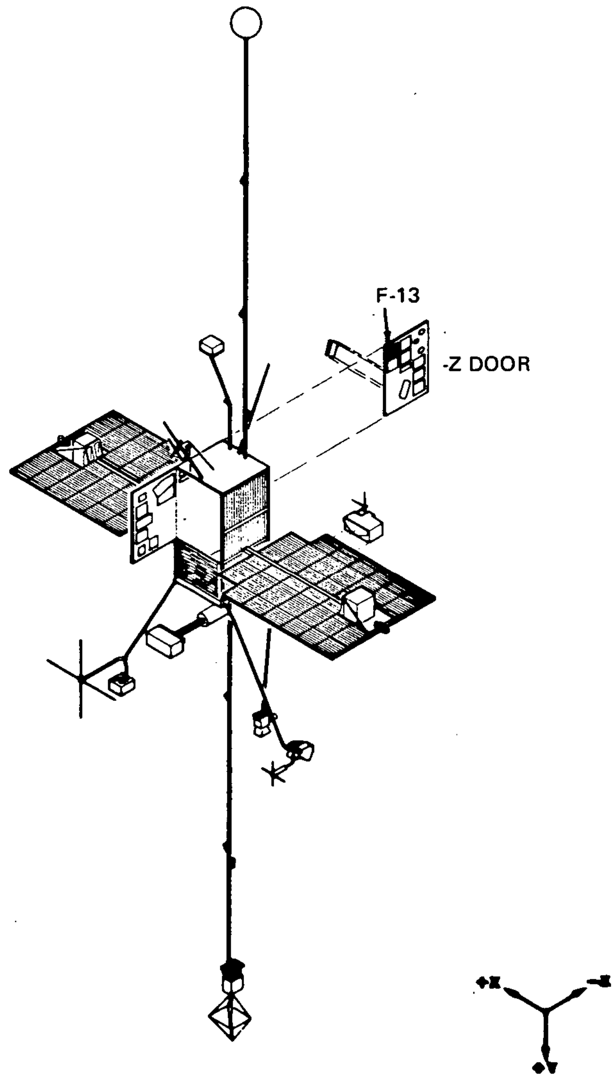

Figure 13. Experiment F-13 Location

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EXPERIMENT DESCRIPTION

FOR

Measurement of the Shape Line of the 6300-Angstrom Airglow Emission

(Experiment F-14)

INVESTIGATOR

The principal investigator for the Atomic Oxygen Measurement Experiment is Professor J. E. Blamont, who is affiliated with the University of Paris.

OBJECTIVES

The objectives of this experiment are (1) to study the shape and width of the oxygen red line at 6300 angstroms emitted in the airglow and (2) to study the evolution of the Doppler temperature obtained from this line width.

INSTRUMENTATION

The sensor unit consists of an optical system, an interference filter at 6300 angstroms, a spherical Fabry-Perot spectrometer, and a photomultiplier. The photomultiplier output is used to drive the electronics system, which contains a pulse amplifier, a counter, and a shift register.

OPERATIONAL USE

This experiment will study airglow emission continuously at all latitudes.

MEASURED DATA

The spectrometer field of view is 8 degrees and spectral range is 70 milliangstroms. The optical system reduces the field of view to 2 degrees, while the interference filter acts as a monochromator with a half width of 10 angstroms.

The altitude of the emission region to be scanned is approximately 250 km. Scanning will be performed by a moving plane mirror, whose angular position will be directed by the horizon sensor error signals as spacecraft altitude varies. For each mirror position there will be five spectral scannings of the interferometer. The period of each scanning is approximately 2 seconds. In one scanning, there are about 2 orders of the interferometer.

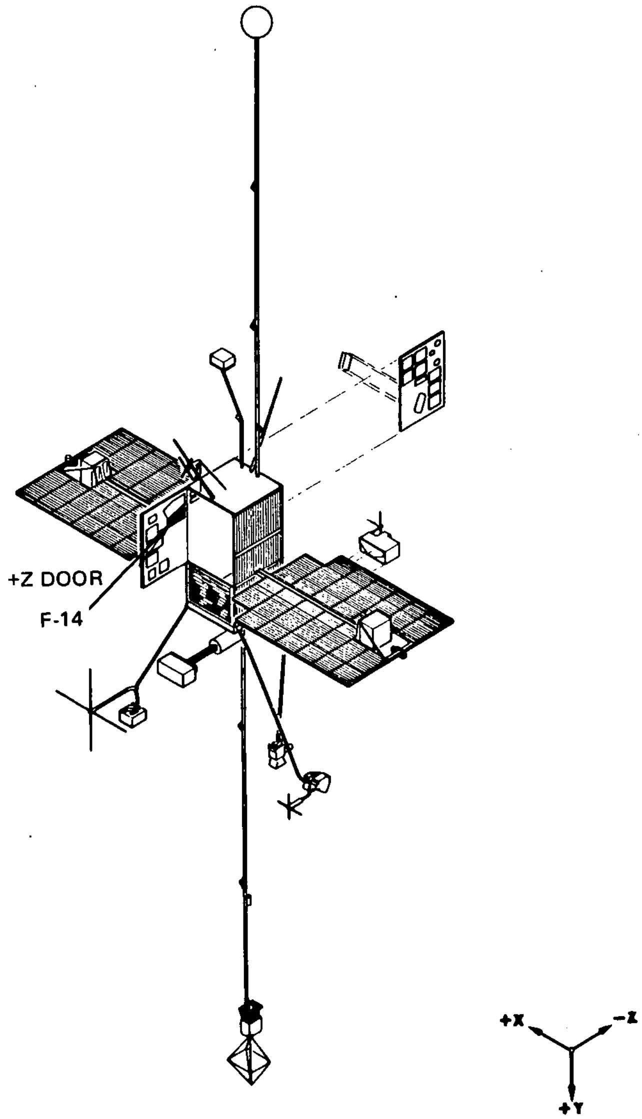

Figure 14. Experiment F-14 Location

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EXPERIMENT DESCRIPTION

FOR

Auroral Particle Measurement for OGO-F

(Experiment F-15)

INVESTIGATOR

The principal investigator for the Auroral Particle Measurement Experiment is Dr. D. S. Evans; the co-investigator is D. E. Stilwell. Both investigators are affiliated with Goddard Space Flight Center.

OBJECTIVE

The objective of this experiment is to measure, with high energy resolution, the spectrum of auroral particles over the energy range 0.7 to ~20 kev and to investigate, with high time and spatial resolution, the variations in the down flux of these particles. Exposure of systematic behavior in these parameters, either in themselves or against such factors as local time or latitude, should shed light of the processes that energize and precipitate these particles.

INSTRUMENTATION

The particle detector units employed in this experiment are channel electron multipliers that are used to detect the charged particles passed by a cylindrical curved-plate electrostatic energy and species analyzer. The energy window of the detector unit is approximately 35 percent of the center energy E_0, which is set by the voltage applied to the analyzer plates.

Eight identical detector units are included in the experiment—one background unit and seven units that are exposed to the low-energy charged particles. The entire array is oriented to view in the -Z direction to measure particles precipitating at high latitude. No pitch angle distributions are obtained. Each detector's field of view is approximately $3° \times 11°$ and the geometric factor is 6×10^{-5} cm^2 ster.

Five of the seven active detectors measure charged particles (either electrons or protons, as selected by ground command) in fixed-energy bands about 1.25, 2.3, 4.1, 7.4, and 13 kev. The plate voltage on two other detectors is swept rather slowly (1.2 seconds) to obtain a high-resolution scan over the energy spectrum 1.2 to 20 kev, for electrons only. The eighth detector is a background monitor for penetrating particles.

The count rates of each of these seven detectors are read out at 60 times/second, the data being stored on an experiment tape recorder. In this manner, a crude 5-point energy spectra is produced every 1/60 sec or ≈100m of spacecraft travel. The high-resolution energy spectra involve 80 points and requires 10 km of spacecraft travel. The validity of the high-resolution spectra will be based upon the time/spatial fluctuations observed on the fixed-energy detectors during the same interval.

The tape recorder has a 600-second record capacity (36 degrees latitude of spacecraft travel) and is dumped on ground command over the special purpose telemetry system. Other modes of data recovery are described below.

OPERATIONAL USE

This experiment is primarily intended to gather data in and near the auroral zone although other regions are accessible; therefore, the experiment is useful around the entire orbit of OGO-F.

MEASURED DATA

The primary mode of operation when data are measured will be the tape record tape dump cycle. In this mode, the OGO orbital period, as clocked by an internal experiment clock, is generated by ground command sequencing and stored in a core register. An additional ground command will initiate a 600-second record cycle at a given geographical position in the orbit. One orbital period later, a record cycle will again be initiated—this time internally. An alternative mode of operation allows two 5-minute record cycles, separated by half of an orbital period, to be taken. In either case, a tape dump over the special-purpose transmitter is done by ground command, usually over a low-latitude station.

Provisions are also made to bypass, on ground command, the tape recorder and transmit data directly from the experiment data system over the special-purpose telemetry. The frequency with which this is done will depend upon the spacecraft power available and the time sharing arrangements with other special-purpose users.

Experiment data are also transmitted at a very low rate (a full eight-detector sample once each eight OGO main frames) over the OGO data system. The data will be intermittent since the high voltage to the detectors is normally on only when data are being taken at the 60 samples/second rate.

REDUCED DATA

The final reduced data will be made available to other experimenters in the form of 1-second average count rate versus time plots for the fixed-energy band detectors and particle intensity versus energy plots for the swept energy detectors.

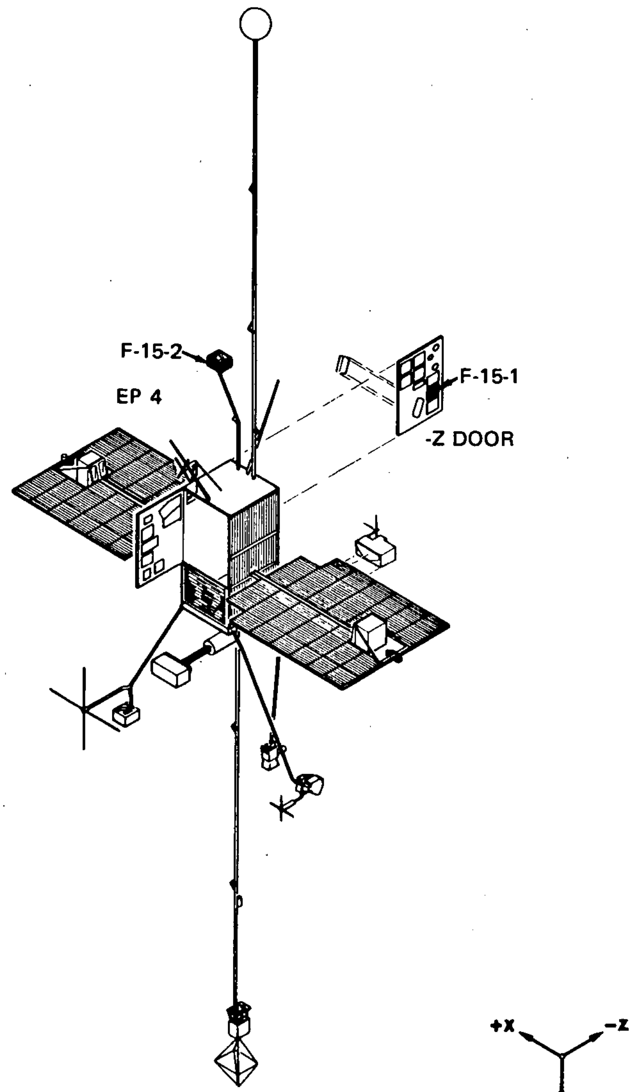

Figure 15. Experiment F-15 Location

EXPERIMENT DESCRIPTION

FOR

Trapped and Precipitating Electrons for OGO-F

(Experiment F-16)

INVESTIGATOR

The principal investigator for the Trapped and Precipitating Electrons Experiment is Dr. T. A. Farley; the co-investigator is M. C. Chapman. Both investigators are affiliated with U. C. L. A.

OBJECTIVES

The objectives of this experiment are (1) to discover the mechanism by which electrons are precipitated into the atmosphere at L values of 2 and greater; (2) to understand the relationship between particle precipitation and particle trapping in the outer radiation zone; (3) to relate the phenomenon of particle precipitation to the structure of the magnetosphere, particularily with the neutral point on the day side and the extended tail on the night side; and (4) to correlate particle precipitation with other time-varying phenomena, such as local magnetic and electric field variations, large-scale geomagnetic disturbances, and auroral displays.

INSTRUMENTATION

The experiment will use six unidirectional electron detectors and one omnidirectional electron detector. All of these detectors employ plastic scintillators cemented to miniature RCA photomultiplier tubes. The tube that will be employed is the RCA C70102-E, a ruggedized, nonmagnetic version of the RCA 7767. All detectors will be designed to measure electron intensities in eight energy channels in the range from 45 to 1200 kev.

The omnidirectional detector will be designed to accept electrons over an entire hemisphere while maintaining collimation, so that the electron energy distribution may be determined from pulse-height analysis. Symmetry of the pitch-angle distribution will ensure that this detector measures the omnidirectional intensity and spectrum regardless of its orientation with respect to the geomagnetic field, except when precipitation events occur. Precipitation introduces asymmetry, and assistance from the unidirectional detectors will be required to determine the omnidirectional intensity at such times. This detector will be designed for a maximum omnidirectional intensity of 6×10^7 electrons/cm^2/sec and will have an omnidirectional geometrical factor of 1.7×10^{-3} cm^2. The flux range will be extended to 10^9 electrons/cm^2/sec by means of an anode current measuring circuit, but energy analysis will be impossible in this extended range.

Five of the unidirectional detectors will be arranged to measure the pitch-angle distribution of the electrons. Since the OGO-F vehicle is not oriented with respect to the magnetic field, an arrangement of detectors is necessary which will ensure that precipitated electrons will be detected regardless of the orientation of the experiment.

In an experiment-fixed spherical polar coordinate system with polar angle θ and azimuthal angle ϕ, the five detectors, will be directed as follows:

1. $\phi = 0°$ $\theta = 0°$
2. $\phi = 0°$ $\theta = 40°$
3. $\phi = 0°$ $\theta = 120°$
4. $\phi = 0°$ $\theta = 180°$
5. $\phi = 70°$ $\theta = 90°$

Since the detectors view a cone of half-angle 6.4 degrees, this directional distribution ensures an excellent sampling of the pitch-angle distribution with no overlap in the most favorable orientations, and at least one detector viewing the loss cone in all possible orientations. The unidirectional detectors will have a unidirectional geometrical factor of 5×10^{-3} cm^{2}-ster, so that the maximum count rate of 10^5 per second will correspond to a unidirectional intensity of 2×10^7 electrons/cm^2-sec ster. The scientific objectives of this experiment will best be met with a choice of geometrical factors that will allow reasonably good counting statistics for the most common events, even if the ability to handle extreme peak intensities must be sacrificed.

The fourth detector is directed anti-parallel to the first detector so that a detailed comparison may be made between particles accelerated downward and those accelerated or reflected upward. This comparison will be particularly valuable because the time resolution of this experiment will be less than the bounce period of the electrons, and particle bunching may be observed if it occurs.

The sixth unidirectional detector will be directed parallel to the third detector and will serve as a background detector. It will be identical to the other five unidirectional detectors except that the aperture will be completely blocked with a nylon plug. The count rate of this detector will be due to bremsstrahlung and high-energy penetrating protons. A low ratio of detector 6 to detector 3 count rate will be an indication of proper shielding of the detectors.

A number of experiments having low-energy proton thresholds near that of this experiment (600 to 800 kev) have shown that proton contamination does not ordinarily occur at these altitudes for L greater than 2. In order to verify this assumption, detector 2 will be fitted with a .002-inch aluminum foil to increase substantially its proton threshold. The electron threshold will also be increased modestly by this foil, sacrificing some of its electron detection ability. The absence of low-energy proton contamination (coming in through the aperture) will be determined by deciding whether the response of detector 2 is consistent with an electron spectrum as measured by the other detectors.

Am^{241} sources will be included for in-flight calibrations of all detectors. Each detector, except the background monitor, has its own preamplifier, eight-channel differential pulse-height analyzer, and a single 14-bit binary storage register. The background monitor shares the pulse-height analyzer and storage register of detector number 3. The background monitor will be connected 10 percent of the time, and detector 3 will be connected 90 percent of the time.

Each storage register contains an 8-bit digital-to-analog converter whose output is presented to the telemetry system. All six of these analog words must be read out once in each telemetry frame. Since the instrument is not allowed to store counts while the six words are being read out, the six words must be closely spaced in the format—not necessarily consecutive but spread out over not more than 12 words.

The instrument will normally operate in a sequence in which 64 consecutive readouts are of the total count (no energy analysis) from each detector and the next 64 readouts are the outputs of the eight-channel analyzer, with each energy level being sampled for eight frames. A separate calibration mode is available for the longer counting periods on each energy channel required for the in-flight calibration.

OPERATIONAL USE

It is intended that this experiment be operated as continuously as possible, consistent with spacecraft operations and the requirements of other experimenters. Geomagnetic storm periods are likely to prove especially interesting.

MEASURED AND REDUCED DATA

Plots of the received data versus time, using high-speed cathode ray tube devices, will be constructed. The plots will show the outputs of all detectors as well as magnetic coordinates. Data points will be averaged over appropriate time intervals so that an entire orbit will appear on one sheet of paper. These plots will be examined for interesting events; these events will be examined in detail by constructing plots of short time intervals without data averaging.

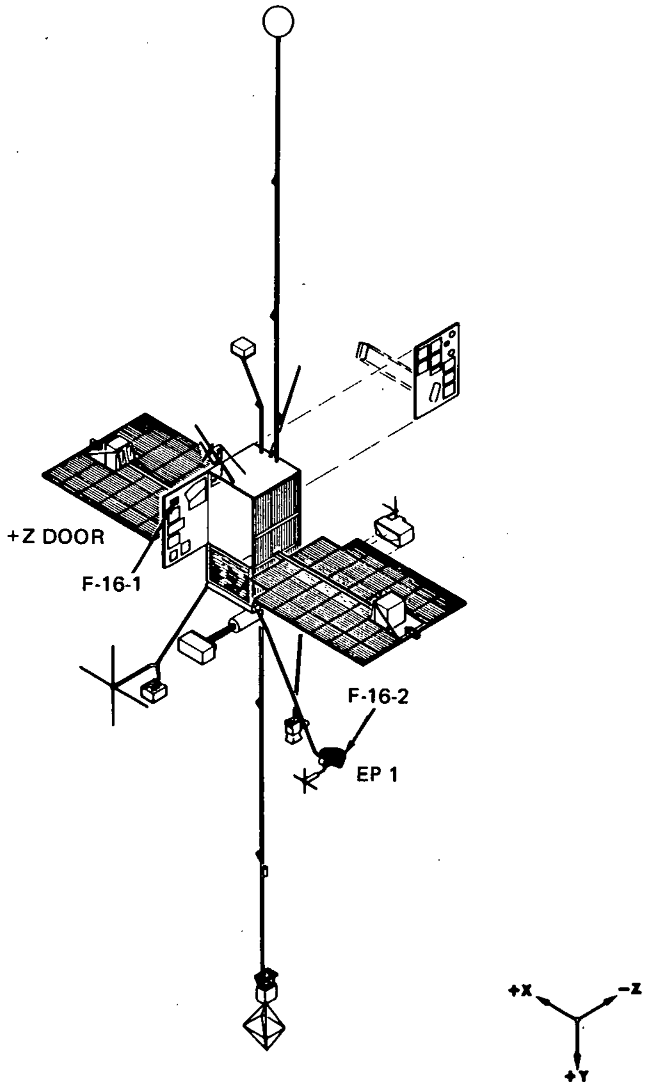

Figure 16. Experiment F-16 Location

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EXPERIMENT DESCRIPTION

FOR

Trapped and Precipitating Electrons for OGO-F

(Experiment F-17)

INVESTIGATOR

The principal investigator for the Trapped and Precipitating Electrons Experiment is Dr. D. J. Williams; the co-investigator is Dr. J. H. Trainor. Both investigators are affiliated with Goddard Space Flight Center.

OBJECTIVE

The experiment's objective is to measure the intensities of trapped and precipitated electrons in the $E_e \geq 30$ kev, ≥ 100 kev, ≥ 300 kev, and ≥ 1 Mev integral energy ranges. The intended OGO-F orbit is suitable for obtaining measurements in these ranges because it offers (1) a high sampling density during periods of observation of the magnetic coordinates, (2) knowledge of which field line is being observed, and (3) a large loss cone and consequent ease of sampling precipitated electrons.

INSTRUMENTATION

Seven solid-state detectors, mounted in a shielding head, are used. The Z axis of this equipment will be aligned parallel to the Z axis of the spacecraft (i.e., along the radius vector to the center of the earth) with detector 7 facing the earth. Because field-line inclinations are $\gtrsim 78$ degrees for L $\gtrsim 4.0$, the above orientation aligns the precipitation and backscatter monitors, (detectors 5, 6, and 7) to within ~ 12 degrees of the local field direction at L = 4.0. Depending on satellite azimuthal orientation, the trapped-electron monitors will be aligned to $\lesssim 12$ degrees of the normal to the local field-line direction and thus will monitor trapped electrons mirroring at, or near, the point of observation.

The full angle of the trapped electron detectors, 1, 2, 3, and 4, is 15 degrees and corresponds to a solid angle of $5.4(10)^{-2}$ ster. Using an illuminated area of 28 mm^2 yields a geometric factor of $1.5(10)^{-2}$ cm^2 ster. Detecting channels 5, 6, and 7, used to detect precipitated and backscattered electrons, employ a 30-degree full angle, a 28-mm^2 area and correspondingly, a geometric factor of $\sim 6.4(10)^{-2}$ cm^2 ster. The 30-degree full angle plus the $\sim$12-degree misalignment with the field at L = 4 is still within the loss cone of 54 degrees at 1000 km and L = 4.

The copper housing provides a minimum shielding of 5.7 gms/cm^2 in all directions except for the detector look angles; this is sufficient to stop $\sim$65 Mev protons and $\sim$11 Mev electrons. All electron range-energy values are based on 10 percent transmission values. The in-line housing provides nearly identical shielding for all trapped particle detectors, No. 1, No. 2, No. 3, and No. 4, when the local angular distributions are considered at these altitudes.

OPERATIONAL USE

This experiment is useful around the entire orbit of OGO-F. Based on observations recorded previously, detectors No. 1 through No. 4 should provide a range of expected count rates, for a 100-kev threshold detector, near $L = 4$ of $2.4(10)^5$ to $2.1(10)^3$ Hz. These count rates are easily tolerated and represent upper limits since the detector efficiency will be less than unity. The average efficiency of a 100-kev channel should approach 0.9. The minimum observable flux will be of the order of ~70 particles/cm^2 sec ster.

For detectors 5 through 7 the minimum observable flux will be ~20 particles/cm^2 sec ster. Background count rates due to cosmic ray particles will be of the order of a few tenths of a count per second.

MEASURED DATA

Two discriminator levels will be used—a lower level at 30 kev for detectors 1, 5 and 7 and at ~100 kev for detectors 2, 3, 4 and 6;and an upper level at ~750 kev. Events registering between the two levels are assumed to be electrons, while events triggering the upper level serve as a heavy particle monitor. Charge pulses from the solid-state detectors are converted to voltage pulses before being shaped and fed to the voltage discriminators that select the lower and the upper level. The lowest energy that will be detected in each channel is the result of absorber over the solid-state detector and of the discriminator level. The upper discriminators are set to lessen the effects of protons and heavier particles.

The seven data channels are commutated so that channels 1, 2, 3, and 4 and channels 1, 5, 6, and 7 are fed alternately to the four floating point accumulators. Data are shifted from the experiment to the spacecraft on demand. Data will always be fed to the higher bit-rate equipment group; i.e., data will be fed to the tape recorder at 4 kbs only in the absence of real-time transmission.

Periodically, the experiment will go to a calibrate mode; known charge pulses are thus applied to the charge amplifier inputs. The amplitude of these charge pulses is increased systematically in synchronization with the data system, to check the lower and upper level discriminators, and accumulators.

REDUCED DATA

Data will be obtained from this experiment at all times except during tape readout periods. All existing solar and geomagnetic conditions, altitudes, local times, and latitudes will be covered.

A system of data handling and display programs will present the data on a rapid and continuing basis in a way suitable for immediate analysis and interpretation.

Data presentation will be in the form of listings and plots of intensities (counts per sec and/or electrons/cm^2sec ster) versus various parameters such as L, Λ, and time. The data listings and plots of all high-latitude data will be available in a microfilm library.

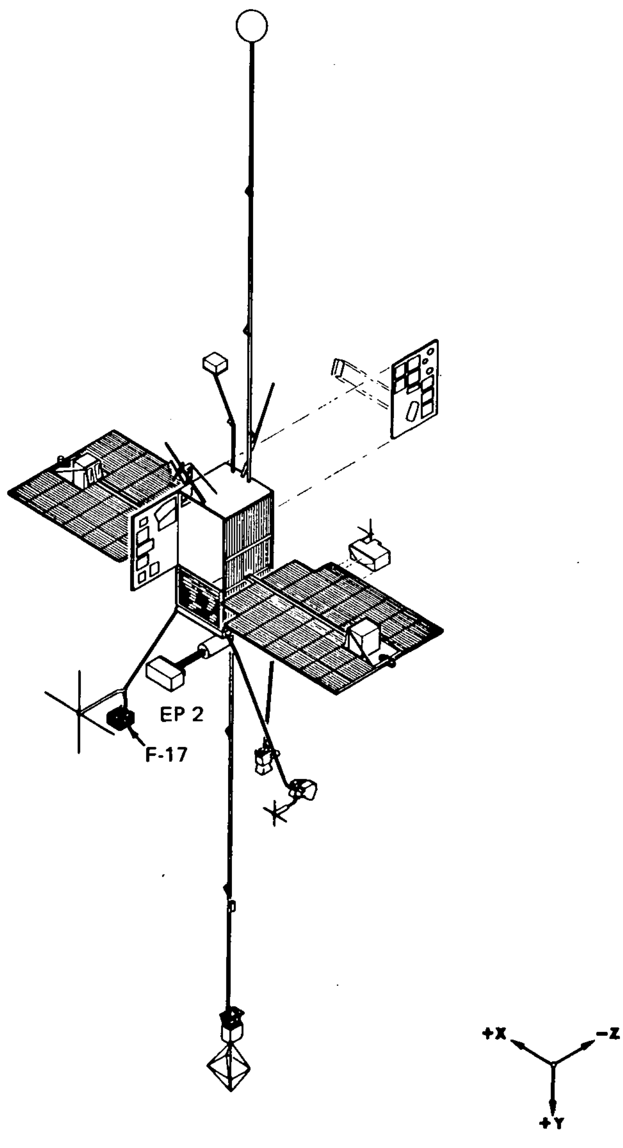

Figure 17. Experiment F-17 Location

EXPERIMENT DESCRIPTION

FOR

Neutron Monitor for OGO-F

(Experiment F-18)

INVESTIGATOR

The principal investigator for the Neutron Monitor Experiment is Dr. J. A. Lockwood; the co-investigator is Dr. E. L. Chupp. Both investigators are affiliated with the University of New Hampshire.

OBJECTIVE

The objective of this experiment is to monitor the integrated neutron flux over a large region of space and time. A relatively simple "standardized" space-neutron detector will be used. The detector will monitor the total neutron flux in the energy interval $1 < E10 < 10^7$ ev and the energy spectrum and flux in the range $1 < E < 10$ Mev (the fast neutron flux).

INSTRUMENTATION

The neutron detector consists of an He^3 proportional counter, encased in scintillator material, that is a moderator for fast neutrons. The moderator is surrounded by charged-particle counters (argon-methane semiproportional counter tubes) to "gate-off" the neutron counter whenever a charged particle enters the moderator. This reduces the effects of local neutron production in the detecting system. The scintillator material used for the moderator is viewed by a photomultiplier operating in delayed coincidence with the He^3 neutron counter to measure the light output from the proton recoils. By this method, a determination can be made of the neutron flux and spectrum in the energy range $1<E<10$ Mev.

OPERATIONAL USE

The experiment will be operated at all times when the satellite is not in the radiation belts. The charged-particle counting rates and the gated and ungated neutron rates will indicate whether meaningful neutron data are being obtained. Data will be acquired at all latitudes, longitudes, and altitudes to construct iso-neutron intensity curves. Very careful correlation with solar and geomagnetic disturbances and the background cosmic-ray fluxes will be necessary to obtain the quiescent neutron fluxes. It is desirable to obtain as much data as possible with the boom not deployed so that production effects may be evaluated.

MEASURED AND REDUCED DATA

The basic data received will be the total and/or fast neutron counts. Counting rates will be obtained by averaging over about five degrees latitude and longitude to reduce the statistical errors. Estimated counting rates are 0.3 and 3.0 counts/sec at geomagnetic latitudes 0 and 90 degrees, respectively.

The integrated neutron counting rates will be converted to a flux as follows:

$$\phi \text{ (flux)} = \frac{\text{R (counts/sec)}}{\text{E (mean efficiency)}}$$

In order to deduce the flux, a spectrum must be assumed; the Lingerfelter neutron spectrum will be assumed to make this conversion. If data acquired on the neutron energy spectrum in the range $1<E<10$ Mev are different from Lingerfelter's calculated spectrum, the spectral form will be changed accordingly. In the event of sporadic bursts of neutrons and protons from solar or geomagnetic events, the data must be handled differently because the neutron spectrum will probably be different.

Thus the basic data points will consist of an average integrated neutron flux, fast neutron flux, and fast neutron energy spectrum over some interval of space $(\Delta r, \Delta\lambda, \Delta\phi)$ and time Δt.

Since it may not be possible to eliminate all sources of local neutron production, an accurate knowledge of the charged-particle spectrum is required. Therefore, data from other experiments on the spacecraft will be valuable.

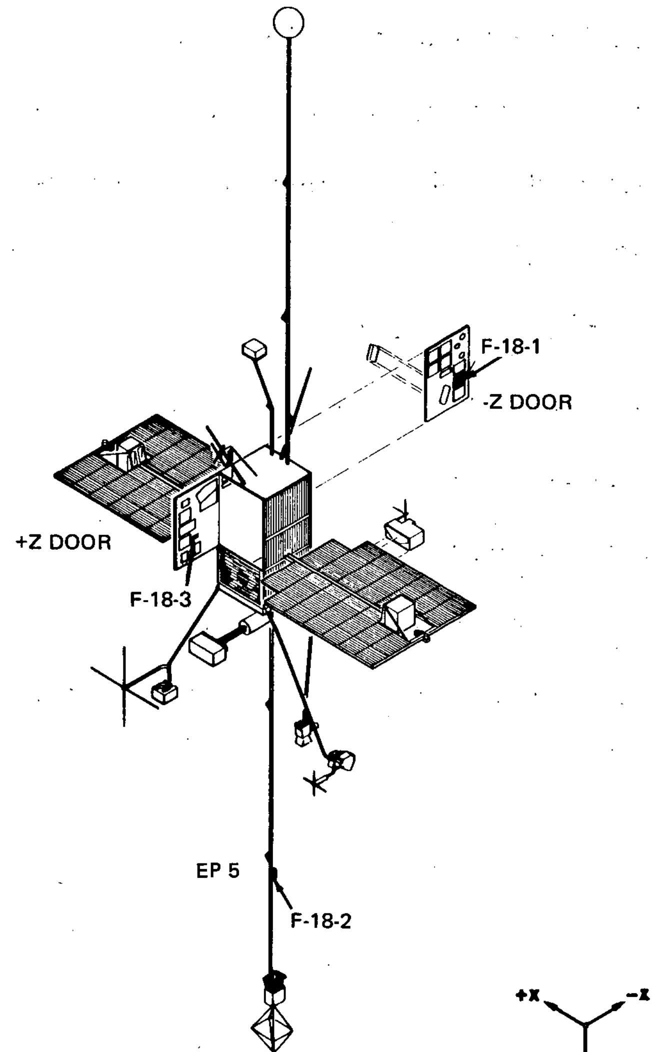

Figure 18. Experiment F-18 Location

EXPERIMENT DESCRIPTION

FOR

Low-Energy Solar Cosmic Ray Measurement for OGO-F

(Experiment F-19)

INVESTIGATOR

The principal investigator for the Low-Energy Solar Cosmic Ray Measurement Experiment is Dr. A. J. Masley; the co-investigator is Dr. P. R. Satterblom. Both investigators are affiliated with the McDonnell Douglas Corporation.

OBJECTIVES

The objective of this experiment is to perform an investigation of solar cosmic radiation and to relate the results to solar and ionospheric studies. The cosmic ray objectives include the following:

1. A measurement of changes in the energy and intensity distribution of solar particles, as a function of time
2. A determination of the geomagnetic cutoff, as a function of latitude
3. A study of the variation in the ratio of the intensities of alpha particles and protons

In conjunction with the Douglas Geophysical Observatory program, correlations will be made with the galactic radio noise absorption data from the riometer stations located at Shepherd Bay, Canada and McMurdo Sound, Antarctica.

INSTRUMENTATION

The sensor unit for this experiment will use two semiconductor particle detectors arranged in the form of a telescope. The geometry factor of the pair is 0.67 cm^{2}-ster. The $(dE/dx)_1$ versus (E_2 or (dE/dx_2)) technique will permit the separation of protons from alpha particles and give differential energy spectra for both species. The range of proton energies from 5 to 80 Mev will be divided into 14 energy intervals. The alpha particles between 18 and 160 Mev are divided into 12 intervals. Two data channels are used to form an integral count of the total number of alpha particles between 18 and 160 Mev and the total number of protons between 5 and 80 Mev. A single channel is used to monitor minimum ionizing protons and electrons. One channel alternately monitors the count rate of an alpha source from each detector. This channel is also used to receive data from an electronic calibration system that, once every 2 hours, measures the thresholds of each discriminator in the logic system and measures the pulse-height analyzer linearity. Data from a complete sequence of 30 channels are obtained every six main frames, or every 0.864 second. Each of the 30 data channels accumulates for 270 msec, reads for 18 msec, and is off for 576 msec.

OPERATIONAL USE

The experiment is designed to study solar cosmic ray events from the time when particles first arrive at the earth until the intensity again returns to the galactic background level. In order to observe start times, the experiment must be operational before the event begins. Since the occurrence of flares cannot be anticipated, the experiment must be on for as much of the time as possible. Solar particles in the energy ranges of this experiment will have direct access to the satellite for at least one-third of the orbit. During storm times, when the normal cutoffs are lowered, this fraction will be even higher. Other phenomena, such as aurorae, particles in the horns of the trapping region, and trapped or precipitating particles in the South Atlantic magnetic anomaly will also give counting rates of interest. The experiment is designed to operate continuously at all altitudes, latitudes, and local times.

MEASURED AND REDUCED DATA

As indicated above, the measured data will consist of counts in differential energy channels for protons and alpha particles. The reduced and analyzed data will give energy spectra as a function of time and location for solar cosmic ray events from the intensity background of galactic particles through the peak rates of the largest solar events recorded to date.

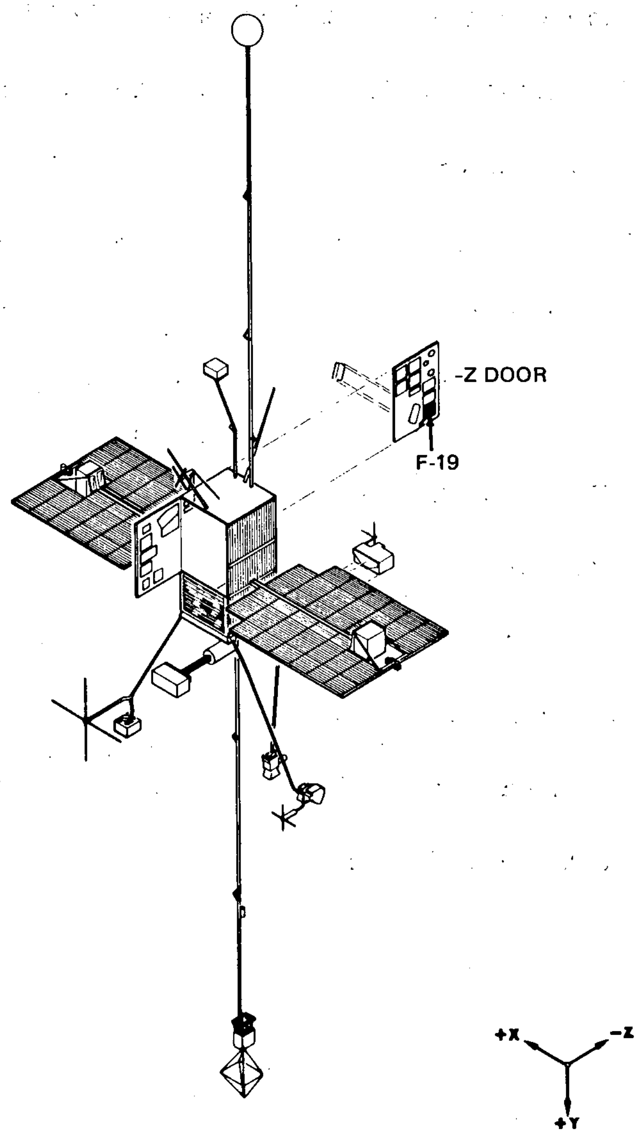

Figure 19. Experiment F-19 Location

EXPERIMENT DESCRIPTION

FOR

Cosmic Ray Study for OGO-F

(Experiment F-20)

INVESTIGATOR

The principal investigator for the Cosmic Ray Study Experiment is Dr. E. C. Stone; the co-investigator is Dr. R. E. Vogt. Both investigators are affiliated with the California Institute of Technology.

OBJECTIVE

The objective of this experiment is to study the following aspects of galactic and solar particle radiation:

1. The acceleration and injection of high-energy particles (protons, alphas, and electrons) by the sun, and their storage and propagation in interplanetary space
2. Solar-induced changes in the earth's magnetosphere, deduced from modifications in geomagnetic cutoffs
3. The nature of the small fluxes of solar particles that produce polar cap absorption
4. The shapes of the galactic proton, alpha, and electron spectra and their variation under solar modulation

INSTRUMENTATION

The three charged-particle telescopes employed in this experiment are:

1. Energy loss-range telescope — Seven solid-state detectors, separated by various absorbers, are arranged in a single stack and surrounded on the side by a plastic scintillator anticoincidence counter. Particles arriving within a cone of 30-degree half-angle with respect to the vertical are analyzed for energy loss in the first detectors and range in the subsequent detectors and absorbers.
2. Energy loss-Čerenkov telescope — Particles arriving within a cone of 35-degree half-angle with respect to the vertical are analyzed for energy loss in a solid-state detector and velocity in a quartz Čerenkov radiator. Collimation is provided by a cylindrical plastic scintillator.
3. Energy loss telescope — Particles arriving within a cone of 4.5-degree half-angle with respect to the vertical are analyzed for energy loss in a solid-state detector. Collimation is provided by requiring a coincidence with a second solid-state detector.

The measurement capability of each telescope is as follows: The energy loss-range telescope will measure the differential energy spectra of the proton (0.4 to 300 Mev), alpha (0.4 to 1200 Mev) and electron (1 to 1000 Mev) components of the galactic and solar fluxes from 10^{-1} to 10^{7} particles -m^{-2} -sec^{-1} -ster^{-1} -Mev^{-1}. The telescope geometrical factor ($A\Omega$) varies from

1.3 cm^2-ster at low energies to 0.4 cm^2-ster at high energies.

The energy loss-Čerenkov telescope will measure the differential energy spectra of the proton (350 to 100 Mev), alpha (1400 to 4000 Mev), Li, Be, B, C, N, and O fluxes from 10^{-1} m^{-2} -sec^{-1} -$ster^{-1}$ -Mev^{-1} to J_o (>17 Mev) = 10^7 m^{-2} -sec^{-1} -$ster^{-1}$. The differential spectra can be extended to 15 by using the geomagnetic field as a rigidity analyzer. The AΩ is 3.0 cm^2-ster.

The energy-loss telescope will measure the differential energy spectra of the proton (17 to 100 Mev) and alpha (70 to 1400 Mev) fluxes for large solar flares with J_o (>17 Mev) = 10^6 to 10^{10} m^{-2} -sec^{-1} -$ster^{-1}$. The AΩ is 0.005 cm^2-ster.

OPERATIONAL USE

OGO-F is presently scheduled for launch during solar maximum. The interpretation of data can be greatly confused by the overlap, storage, and recurrence of closely spaced events, unless the event histories are carefully monitored with minimum time gaps. Thus, a sequence of observations should last at least one solar rotation, during which time the length of any data gap would be limited ideally to approximately one revolution. (The operations plan of 2 days on and 2 days off has seriously degraded the usefulness of the D-08 data for solar flare and magnetospheric studies, indicating that the F-20 observations should be as nearly continuous as possible. Such operation normally will require only the power command.) Since the counter systems will be inoperative in the trapped particle regions, the lowest possible altitude is the most appropriate one.

REDUCED DATA

During quiescent periods, the proton differential energy spectrum can be determined to approximately 10 percent with a daily average. A weekly average is required for similar statistical errors in the alpha spectrum. During typical solar flare events, spectra can be determined each polar pass, averaged over a 15-minute interval once every 50 minutes.

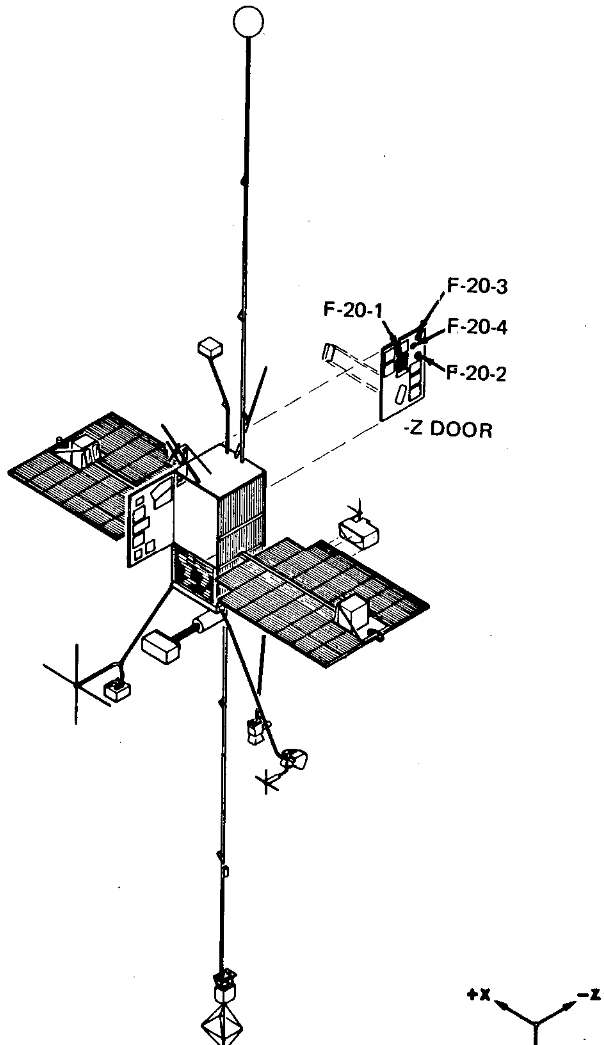

Figure 20. Experiment F-20 Location

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EXPERIMENT DESCRIPTION

FOR

Magnetic Field Measurements for OGO-F

(Experiment F-21)

INVESTIGATOR

The principal investigator for the Magnetic Field Measurements Experiment is Dr. J. C. Cain; the co-investigators are R. A. Langel and W. Folz. All investigators are affiliated with Goddard Space Flight Center.

OBJECTIVE

The objective of this experiment is the understanding of the physical processes creating and altering the main geomagnetic field and the sources external to the earth's surface contributing to the ambient field in the F-layer. If possible, gross features of surface magnetic anomalies will be located and mapped for use by geologists. The external sources to be investigated include tidal oscillations of the ionosphere by the gravitational gradients of the sun and moon (lunisolar magnetic variations) and diurnal changes on quiet days (Sq). During periods of magnetic disturbance, the effect of trapped plasma and variations in the external pressure on the magnetosphere will be evaluated (Dst/DS). One of the main functions of the analysis will be to separate the magnetic variations seen at the earth's surface that arise from the ionosphere from those with sources in the trapping and boundary regions.

Other effects, such as longitudinal pulsations in field and electrojets (auroral and equatorial), are to be investigated and correlated with other experimental data on the spacecraft.

INSTRUMENTATION

The measurements are made by a Rubidium vapor magnetometer averaging the total scalar magnetic field over intervals of 0.288 second. In addition, the Rubidium frequency divided by 4 is transmitted on special-purpose telemetry to allow study of higher frequency pulsations by special techniques. The two twin-cell magnetometers are mounted on the EP-6 boom. The magnetometers are far enough from the main body so that the interference is less than 1γ. The overall accuracy of the measurements is of this order.

OPERATIONAL USE

Because of the experiment's broad scope, it is necessary to operate the magnetometer as continuously as possible. An attempt should be made to make any gaps in operation or data accrual random in regard to position over the earth, local time, condition of disturbance, etc. Systematic deletions of data would increase the difficulty of sorting out the various sources of magnetic variation. It is also important that data be obtained during times when the spacecraft is passing nearest to the equatorial electrojet and locations favorable for occurrence of auroral electrojets.

REDUCED DATA

The reduced data will be a series of measurements giving the total ambient magnetic field at the spacecraft at the times of measurement. Data will be deleted if there are uncertainties in time or orbital position amounting to more than 2γ in magnetic field.

The intermediate results of analysis are expected to include:

1. A continuous numerical model of the main field including its secular variation
2. A numerical model of ionospheric currents during the times of observation including an index of polar electrojet intensity
3. A measure of the combined effect of trapped plasma and boundary pressures at the two local times of the orbit plane (asymmetric ring current)

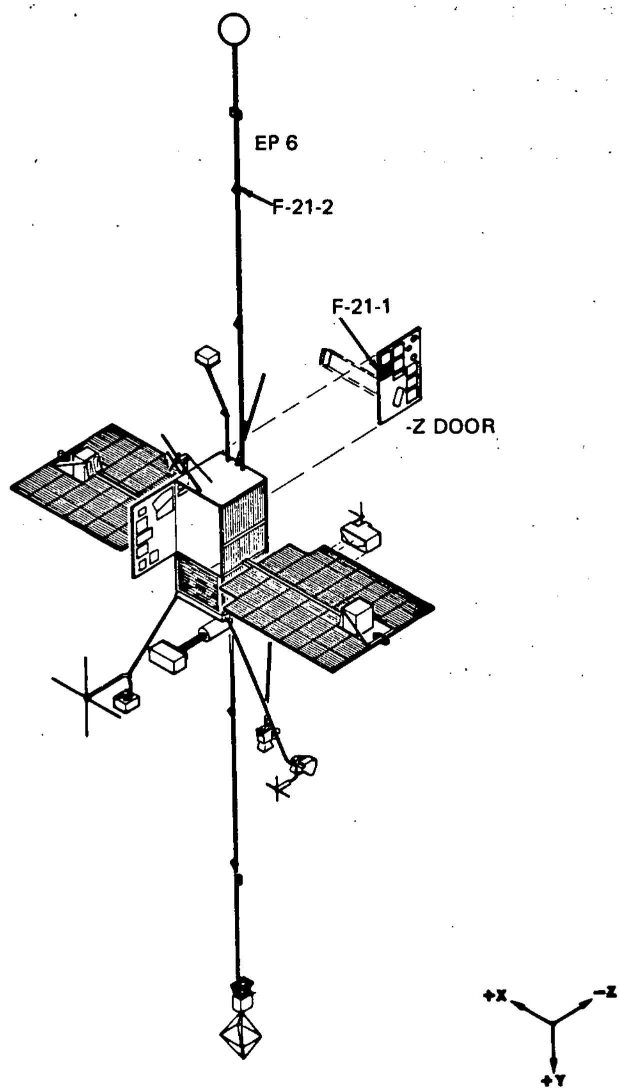

Figure 21. Experiment F-21 Location

EXPERIMENT DESCRIPTION

FOR

Search Coil Magnetometer for OSO-F

(Experiment F-22)

INVESTIGATOR

The principal investigator for the Search Coil Magnetometer Experiment is Dr. E. J. Smith, who is affiliated with the Jet Propulsion Laboratory. The co-investigator is Dr. R. E. Holzer, who is affiliated with U. C. L. A.

OBJECTIVES

The objective of this experiment is to investigate natural magnetic field variations within the ionosphere and lower magnetosphere in the frequency range of 0.01 to 1 kHz.

Signals originating within or above the ionosphere have been detected at the earth's surface throughout this frequency range. Several species of micropulsations are known to exist below 1 Hz, and hydromagnetic emissions between 1 and 5 Hz have been found to exhibit a complex frequency-time behavior. At higher frequencies and at high latitudes, auroral zone emissions (in bands below 500 Hz and from 500 to 1500 Hz) and extremely low frequency whistlers have been observed. Satellite measurements by Gurnett and O'Brien have produced evidence of relatively strong signals above the ionosphere with frequency components as low as the low frequency cutoff of 200 Hz. The presence of signals at 700 Hz was also indicated.

The investigation of the spatial, temporal, and spectral distribution of natural magnetic signals in this frequency range should determine physical causes and modes of propagation, both of which are implicitly related to the electrodynamic properties of the earth's outer atmosphere. Another important aspect of the measurements is their relation to simultaneously occurring geophysical phenomena, such as the injection or acceleration of charged particles.

INSTRUMENTATION

Three orthogonal coils wound on high permeability cores are mounted in an experiment package located at the end of a 20-foot boom. Voltages induced in these coils by ambient magnetic field variations will be preamplified and transmitted through the boom cable to the main electronics assembly in the spacecraft.

OPERATIONAL USE

The experiment is operational around the entire orbit of OGO-F. The sensitivity of the instrumentation will allow detection of signals having a rms amplitude of $\frac{0.03}{F}$ for less than 3 Hz to signals having a rms an amplitude of 0.0005 for 800 Hz. The dynamic range is 10^2, 10^3, or 10^4 times the internally generated electronic noise level as determined by ground command.

MEASURED DATA

Data are obtained by the following patterns: (1) continuous acquisition over an entire orbit, (2) acquisition at specified orbital positions, (3) acquisition at regular time intervals (e.g., 5 minutes every 30 minutes), and (4) quick-look data acquisition at regular intervals to command scale changes during special geophysical events.

Data are obtained by the following patterns: (1) voltages representing signal waveforms in the frequency range of 0.01 to 2 Hz (magnetic tape recording or data transmission at 4000 bits per second) or 0.01 to 130 Hz (data transmission at 64,000 bits per second), (2) the equivalent of three subcarrier oscillator outputs containing wideband waveforms with frequency components between 5 and 1000 Hz to be transmitted to earth by the special-purpose telemetry, (3) three analog words in the wideband telemetry subcommutator frame representing the three components of the average signal energy contained in the broadband fluctuations or in a relatively narrow passband (~100 Hz) centered at a variable frequency between 100 and 1000 Hz.

REDUCED DATA

After the data are received on the ground, analysis will be performed in the laboratory to investigate the natural magnetic field variations.

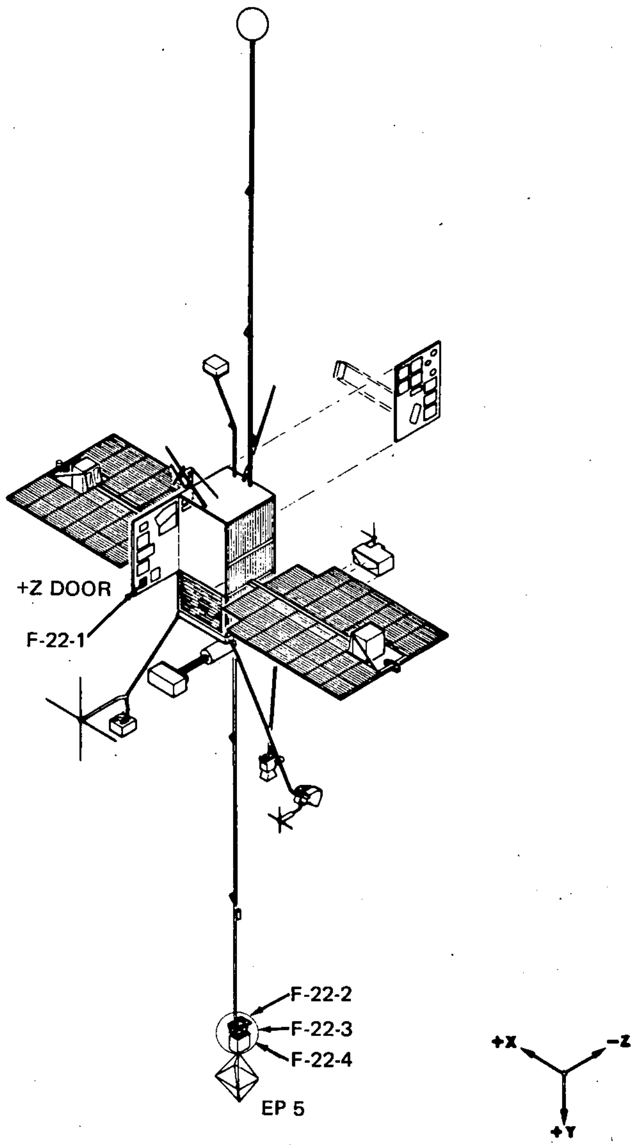

Figure 22. Experiment F-22 Location

EXPERIMENT DESCRIPTION

FOR

DC Electric Field Measurements for OGO-F

(Experiment F-23)

INVESTIGATOR

The principal investigator for the DC Electric Field Measurements Experiment is Dr. T. L. Aggson; the co-investigators are Dr. J. P. Heppner and Dr. N. Maynard. All investigators are affiliated with Goddard Space Flight Center.

OBJECTIVE

The objective of this experiment is to measure dc electric field intensity in the magnetosphere. Aurora and high-latitude ionospheric electric currents, magnetic field-aligned irregularities, plasma waves, and the different forms of irregularities previously observed by rocket measurements will be of particular interest.

INSTRUMENTATION

The sensors are two 30-foot unfurlable antennas similar to those on the Alouette spacecraft. The electronics consists of a high-impedance differential voltmeter, a log compressor, and a Fourier analyzer operating from 4 Hz to 4 kHz.

OPERATIONAL USE

The experiment is designed to detect small changes in the ambient electric field in the presence of high induced voltage on the sensor unit. This induced voltage is created by the velocity of the spacecraft, relative to the inertial coordinates of the plasma that pass through the magnetic fields. This detection places particular emphasis on electric field changes that occur in less than 10 seconds.

Finding the true configuration of the E fields relates directly to problems of local versus large-scale magnetospheric acceleration of particles, the structure of the auroral form, and the different types and velocities of auroral motions.

MEASURED DATA

E fields with periods less than 70 seconds are sampled twice per telemetry frame, i.e., about seven samples per second. DC fields, including the total magnitude of induced voltage, and rms values of ac fields in each of the bands (4 to 16, 16 to 64, 64 to 256, 256 to 1024, and 1024 to 4096 Hz) are sampled once every six telemetry frames, i.e., every 1.7 seconds. These rates apply to 8-kilobit recordings and transmissions; for 16- and 64-kilobit wideband telemetry, they are multiplied by 2 and 8, respectively.

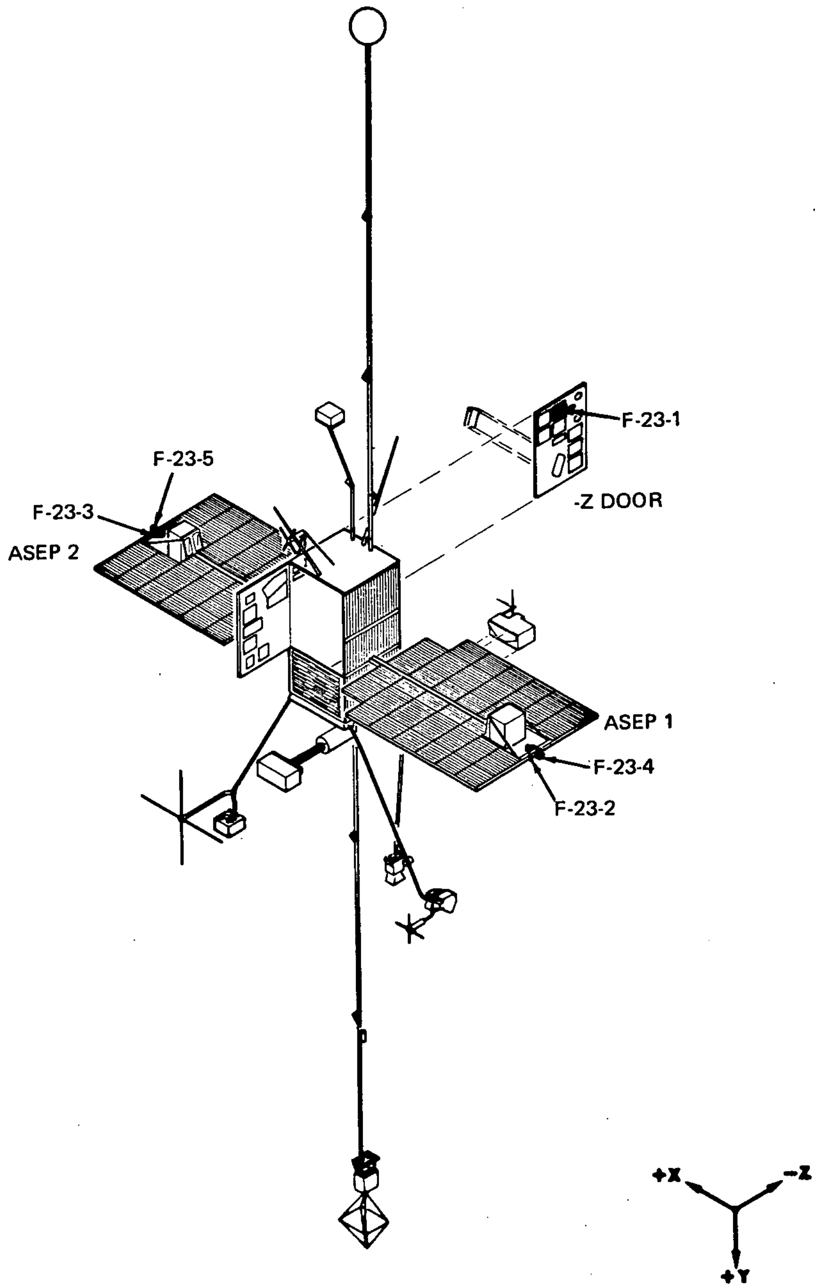

Figure 23. Experiment F-23 Location

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EXPERIMENT DESCRIPTION

FOR

VLF Noise and Propagation Measurement for OGO-F

(Experiment F-24)

INVESTIGATOR

The principal investigator for the VLF Noise and Propagation Measurement Experiment is Professor R. A. Helliwell; the co-investigator is R. L. Smith. Both investigators are affiliated with Stanford University.

OBJECTIVES

The primary objectives of this experiment are the measurement of the polarization, wave-normal direction, and the E/H ratio of signals in the frequency range 30 Hz to 30 kHz.

The secondary objectives include the measurement of antenna impedance and current with and without bias, the measurement of the phase and amplitude of VLF transmitter signals, the measurement of the integrated natural VLF noise, and the measurement of the observed ion-gyrofrequency whistlers. The latter measurements will be compared with the data observed by ion probes and with the magnetometer observations.

INSTRUMENTATION

The sensors will consist of three mutually perpendicular magnetic loop antennas and one electric dipole. The signals from the various inputs can be preprocessed by phase shifting and adding in many different combinations. The various frequency bands with widths of 120 Hz or 2.4 kHz can be selected in the frequency range 30 Hz to 30 kHz.

OPERATIONAL USE

All altitudes and latitudes are of interest. Special-purpose data transmissions at high latitudes in the southern hemisphere are desirable, since Stanford University has special-purpose telemetry readout facilities at Byrd Station, Antarctica.

MEASURED AND REDUCED DATA

Most of the data will be transmitted on the special-purpose transmitter system. The principal form of the reduced data will be frequency versus time spectra.

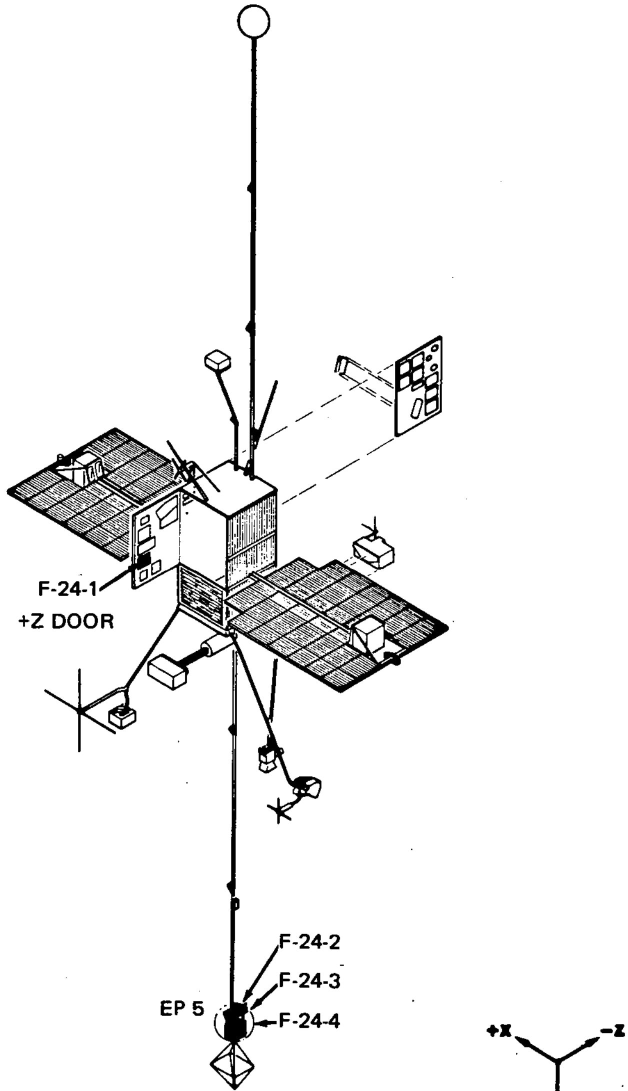

Figure 24. Experiment F-24 Location

EXPERIMENT DESCRIPTION

FOR

Whistler and Low Frequency Electric Field Study for OGO-F

(Experiment F-25)

INVESTIGATOR

The principal investigator for the Whistler and Low Frequency Electric Field Study Experiment is Professor T. Laaspere; the co-investigator is Professor M. G. Morgan. Both investigators are affiliated with Dartmouth College.

OBJECTIVES

The main objective of this experiment is to study the electric field of waves (e.g., whistlers) over an extended range of frequencies (10 Hz to 540 kHz). Another objective is to measure the impedance of the experiment's electric dipole antenna at several frequencies (8, 24, 103, and 284 kHz).

INSTRUMENTATION

The receiving antenna of the experiment will consist of two 30-foot monopoles that will project from the end of the solar panels. (The antenna is shared with experiment F-23.) A broadband preamplifier (10 Hz to 540 kHz) is mounted at the foot of each monopole. The main electronics package is located in the main body of the spacecraft.

OPERATIONAL USE

One of the objectives of the experiment is to compare whistler and emission data with observations made simultaneously at an existing network of whistler stations, which extend north-south from the Arctic to the Antarctic (approximately along 65°W. geographic longitude). For this reason, broadband (special-purpose) data when the spacecraft is in the longitude of the eastern United States are of particular interest. On the basis of data from the OGO-2 and OGO-4 experiments, interesting special-purpose data from Alaska; and Orroral, Australia, especially in lower hybrid resonance emissions, are also anticipated.

It is known that emission phenomena such as chorus and hiss are related to particle fluxes such as those observed under auroral conditions. To increase understanding of these relationships, it would be very interesting to correlate the measurements of this experiment with data obtained simultaneously via other experiments on particle fluxes. Data on low-energy electrons are of special interest. It is anticipated that the emphasis will, however, be placed on studying those lower hybrid resonance phenomena that are seen only with electric dipole antennas. For such a study it is essential to obtain simultaneous data on electron density and positive ion composition.

MEASURED DATA

Data are transmitted to the ground as follows:

1. Via the special-purpose telemetry, either automatically or in ground-commanded steps, signals are received in sequential order

in the bands 0.01-15, 15-30, 92.5-107.5 (Loran C channel), and 280 to 295 kHz.

2. On two main-comm words, the intensity of the carrier wave of two high-power broadcast stations (BBC, Droitwich, England, at 200 kHz; and XERW, San Luis Potosi, Mexico, at 540 kHz)

3. On sub-comm words, information on the complex antenna impedance (when the experiment is in the impedance-measuring mode)

Telemetry word assignment is as follows:

1. MC 63— 540-kHz narrowband receiver
2. MC 128 — 200-kHz narrowband receiver
3. SC 21— Frequency band status of broadband receiver
4. SC 43— Gain status of broadband receiver
5. SC 99— Impedance amplitude
6. SC 100— Impedance phase
7. SC 102— Level of current injected into antenna
8. SC 125— SP and impedance measurement status

The experiment will use the special-purpose band from 30 to 100 kHz on a time-sharing basis.

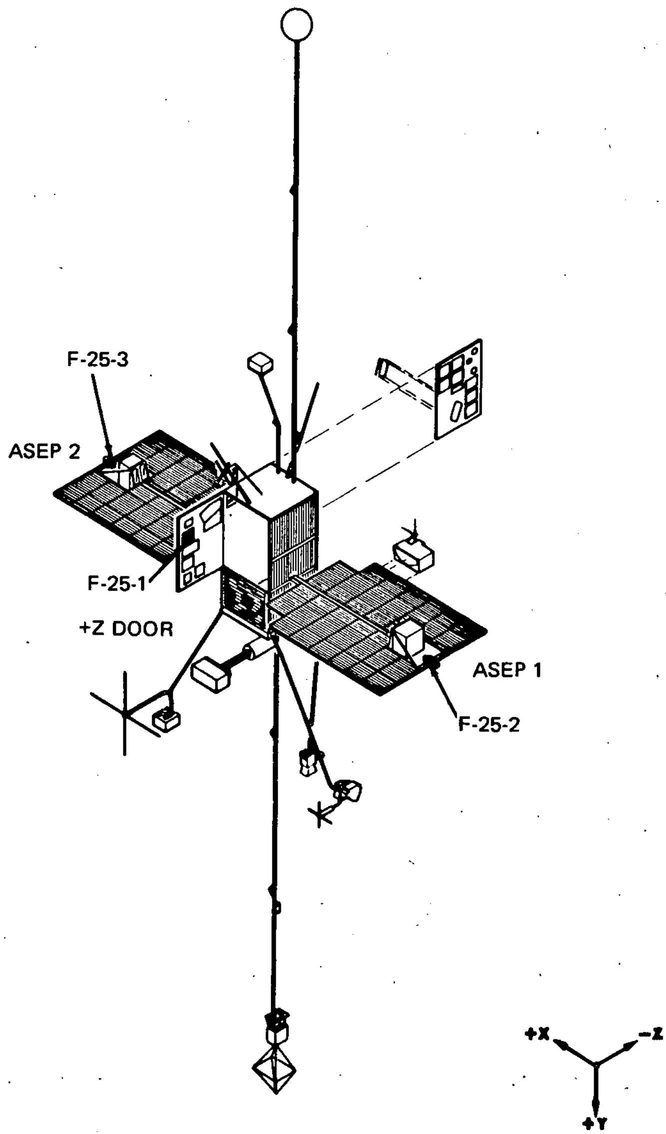

Figure 25. Experiment F-25 Location

EXPERIMENT DESCRIPTION

FOR

Sodium Excitation Measurements for OGO-F

(Experiment F-26)

INVESTIGATOR

The principal investigator for the Sodium Experiment Measurements Experiment is Dr. T. M. Donahue, who is affiliated with the Department of Physics, University of Pittsburgh. The co-investigators are Professor J. E. Blamont, who is affiliated with the University of Paris, and B. W. Guenther, who is affiliated with the University of Pittsburgh.

OBJECTIVE

The objective of this experiment is to measure the variation of the absolute brightness of the sodium D lines and the atomic oxygen green line (5577 angstroms) during the day, twilight, and night airglows.

INSTRUMENTATION

The sensor unit consists of an optical system, an interference filter, and a photomultiplier. The electronics consist of an electrometer, a shift register, and associated switching circuits.

OPERATIONAL USE

A large diurnal and seasonal variation in free-sodium abundance has been observed. Rocket measurements reveal that it is confined to a very thin layer at approximately 92.5 km. Global measurements of the altitude and sodium content of the source of this abundance should identify many problems related to dust in flux, sporadic-E, noctilucent clouds, atmospheric circulation, and O, O_3 chemistry.

There have been few systematic nightglow studies at latitudes higher than 45 degrees nor dayglow studies at latitudes below 45 degrees. Observed similarities in dayglow, twilight glow, and nightglow variations will be studied further.

It is also desirable to determine how much OI (^1S) excitation accompanies OI (^1D) excitation in the F region, both in the dayglow and the nightglow.

MEASURED DATA

The photometer is equipped with a mirror that is pivoted to scan the sky ahead of the spacecraft. This scan will extend vertically from a point up to approximately 10 degrees below the horizontal plane of the spacecraft.

Previous measurements reveal the level of maximum emission of sodium dayglow to be at about 93 km ±3 km. This experiment will obtain continuous measurements of the vertical distribution of the dayglow (both as a function of latitude and diurnal time) for comparison with twilight altitude emission. Intensities of 600 Kilo Rayleighs during the day and 3 Kilo Rayleighs during the night can be expected.

The green line of atomic oxygen at 5577 angstroms is one of the most prominent features of the airglow. Moreover, the altitude of the layer emitting 5577 angstroms appears to be established between 85 and 105 km. By using an interference filter centered at 5577 angstroms which will automatically alternate with the D doublet sodium filter in front of the same photometer, it will be possible to scan the green line approximately in the same altitude range.

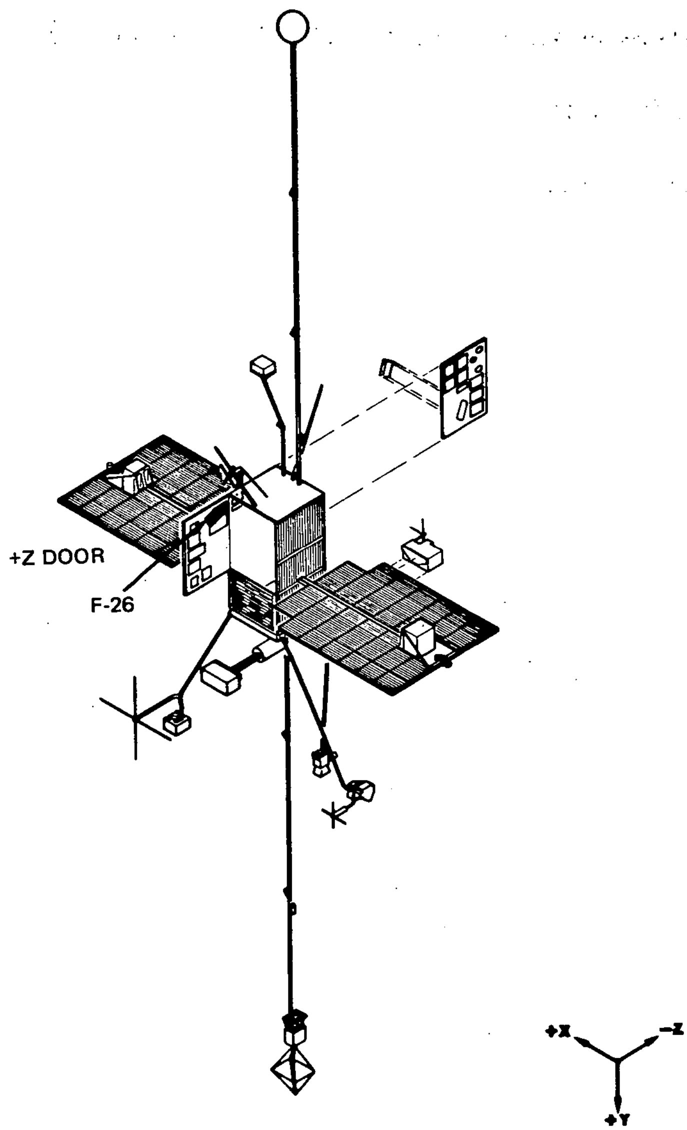

Figure 26. Experiment F-26 Location

APPENDIXES

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APPENDIX A

POWER

Table A-1

Average Power for OGO-F Experiments

EXPERIMENT NUMBER	FLIGHT UNIT	AVERAGE POWER* AT 28 VOLTS IN WATTS	REMARKS
F01	F-1	5.33	
F02	F-1	2.43	PC 217 Only
F03	P-1	1.73	
F04	F-1	19.20	Sweep Mode
F05	F-1	5.70	
F06	F-1	7.2	Sweep Mode
F07	F-1	3.08	
F08	P-1	2.46	
F09	F-1	15.68	
F10	F-1	9.86	
F11	P-1	3.42	
F12	F-1	3.58	PC 304 Only
F13	F-1	4.77	
F14	P-1	5.97	
F15	P-1	3.24	Orbit Operation
F16	F-1	2.79	Normal Mode
F17	F-1	2.20	
F18	P-1	3.66	
F19	F-1	2.40	
F20	F-1	3.05	
F21	P-1	10.20	
F22	F-1	2.86	
F23	P-1	2.0	
F24	P-1	3.75	
F25	F-1	2.9	Receiver Mode
F26	P-1	6.58	
F97 (R&RR)	F-1	3.78	Stand-By
F98	S/N 5	0.59	
F99 (R&RR)	F-1	5.60	Stand-By

*SUM AVERAGE POWER = 145.95

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OGO-F Weight Summary

The following is a breakdown of the OGO-F weight, on a system basis.

Total Observatory Weight (orbital flight)	1369.4
Structure & temperature control	224.3
Attitude control system	228.8
Power supply	202.0
Integration assemblies including Data Switching assembly (5.6 lbs)	194.6
Communications & data handling	131.1
Range and range rate	17.0
Ballast (SOEP-2)	2.5
Experiments & experiment containers & harnesses	371.2

The following is a further weight breakdown by internal and external experiments, containers, insulation, mounting hardware, and harnesses.

<u>External Experiments and Containers</u>

1. EP-1, container and insulation (contains part of F-16)	6.6
2. EP-2 and container (contains F-17)	8.3
3. EP-3 and container (contains F-11)	9.4
4. EP-4, container and insulation	5.3

5.	EP-5 (Includes 1.1 lb for ejection system) (contains part of F-22 and F-24)	13.8
6.	EP-6, container, insulation, and last boom element (contains part of F-21)	9.9
7.	SOEP-1 (contains F-08 and F-10)	19.5
8.	SOEP-2 (contains F-09)	18.6
9.	ASEP-1 (contains part of F-23 and F-25)	4.1
10.	ASEP-2 (contains part of F-23 and F-25)	4.1
11.	OPEP-1 (contains F-01, F-03, F-06 and F-07)	26.2
12.	OPEP-2 (contains F-04, F-05 and part of F-02)	27.0

Internal Experiments

1.	F-02	5.2
2.	F-07	3.6
3.	F-12	19.52
4.	F-13	9.6
5.	F-14	15.7
6.	F-15	12.5
7.	F-16	4.6
8.	F-18	5.7
9.	F-19	6.5
10.	F-20	17.7
11.	F-21	11.6

12.	F-22	4.4
13.	F-23 (Includes 6A23-8 Relay Box)	5.6
14.	F-24	12.8
15.	F-25	7.9
16.	F-26	11.6

<u>External Experiment Container Installation, Insulation and Mounting Provisions</u>

1.	EP-1 Installation Hardware	0.1
2.	EP-2 Installation Hardware and Insulation	0.1
3.	EP-3 Installation Hardware and Insulation	0.4
4.	EP-4 Installation Hardware and Insulation	0.1
5.	EP-5 Container, Installation Hardware, Insulation and Heater Mounting	3.3
6.	EP-6 Installation Hardware	0.1
7.	OPEP 1 Container Installation, Insulation and Ground Screen	5.3
8.	OPEP 2 Container Installation, Insulation and Ground Screen	5.6
9.	SOEP 1 Container Installation and Insulation	4.1
10.	SOEP Mounting Hardware	0.2
11.	F-12 Mounting Support and Insulation	2.9
12.	Radiation Panel Retaining Frame for F-14 and F-26	1.3

Experiment Harnesses

1.	Experiment Harness No. 6	36.4
2.	SOEP Harness No. 16	1.2
3.	SOEP Harness No. 17	1.2
4.	OPEP Experiment Harness No. 21 and No. 22	4.0
5.	OPEP 1 and 2 Interconnection Harness No. 63	0.8
6.	Boom EP-1 Harness	2.7
7.	Boom EP-2 Harness	2.1
8.	Boom EP-3 Harness	1.8
9.	Boom EP-4 Harness	1.1
10.	Boom EP-5 Harness	6.0
11.	Boom EP-6 Harness	3.3
12.	Solar Array Harness for 6A23 Relay Box	1.8

*The above weights are based on OGO-F "all-up" weighing performed February 5, 1969.

3

APPENDIX C
COMMANDS

(COMMAND ADDRESS 080/044)
(FLEX FORMAT ADDRESS 081/045)

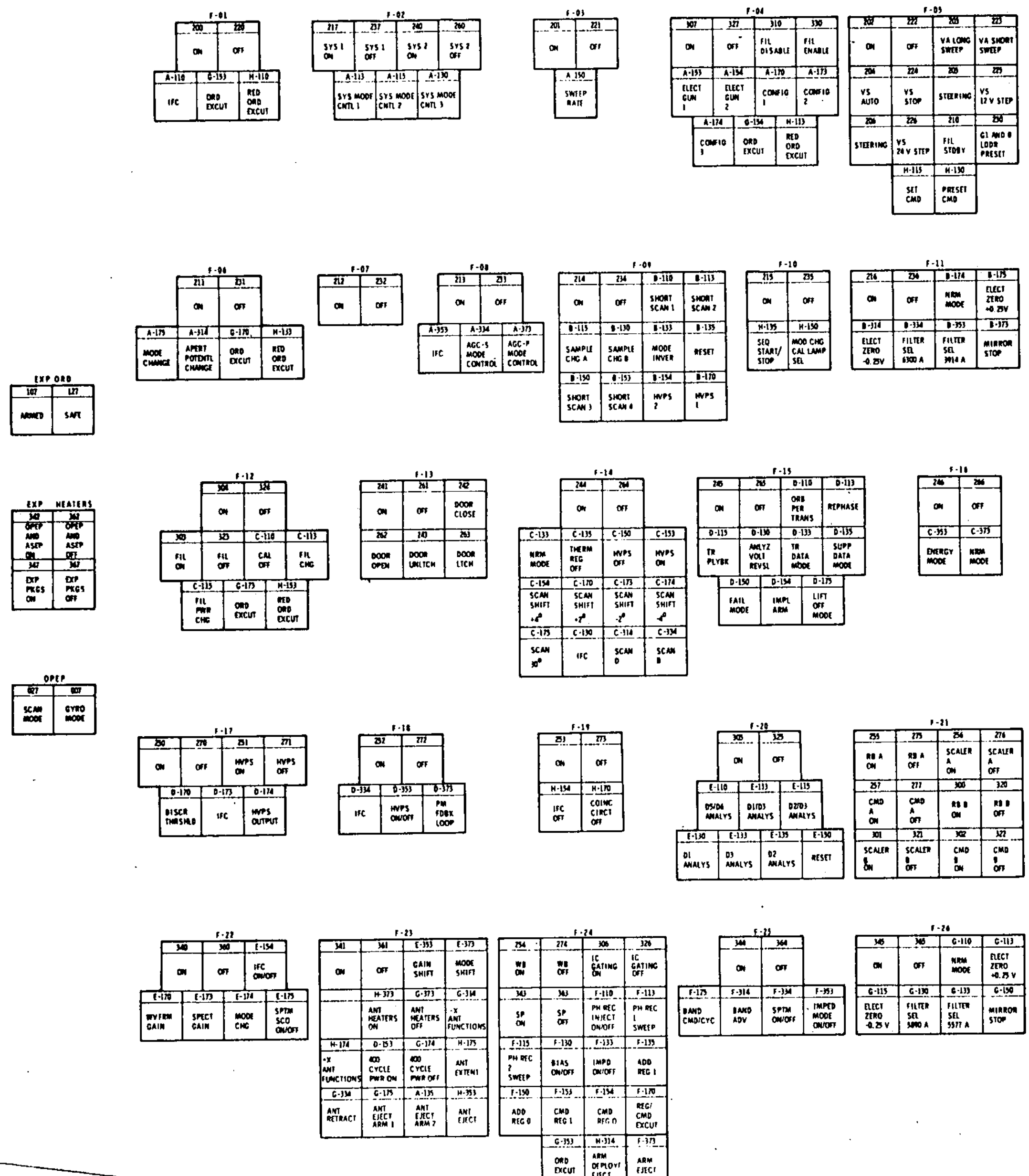

Figure C-1. OGO-F EXPERIMENT COMMANDS

(COMMAND ADDRESS 060/044)

POWER

354	374	315	335	
REG 1 NRM	REG 1 FAIL	REG 2 NRM	REG 2 FAIL	
356	376	317	337	
REG 1 0.4/3.7	REG 1 8.7/12	REG 2 0.4/3.7	REG 2 8.7/12	
144	164	316	336	
CH RT 0.4/8.7	CH RT 3.7/12	CH MODE CONT LT	CH MODE CYCLE	
104	124	016	036	120
BAT 1 CNCT	BAT 1 DISC	BAT 2 CNCT	BAT 2 DISC	BAT EXECUT
145	165	017	037	
BAT 1 NRM	BAT 1 RECOND	BAT 2 NRM	BAT 2 RECOND	
056	076	105	125	
CH BUS PRL NRM	CH BUS PRL INH	95° SW NRM	95° SW OVRD	
006	026	046	066	
UV BUS 1 RESET	UV BUS 1 OVRD	UV BUS 2 RESET	UV BUS 2 OVRD	

ACS

	121	141	161
	ACS NORMAL	ACS ENABLE	ACS EXECUT
102	122	142	162
ACS MODE 1	ACS MODE 2A	ACS MODE 2C	ACS MODE 3
146	101	146	034
ACS ON	ACS OFF	JETS ENABLE	GAS DELAY
103	123	035	015
SUN SEN NORM	SUN SEN SWITCH	PR GYRO ON	PR GYRO OFF
067	047	346	366
CSA ARM	CSA SAFE	SAI ON	SAI OFF
207	267	247	014
ARRAY SLEW CW	ARRAY SLEW NRM	ARRAY SLEW CCW	WHEEL DELAY
355	375		
ARY DEL ENABLE	ARY DEL DISABL		

COMMUNICATION

001	020	040	060
WB XMTR OVRD	WB A ON TC12	WB B ON TC 2	WB XMTR OFF TC 3
024	044	054	074
SP XMTR ON	SP XMTR OFF	SP MOD NORM	SP MOD SWITCH
	143	163	
	SP XMTR OMNI 1	SP XMTR OMNI 2	

DATA HANDLING

002	022	042	062	061
TR 1 ON	TR 1 OFF	TR 2 ON	TR 2 OFF	TAPE PLAYBK TC 4
	011	031	051	
	RT MAIN COMM	RT ACC SUBCOM	RT FLX FORMAT	
	012	032	052	
	DS MAIN COMM	DS ACC SUBCOMM	DS FLX FORMAT	
	013	033	053	
	LOW BIT RATE	MED BIT RATE	HI BIT RATE	
003	023	041	010	050
EG 1 ON	EG 1 OFF	EG 1 RT TC 6	MO 1 SELECT	HFTU 1 SEL
043	063	021	030	070
EG 2 ON	EG 2 OFF	EG 2 RT TC 7	MO 2 SELECT TC 9	HFTU 2 SEL TC11
	357	073		
	CMD ADD 060 ENABLE	CMD ADD 060 DISABLE		

TRACKING

005	025	064	
100 MW A ON	100 MW B ON	100 MW OFF	
055	075	350	370
R AND RR 1 ON	R AND RR 1 OFF	R AND RR 2 ON (1 DISABL)	R AND RR 2 OFF
G-135			
R AND RR 1 CHNL SELECT			

LAUNCH

100	140	160
ORD SEQ ARMED	BOOM 1 DEPLOY	BOOM 2 DEPLOY
107	127	
EXP ORD ARMED	EXP ORD SAFE	

ACS (JET CONTROL)

	067	047	
	CSA ARM	CSA SAFE	
D-314	E-314	H-173	H-334
- PITCH SELECT	+ PITCH SELECT	- ROLL SELECT	+ ROLL SELECT
F-173	B-173	F-174	E-334
- YAW SELECT	+ YAW SELECT	PITCH + ROLL SELECT	YAW - ROLL SELECT
A-133	166	E-153	004
PITCH JET DISABL	ROLL JET DISABL	YAW JET DISABL	JET PULSE EXECUT

ACS (OPEP)

		147	167
		OPEP DISABL	OPEP ENABLE
077	072	071	057
OPEP GYRO OFF HTR ON	OPEP GYRO 1 SEL	OPEP GYRO AUTO	OPEP GYRO PWR OFF
	027	007	
	OPEP SCAN MODE	OPEP GYRO MODE	

HEATERS

126	106
OPEP WRP-UP ON	OPEP WRP-UP OFF
347	367
EXP PKG ON	EXP PKG OFF
342	362
OPEP AND ASEP ON	OPEP AND ASEP OFF

CMD RELAY GROUP SELECT

INITIAL CMD	MODE OF OPERATION	RELAY GROUP A	B	C	D	E	F	G	H	
114	NORMAL	111	131	151	171	311	331	351	371	FOLLOW WITH DESIRED OPERATIONAL CMD
134 OR 155	ALTERNATE	312	332	352	372	112	132	152	172	

APPENDIX D
TELEMETRY FORMATS

*THROUGH DSA

1 · 001 SYNC WORD #1	2 · 002 SYNC WORD #2	3 · 003 SYNC WORD #3	4 · 004 **16** Det 2	5 · 005 **16** Det 3	6 · 006 **16** Det 4	7 · 007 **16** Det 5	8 · 010 **16** Det 6	9 · 011 **20** Flare, Range or Cerenkov Event	10 · 012 **20** Event Data	11 · 013 **20** Event Data	12 · 014 **20** Event Data	13 · 015 **21** A Amplitude	14 · 016 **22** Waveform A (X-axis)	15 · 017 **22** Waveform A (Y-axis)	16 · 020 **22** Waveform A (Z-axis)
17 * 021 **24** Threshold Counter	18 · 022 **21** Mag A Output	19 · 023 **21** Mag A Output	20 · 024 **04** Mass Marker	21 · 025 **04** Main Output Range 1	22 · 026 **04** Main Output Range 2	23 · 027 **03** Electro/ Amplf Output	24 · 030 **02** Output Voltage	25 · 031 **14** PM Output	26 · 032 **14** Exp Status	27 · 033 **18** Total Neutrons and Coinc	28 · 034 **05** Ch 9 Output	29 · 035 **05** Ch 10 Output	30 · 036 **05** Ch 11 Output	31 · 037 **05** Ch 12 Output	32 · 040 **05** Ch 13 Output
33 Δ 041	34 · 042 ACCUMULATED TIME (SECS)	35 · 043	36 · 044 **26** Range ID	37 · 045 **11** Electrometer x1.0	38 · 046 **12** Scanner Angle	39 · 047 **20** Det D8	40 · 050 **11** Electrometer x 0.1	41 · 051 **18** Gate Neutrons and Scint Output	42 * 052 **07** Sync and Probe Output	43 * 053 **07** Probe Output	44 * 054 **07** Cal and Window Status	45 · 055 **A14** OPEP Sine	46 · 056 **01** Prime Data	47 · 057 **01** Range Data	48 · 060 **12** Inst Status
49 · 061 **09** Exp Config Status and Aspect	50 · 062 **09** Collimator Position and Aspect	51 · 063 **09** Counter Data	52 · 064 **09** Counter Data	53 · 065 **22** Spectrum Ch (X-axis)	54 · 066 **22** Spectrum Ch (Y-axis)	55 · 067 **22** Spectrum Ch (Z-axis)	56 · 070 **11** Log Output	57 * 071 **08** Exp Status and Data	58 * 072 **08** Exp Status and Data	59 * 073 **06** Digital Output	60 · 074 **06** Electrometer Output	61 · 075 **13** UV Data Ch A	62 · 076 **23** Log Ampl Data	63 · 077 **25** 540 Khz Rcv Output	64 · 100 **10** Scaler
65 · 101	66 · 102	67 · 103	68 · 104 **26** Electrometer Output	69 · 105 **24** Phase Trk Rcv 1- Phase	70 · 106 **24** Phase Trk Rcv 1 - Amplitude	71 · 107 **24** Bias Voltage	72 · 110 **03** Electro/ Amplf Output	73 · 111 **14** Exp Status	74 · 112 **12** PM Counter Rate	75 · 113 **12** PM Counter Rate	76 * 114 **19** Shift Reg 1	77 · 115 **12** Electrometer Data	78 · 116 **22** Waveform B (X-axis)	79 · 117 **22** Waveform B (Y-axis)	80 · 120 **22** Waveform B (Z-axis)
81 * 121 **24** '0' Crossing Counter	82 · 122 **21** Mag B Output	83 · 123 **21** Mag B Output	84 * 124 **19** Shift Reg 2	85 · 125 **04** Main Output Range 1	86 · 126 **04** Main Output Range 2	87 · 127 **20** Det D4	88 · 130 **02** Output Voltage	89 * 131 **19** Shift Reg 3	90 * 132 **19** Shift Reg 4	91 * 133 **19** Shift Reg 5	92 · 134 **05** Ch 9 Output	93 · 135 **05** Ch 10 Output	94 · 136 **05** Ch 11 Output	95 · 137 **05** Ch 12 Output	96 · 140 **05** Ch 13 Output
97 · 141 SUBCOM 1 DATA WORD HERE	98 · 142 SUBCOM 2 DATA WORD HERE	99 · 143 SUBCOM 3 DATA WORD HERE	100 · 144 **06** Sweep Potential	101 · 145 **24** Phase Trk Rcv 2 - Phase	102 · 146 **24** Phase Trk Rcv 2 - Amplitude	103 · 147 **24** Bias Current	104 · 150 **A15** OPEP Cosine	105 · 151 **15** Det Data	106 · 152 **26** Exp Status	107 · 153 **A46** Sun Aspect Angle	108 · 154 **18** Total Chrg Particle	109 · 155 **12** Electrometer Cal	110 · 156 **05** V_A Monitor	111 · 157 **12** Lamp Current	112 · 160 **13** UV Data Ch B
113 · 161 **20** Disc and Coinc Pulse Rate	114 · 162 **20** Disc and Coinc Pulse Rate	115 · 163 **11** Exp Status	116 · 164 **23** Spectrum Analy Data	117 · 165 **10** Det Output	118 · 166 **21** B Amplitude	119 · 167 **03** Electrometer Output	120 · 170 **03** Amplifier Output	121 * 171 **17** Det 1	122 * 172 **17** Det 2, 5	123 * 173 **17** Det 3, 6	124 * 174 **17** Det 4, 7	125 · 175 **16** Det 1	126 · 176 **23** Log Ampl Data	127 · 177 **11** Electrometer x 10.0	128 · 200 **25** 200 Khz Rcv Output

Figure D-1. OGO-F MAIN TELEMETRY FORMAT—EQUIPMENT GROUPS 1 AND 2

*THROUGH DSA

1 200	2 201 14 Exp Status	3 202 21 A Status	4 * 203 24 Exp Status	5 204 18 (Not Used)	6 205 15 Exp Status	7 206 15 Calendar Clock	8 207 15 Calendar Clock
9 210 C19 R and RR II Status	10 211 01 Exp Status I	11 212 03 Electrometer Range Data	12 213 05 V_A+V_B Monitor	13 214 07 Tube Temp	14 215 03 Grid Sweep	15 216 01 Exp Status 2	16 217 24 Bias Voltage
17 220 05 V_S Monitor	18 221 26 Hi Voltage Monitor	19 222 12 Volt Monitor	20 223 16 Mode Status Logic Box Temp	21 224 25 Band Status	22 225 23 Ant. Temp.	23 226 04 Anode Current Status	24 227 14 Hi Voltage Pwr Status
25 230 04 Emission Current Status	26 231 12 Cell Voltage	27 232 11 PMT Temp	28 233 16 Det Temp Monitor	29 234 18 Hi Voltage	30 235 13 UV Data Ch A	31 236 09 Hi Voltage Pwr 1	32 237 F51 DSA Switch Signal Status
33 240 21 Lamp A Temp	34 241 16 Anode Current	35 242 05 RF Monitor	36 243 19 Rate Meter	37 244 04 Hi Voltage Multiplier	38 245 12 Cell Current	39 246 05 GI Monitor	40 247 23 Ant. Deploy
41 250 10 Exp Status	42 251 02 System and Mode Status	43 252 25 Gain Status	44 253 12 Hi Voltage	45 254 05 G15 Monitor	46 255 03 Grid Sweep	47 256 23 Ant. Arm	48 257 24 Bias Current
49 260 05 V_S Monitor	50 261 14 Pot Volt Monitor	51 262 13 UV Data Ch B	52 263 23 Exp Status	53 264 19 Det A	54 265 18 Threshold Voltage	55 266 05 +20 DC Monitor	56 * 267 10 Exp Status
57 270 01 Pwr Status	58 271 04 Fil Ref Status	59 272 12 Pwr Status	60 273 13 Hi Voltage Ch A	61 274 14 PMT Temp	62 275 09 Hi Voltage Pwr 2	63 276 21 Cell A Temp	64 277 02 System and Mode Status
65 300 26 Exp Status	66 301 11 Exp Status	67 302 21 B Status	68 * 303 24 Exp Status	69 * 304 10 Det Output	70 * 305 10 Det Output	71 306 14 Exp Status	72 307 20 Cmd Status
73 310 17 Exp Config	74 311 22 Waveform Gain and Mode Status	75 312 03 Electrometer Range Data	76 313 05 Exp Temp	77 314 13 Hi Voltage Ch B	78 315 03 Grid Sweep	79 316 12 G Temp	80 317 24 Bias Voltage
81 320 05 V_S Monitor	82 321 04 Elect Pkg Temp	83 322 C18 R and RR I Pwr Output	84 323 C17 R and RR I Status	85 324 03 Sweep Mode	86 325 18 Log Counting Meter	87 326 20 Range Telsc Temp	88 327 13 Reg Bus +15V
89 330 04 Ion Source Temp	90 331 06 Exp Status	91 332 10 Exp Status	92 333 14 HVPS Volt Monitor	93 334 17 Exp Status	94 335 04 Cmd Status	95 336 13 Reg Bus -15V	96 337 22 Spectrum Gain and Mode Status
97 340 15 Exp Status	98 341 16 Anode Current	99 342 25 Imped Ampl	100 343 25 Imped Phase	101 344 21 A Pwr Status	102 345 25 Injection Level	103 346 11 Filter Temp	104 347 04 Press Sensor Status
105 350 14 Interf Filter Temp	106 351 20 Cerenkov Telsc Temp	107 352 17 Exp Status	108 353 22 Waveform Bandwith Status	109 354 13 Pwr Status	110 355 03 Grid Sweep	111 356 23 Ant Status	112 357 24 Bias Current
113 360 05 V_S Monitor	114 361 12 T Temp	115 362 22 Spectrum Ch Status	116 363 22 Spec Purpose Status	117 364 08 Exp Status	118 365 F49 IC Ground Select	119 366 21 Lamp B Temp	120 367 F50 IC Group Select
121 370 22 Cal Status	122 371 19 Det B	123 372 21 Cell B Temp	124 373 F52 DSA Switch Signal Status	125 374 25 SP and Imped Status	126 375 21 B Pwr Status	127 376 12 H Temp	128 377 22 Pwr Status

Figure D-2. OGO-F EXPERIMENT TELEMETRY FORMAT—SUBCOM 1 EQUIPMENT GROUPS 1 AND 2

1 400 C6 WB TX A REV POWER	2 401 C8 WB TX B REV POWER	3 402 F24 EG 1 / F32 EG 2 A/D CONV TEMP	4 403 A1 ARGON HIGH PRESSURE	5 404 B1 EP5 DEPLOY	6 405 A42 SCAN HEAD C ANGLE	7 406 A12 ARRAY SHAFT ANGLE SINE	8 407 A13 ARRAY SHAFT ANGLE COSINE
9 410 D1 BATTERY 1 CURRENT	10 411 F40 S/C DEPLOY AND EXP ORD	11 412 A31 REACTION WHEELS ON OFF	12 413 A21 GAS CONTROL VALVES 1, 2, 5	13 414 A22 GAS CONTROL VALVES 3, 4, 6	14 415 D64 BAT 1 CURRENT DIRECTION	15 416 B10 PRE-DEPLOYMENT 3	16 417 D2 BATTERY 2 CURRENT
17 420 D65 BAT 2 CURRENT DIRECTION	18 421 D17 ARRAY 1C CURRENT	19 422 D4 ARRAY 1 CURRENT	20 423 D5 ARRAY 2 CURRENT	21 424 D10 LOAD BUS VOLTAGE	22 425 D58 ARRAY 2 THERMAL FIN DRIVE VOLTS	23 426 A41 SCAN HEAD B ANGLE	24 427 A11 ARRAY ERROR DEGREES
25 430 A4 PITCH ERROR DEGREES	26 431 A5 ROLL ERROR DEGREES	27 432 A6 SCAN HEADS SUN ALARM	28 433 A21 GAS CONTROL VALVES 1, 2, 5	29 434 A22 GAS CONTROL VALVES 3, 4, 6	30 435 D8 BATTERY 1 VOLTAGE	31 436 D9 BATTERY 2 VOLTAGE	32 437 D57 ARRAY 1 THERMAL FIN DRIVE VOLTS
33 440 B12 DEPLOY BOTTLE 2 PRESSURE	34 441 B13 DEPLOY BOTTLE 3 PRESSURE	35 442 F9 RECORDER 2 +9.5 VOLTS	36 443 C5 WB TX A FWD PWR	37 444 D42 CONV 9 +20 VOLTS	38 445 D44 CONV 9 -20 VOLTS	39 446 D45 CONV 9 28 VAC	40 447 D46 ACS INVERTER 115 V 400 CPS
41 450 A7 SCAN HEADS TRACKING CHECK	42 451 A10 YAW ERROR DEGREES	43 452 A31 REACTION WHEELS ON-OFF	44 453 A21 GAS CONTROL VALVES 1, 2, 5	45 454 A22 GAS CONTROL VALVES 3, 4, 6	46 455 D60 ARRAY 2C SHUNT CURRENT	47 456 D43 CONV 9 +10 VOLTS	48 457 D59 LOAD BUS CURRENT
49 460 A16 OPEP AND ARRAY DRIVE MOTORS	50 461 A17 ROLL TACH WHEEL RPM	51 462 A18 PITCH TACH WHEEL RPM	52 463 A19 YAW TACH WHEEL RPM	53 464 A20 REACTION WHEELS DIRECTION	54 465 A23 ACS MODES SUN SENSOR	55 466 A24 PITCH RATE GYRO DEMOD	56 467 B3 ARRAY 1 DEPLOY
57 470 B2 EP6 DEPLOY	58 471 B6 EP3, EP4 JETS DEPLOY	59 472 B7 OPEP DEPLOY	60 473 A21 GAS CONTROL VALVES 1, 2, 5	61 474 A22 GAS CONTROL VALVES 3, 4, 6	62 475 D61 REG CHARGE RATE	63 476 D20 CONV 2 +16 VOLTS	64 477 D23 CONV 2 -6 VOLTS
65 500 A47 ROLL/YAW GAS JET STATUS	66 501 F10 RECORDER 2 -9.5 VOLTS	67 502 F11 RECORDER 2 PLAYBACK 6.4 KBS	68 503 C9 SP TX FWD POWER	69 504 D62 BAT CHG & RECON CMDS	70 505 D22 CONV 2 +5 VOLTS	71 506 B8 PRE-DEPLOYMENT 1	72 507 A43 SCAN HEAD D ANGLE
73 510 D1 BATTERY 1 CURRENT	74 511 F40 S/C DEPLOY AND EXP ORD	75 512 A31 REACTION WHEELS ON-OFF	76 513 A21 GAS CONTROL VALVES 1,2,5	77 514 A22 GAS CONTROL VALVES 3,4,6	78 515	79 516 F42 RECORDER 1 STATUS	80 517 D2 BATTERY 2 CURRENT
81 520 A40 SCAN HEAD A ANGLE	82 521 F25 EG 1 / F33 EG 2 0.00-0.02	83 522 F27 EG 1 / F35 EG 2 1.70-1.72 A/D CALIBRATION VOLTS	84 523 F29 EG 1 / F37 EG 2 3.18-3.20	85 524 F31 EG 1 / F39 EG 2 5.06-5.08	86 525 B4 SEPARATION & ARRAY 2 DEPLOY	87 526 D3 REGULATOR MODES	88 527 C7 WB TX B FWD POWER
89 530 A4 PITCH ERROR DEGREES	90 531 A5 ROLL ERROR DEGREES	91 532 A6 SCAN HEADS SUN ALARM	92 533 A21 GAS CONTROL VALVES 1,2,5	93 534 A22 GAS CONTROL VALVES 3,4,6	94 535	95 536 F43 RECORDER 2 STATUS	96 537
97 540 F14 DDHA 1 OSC TEMP	98 541 D11 BAT CMDS STATUS	99 542 F15 DDHA 2 OSC TEMP	100 543 D50 BATT 2 TEMP	101 544 D51 BATT 1 TEMP	102 545 D63 BAT DISCON CMD	103 546 B9 PRE-DEPLOYMENT 2	104 547 F5 RECORDER 1 GAS PRESSURE
105 550 A7 SCAN HEADS TRACKING CHECK	106 551 A10 YAW ERROR DEGREES	107 552 A31 REACTION WHEELS ON-OFF	108 553 A21 GAS CONTROL VALVES 1,2,5	109 554 A22 GAS CONTROL VALVES 3,4,6	110 555	111 556 F44 LFTA BIT RATES	112 557 D59 LOAD BUS CURRENT
113 560 A16 OPEP AND ARRAY DRIVE MOTORS	114 561 A17 ROLL TACH WHEEL RPM	115 562 A18 PITCH TACH WHEEL RPM	116 563 A19 YAW TACH WHEEL RPM	117 564 A20 REACTION WHEELS DIRECTION	118 565 A23 ACS MODES SUN SENSOR	119 566 A24 PITCH RATE GYRO DEMOD	120 567 B3 ARRAY 1 DEPLOY
121 570 B2 EP6 DEPLOY	122 571 B6 EP3, EP4 JETS DEPLOY	123 572 B7 OPEP DEPLOY	124 573 A21 GAS CONTROL VALVES 1,2,5	125 574 A22 GAS CONTROL VALVES 3, 4, 6	126 575	127 576 F45 EG 1 / F47 EG 2 DDHA MODE	128 577 F46 EG 1 / F48 EG 2

Figure D-3. OGO-F SPACECRAFT TELEMETRY FORMAT—SUBCOM 2 EQUIPMENT GROUPS 1 AND 2

1 600 E1 ARRAY 1 INBO TEMP	2 601 E33 ARRAY 1 SUN SHADE TEMP	3 602 E3 ARRAY 2 INBO TEMP	4 603 E34 ARRAY 2 SUN SHADE TEMP	5 604 A3 ARGON BOTTLE TEMP	6 605 E6 +X SIDE (ADJ PCU) TEMP	7 606 E7 -Z DOOR (ADJ EXP 12, 18) TEMP & CON. 9	8 607 E8 -X SIDE (ADJ ACS INV.) TEMP
9 610 A2 ARGON LOW PRESSURE	10 611 A27 OPEP GYROS ON OFF	11 612 A29 OPEP GYRO TORQUE CURRENT	12 613 F41 RX SIGNAL PRESENT, DEPLOY SAFE	13 614 A32 ACS INVERTER TEMP	14 615 E17 EP5A EXP 18 TEMP	15 616 A14 OPEP ANGLE SINE	16 617 A15 OPEP ANGLE COSINE
17 620 E5 +X SIDE (ADJ DDHA) TEMP	18 621 E31 ASEP 1 TEMP	19 622 D13 ARRAY 1A THERMAL FIN TEMP	20 623 D14 ARRAY 2A THERMAL FIN TEMP	21 624 E13 EP 1 EXP 16 TEMP	22 625 E14 EP2 EXP 17 TEMP	23 626 E15 EP3 EXP 11 TEMP	24 627 E16 EP4 EXP 15 TEMP
25 630 D15 400 CPS SYNC	26 631 D16 2461 CPS SYNC	27 632 D36 CONV 7 +16 VOLTS	28 633 D37 CONV 7 +9 VOLTS	29 634 D38 CONV 7 -6 VOLTS	30 635 E26 SOEP 1 EXP 8,10 TEMP	31 636 F13 RECORDER 2 GAS PRESS	32 637 A44 CSA STATUS
33 640 A37 OPEP DRIVE SHAFT TEMP	34 641 E19 OPEP 1 TEMP	35 642 E20 OPEP 2 TEMP	36 643 E21 -Z DOOR (ADJ EXP 13,20, 21,23) TEMP	37 644 E22 +Z DOOR (ADJ EXP 14, 25, 28) TEMP	38 645 E23 +X SIDE (ADJ EXP 14, 28) TEMP	39 646 E24 -X SIDE (ADJ CON 8) TEMP	40 647 B14 DEPLOY BOTTLE 4 PRESSURE
41 650 C13 RX 1 AGC 1 DBM	42 651 C14 RX 1 AGC2 DBM	43 652 D24 CONV 3 +70 VOLTS	44 653 D25 CONV 3 +23 VOLTS	45 654 A35 PITCH RATE GYRO TACH RPM	46 655 E32 ASEP 2 EXP 23,25 TEMP	47 656 D26 CONV 4 +70 VOLTS	48 657 D27 CONV 4 +23 VOLTS
49 660 D39 CONV 8 +16 VOLTS	50 661 D40 CONV 8 +9 VOLTS	51 662 D41 CONV 8 -6 VOLTS	52 663 A28 OPEP MOTOR GYRO TACH	53 664 D32 CONV 6 +16 VOLTS	54 665 D33 CONV 6 +3 VOLTS	55 666 D34 CONV 6 -6 VOLTS	56 667 D35 CONV 6 -16 VOLTS
57 670 D28 CONV 5 +16 VOLTS	58 671 D29 CONV 5 +9 VOLTS	59 672 D30 CONV 5 -6 VOLTS	60 673 D31 CONV 5 -16 VOLTS	61 674 B11 DEPLOY BOTTLE 1 PRESSURE	62 675	63 676 C15 RX 2 AGC 1 DBM	64 677 C16 RX 2 AGC 2 DBM
65 700 E29 SOEP 2 EXP 9 TEMP	66 701 D21 CONV 2 +3 VOLTS	67 702 D6 ARRAY 1C FULL VOLTAGE	68 703 F1 RECORDER +9.5 VOLTS	69 704 F2 RECORDER -9.5 VOLTS	70 705 C1 WB TX A TEMP	71 706 C2 WB TX B TEMP	72 707 C3 SP TX TEMP
73 710 A2 ARGON LOW PRESSURE	74 711 A27 OPEP GYROS ON-OFF	75 712 A29 OPEP GYRO TORQUE CURRENT	76 713 F41 RX SIGNAL PRESENT, DEPLOY SAFE	77 714 A32 ACS INVERTER TEMP	78 715	79 716 A14 OPEP ANGLE SINE	80 717 A15 OPEP ANGLE COSINE
81 720 F26 EG 1 / F34 EG 2 030-032	82 721 F28 EG 1 / F36 EG 2 264-266 A/D CALIBRATION VOLTS	83 722 F30 EG 1 / F38 EG 2 412-414	84 723 F8 RECORDER 1 BASE TEMP	85 724 F16 RECORDER 2 BASE TEMP	86 725 F17 LFTA BOARD 2 TEMP	87 726 F20 DDHA 1 BOARD 4 TEMP	88 727 F22 DDHA 2 BOARD 4 TEMP
89 730 D15 400 CPS SYNC	90 731 D16 2461 CPS SYNC	91 732 D36 CONV 7 +16 VOLTS	92 733 D37 CONV 7 +9 VOLTS	93 734 D38 CONV 7 -6 VOLTS	94 735	95 736 F13 RECORDER 2 GAS PRESS	96 737 A44 CSA STATUS
97 740 A34 PITCH WHEEL TEMP	98 741 A33 YAW WHEEL TEMP	99 742 B5 EP 1, EP2 136 ANT DEPLOY	100 743 A30 OPEP GYRO CASE TEMP	101 744 A26 SUN SENSOR 2 TEMP	102 745 A25 SUN SENSOR 1 TEMP	103 746 A9 HOR SCAN HEAD A TEMP	104 747 E30 -Y PANEL TEMP
105 750 C13 RX 1 AGC 1 DBM	106 751 C14 RX 1 AGC 2 DBM	107 752 D24 CONV 3 +70 VOLTS	108 753 D25 CONV 3 +23 VOLTS	109 754 A35 PITCH RATE GYRO TACH RPM	110 755	111 756 D26 CONV 4 +70 VOLTS	112 757 D27 CONV 4 +23 VOLTS
113 760 D39 CONV 8 +16 VOLTS	114 761 D40 CONV 8 +9 VOLTS	115 762 D41 CONV 8 -6 VOLTS	116 763 A28 OPEP GYRO MOTOR TACH	117 764 D32 CONV 6 +16 VOLTS	118 765 D33 CONV 6 +9 VOLTS	119 766 D34 CONV 6 -6 VOLTS	120 767 D35 CONV 6 -16 VOLTS
121 770 D28 CONV 5 +16 VOLTS	122 771 D29 CONV 5 +9 VOLTS	123 772 D30 CONV 5 -6 VOLTS	124 773 D31 CONV 5 -16 VOLTS	125 774 B11 DEPLOY BOTTLE 1 PRESSURE	126 775	127 776 C15 RX 2 AGC 1 DBM	128 777 C16 RX 2 AGC 2 DBM

Figure D-4. OGO-F SPACECRAFT TELEMETRY FORMAT—SUBCOM 3 EQUIPMENT GROUPS 1 AND 2

APPENDIX E

COMMAND VERIFICATION PROCEDURES

SIMPLIFIED OGO-F CMD VERIFICATION PROCEEDURE   FEB 27, 1969
ACCORDING TO S/C SYSTEM

CMD	LITERAL	VERIFICATION
POWER SYSTEM		
354	REG 1 NORM	ENABLE BIT
374	REG 1 FAIL	ENABLE BIT
315	REG 2 NORM	ENABLE BIT
335	REG 2 FAIL	ENABLE BIT
376	REG 1 8.3/12 A	ENABLE BIT
356	REG 1 0.4/3.7 A	ENABLE BIT
337	REG 2 8.3/12 A	ENABLE BIT
317	REG 2 0.4/3.7 A	ENABLE BIT
144	REG1+2 0.4/8.7 A	ENABLE BIT
164	REG 1+2 3.7/12A	ENABLE BIT
056	CHG BUS PAR-NORM	ENABLE BIT
076	CHG BUS PAR-INHIB	ENABLE BIT
336	CYCLE CHARGE	ENABLE BIT
316	CONT CHARGE	ENABLE BIT
120	BAT EXECUTE	ENABLE BIT
104	BAT 1 NORM	ENABLE BIT
124	BAT 1 DISCONNECT	ENABLE BIT
145	BAT 1 CONDITIONED	ENABLE BIT
165	BAT 1 RECONDITION	ENABLE BIT
016	BAT 2 NORM	ENABLE BIT
036	BAT 2 DISCONNECT	ENABLE BIT
017	BAT 2 CONDITIONED	ENABLE BIT
037	BAT 2 RECONDITION	ENABLE BIT
105	95F SW NORM	ENABLE BIT
125	95F SW OVRD	ENABLE BIT
006	UV 1 RESET	ENABLE BIT
026	UV 1 OVRD	ENABLE BIT
046	UV 2 RESET	ENABLE BIT
066	UV 2 OVRD	ENABLE BIT
ACS SYSTEM		
101	ACS OFF	S2-040(D46) = 000 TO 010 OCTAL
146	ACS ON-JETS NORM	ENABLE BIT
047	CSA SAFE	ENABLE BIT
067	CSA ARM	S3-032(A44) = 033 TO 072 OCTAL OR 247 TO 306 OCTAL
014	WHEEL DELAY ENABLE	ENABLE BIT
355	ARRAY DELAY ENABLE	ENABLE BIT
375	ARRAY DELAY DISABL	ENABLE BIT
141	ACS ENABLE	ENABLE BIT
161	ACS EXECUTE	ENABLE BIT
121	ACS NORM	ENABLE BIT
102	ACS MODE 1	ENABLE BIT
122	ACS MODE 2A	ENABLE BIT
142	ACS MODE 2C	ENABLE BIT
162	ACS MODE 3	ENABLE BIT
167	OPEP ENABLE	ENABLE BIT
147	OPEP DISABLE	ENABLE BIT
057	OP GYRO/HTR OFF	ENABLE BIT
077	OP GYRO OFF/HTR ON	ENABLE BIT
072	OPEP GYRO ON/1 SEL	S3-010(A27) = 032 TO 125 OCTAL
071	OPEP GYRO SEL AUTO	ENABLE BIT
007	OPEP GYRO MODE	ENABLE BIT
027	OPEP SCAN MODE	ENABLE BIT
267	ARRAY SLEW NORM	ENABLE BIT
247	ARRAY SLEW CCW	ENABLE BIT
207	ARRAY SLEW CW	ENABLE BIT
035	PR GYRO ON	S3-045(A35) = 013 TO 074 OCTAL
015	PR GYRO OFF	S3-045(A35) = 000 TO 012 OCTAL

103	SUN SENSOR NORM	ENABLE BIT
123	SUN SENSOR COARSE	ENABLE BIT
034	GAS DELAY ENABLE	ENABLE BIT
166	ROLL JETS DISABLE	ENABLE BIT
133	A PITCH JETS DISAB	ENABLE BIT
153	E YAW JETS DISABLE	ENABLE BIT
004	GAS PULSE EXECUTE	ENABLE BIT
174	F PTCH/ROLL PRESEL	ENABLE BIT
334	E YAW/-ROLL PRESEL	ENABLE BIT
334	H ROLL(2) SELECT	ENABLE BIT
314	D -PITCH(3/6) SEL	ENABLE BIT
314	E PLUS PITCH(1/4)	ENABLE BIT
173	H -ROLL(5) SELECT	ENABLE BIT
173	F -YAW(3/4) SELECT	ENABLE BIT
173	B YAW(1/6) SELECT	ENABLE BIT

C+DH SYSTEM

060	WB OFF	LOS 400.25 MHZ
020	WB A ON	AOS 400.25 MHZ, THEN S3-043 (D24) = 250 TO 271 OCTAL
040	WB B ON	AOS 400.25 MHZ,THEN S3-043(D24) = 250 TO 271 OCTAL
001	WB OVERRIDE	AOS 400.25 MHZ
044	SP OFF	LOS 400.85 MHZ
024	SP ON	AOS 400.85 MHZ
054	SP MOD NORM	FM/PM DATA ON 400.85 MHZ
074	SP MOD PCM	PCM/PM DATA ON 400.85 MHZ
143	SP TO OMNI 1/EP 1	ENABLE BIT
163	SP TO OMNI 2/MB	ENABLE BIT
064	100 MW OFF	LOS 136.2 MHZ
005	100 MW A ON	ENABLE BIT
025	100 MW B ON	ENABLE BIT
075	R+RR 1 OFF	S1-084(C17) = 000 TO 040 OCTAL
055	R+RR 1 ON	S1-084(C17) = 041 TO 341 OCTAL
350	R+RR 2 ON/1 DISABL	S1-009(C19)= 031 TO 377
370	R+RR 2 OFF/1 ENABL	S1-009(C19) = 000 TO 030 OCTAL
357	CMD ADD 060 ENABLE	ENABLE BIT
073	CMD ADD 060 DISABLE	ENABLE BIT
002	TR 1 ON	S2-079(F42)=417 OCTAL
022	TR 1 OFF	S2-079(F42) = 400 OCTAL
042	TR 2 ON	S2-095(F43) = 417 OCTAL
062	TR 2 OFF	S2-095(F43) = 400 OCTAL
061	TAPE PB	PCM DATA TO 128 KB
003	EG 1 ON	S3-057(D28)=230 TO 267 OCTAL
023	EG 1 OFF	S3-057(D28) = 000 TO 010 OCTAL
043	EG 2 ON	S3-053(D32) = 230 TO 270 OCTAL
063	EG 2 OFF	S3-053(D32) = 000 TO 010 OCTAL
041	EG 1 RT	MC-065/BIT-9 TO 1
021	EG 2 RT	MC 065/BIT-9 TO ZERO
011	RT MC	MC-066 = 600 TO 637 OCTAL
031	RT ASC	LOSE SUBCOM LOCK
051	RT FF	MC-066 = 440 TO 477 OCTAL
012	DS MC	MC-067 = 200 TO 237 OCTAL
032	DS ASC	MC-067 = 100 TO 137 OCTAL
052	DS FF	MC-067 = 040 TO 077 OCTAL
053	64 KB RATE	PCM DATA AT 64 KBS
033	16 KB RATE	PCM DATA AT 16 KBS
013	8 KB RATE	PCM DATA AT 8 KBS SPLIT-PHASE
010	MO 1 SEL	ENABLE BIT
030	MO 2 SEL	ENABLE BIT
		MC-066 = 500 TO 537 OCTAL
050	HFTU 1 SEL	ENABLE BIT
070	HFTU 2 SEL	ENABLE BIT

CMD SYSTEM

114	CMD NET 1 SEL	S1-118(F49) = 304 TO 330 OCTAL
134	CMD NET 2 SEL	S1-118(F49) = 140 TO 164 OCTAL
155	CMD NET 2 SEL/ALT	S1-118(F49) = 140 TO 164 OCTAL
111	GRP A NET 1	S1-120(F50) = 303 TO 330 OCTAL
131	GRP B NET 1	S1-120(F50) = 252 TO 277 OCTAL
151	GRP C NET 1	S1-120(F50) = 224 TO 251 OCTAL
171	GRP D NET 1	S1-120(F50) = 171 TO 215 OCTAL
311	GRP E NET 1	S1-120(F50) = 140 TO 164 OCTAL
331	GRP F NET 1	S1-120(F50) = 107 TO 133 OCTAL
351	GRP G NET 1	S1-120(F50) = 055 TO 101 OCTAL
371	GRP H NET 1	S1-120(F50) = 024 TO 050 OCTAL
312	GRP A NET 2	S1-120(F50) = 303 TO 327 OCTAL
332	GRP B NET 2	S1-120(F50) = 252 TO 276 OCTAL
352	GRP C NET 2	S1-120(F50) = 224 TO 250 OCTAL
372	GRP D NET 2	S1-120(F50) = 171 TO 215 OCTAL
112	GRP E NET 2	S1-120(F50) = 140 TO 165 OCTAL
132	GRP F NET 2	S1-120(F50) = 107 TO 134 OCTAL
152	GRP G NET 2	S1-120(F50) = 055 TO 102 OCTAL
172	GRP H NET 2	S1-120(F50) = 024 TO 050 OCTAL

OTHER

106	OPEP WRAP HTR OFF	ENABLE BIT
126	OPEP WRAP HTRS ON	ENABLE BIT
347	EP HTRS ON	ENABLE BIT
367	EP HTRS OFF	ENABLE BIT
342	OPEP/ASEP HTR ON	S1-022 = 001 TO 377 OCTAL
362	OPEP/ASEP HTRS OFF	S1-022 TO 000
100	ORD SEQ ARM	ENABLE BIT
107	EXP ORD ARM	S2-010(F40) = 136 TO 377 OCTAL
127	EXP ORD SAFE	S2-010(F40) = 000 TO 127 OCTAL
346	SAI ON	ENABLE BIT
366	SAI OFF	ENABLE BIT
140	BOOM 1 DEPLOY	ENABLE BIT
160	BOOM 2 DEPLOY	ENABLE BIT

EXP F01

200	F01 ON	S1-057 = 020 TO 377 OCTAL
220	F01 OFF	S1-057 = 000 TO 017 OCTAL
110	A F01 IFC	ENABLE BIT
153	G F01 ORD FIRE/IFC	ENABLE BIT
110	H F01 RED ORD/IFC	ENABLE BIT

EXP F02

217	F02 SYS 1 ON	S1-042 = 016 TO 170 OCTAL
237	F02 SYS 1 OFF	S1-042 = 000 TO 015 OR 171 TO 377 OCTAL
240	F02 SYS 2 ON	S1-042 = 171 TO 377 OCTAL
260	F02 SYS 2 OFF	S1-042 = 000 TO 170 OCTAL
113	A F02 SYS MODE 1	ENABLE BIT
115	A F02 SYS MODE 2	ENABLE BIT
130	A F02 SYS MODE 3	ENABLE BIT

EXP F03

201	F03 ON	MC-120 = 020 TO 377 OCTAL
221	F03 OFF	MC-120 = 000 TO 017 OCTAL
150	A F03 SWEEP RATE	ENABLE BIT

EXP F04

307	F04 ON	S1-094 = 030 TO 377 OCTAL
327	F04 OFF	S1-094 = 000 TO 027 OCTAL
330	F04 ELEC GUN ON	ENABLE BIT
310	F04 ELEC GUN INHBT	ENABLE BIT
153	A F04 ELECT GUN 1	ENABLE BIT
154	A F04 ELECT GUN 2	ENABLE BIT

170	A F04 CONFIG 1	ENABLE BIT
173	A F04 CONFIG 2	ENABLE BIT
174	A F04 CONFIG 3	ENABLE BIT
154	G F04 ORD FIRE	ENABLE BIT
113	H F04 RED ORD FIRE	ENABLE BIT
EXP F05		
202	F05 ON	S1-055 = 200 TO 377 OCTAL
222	F05 OFF	S1-055 = 000 TO 177 OCTAL
203	F05 VA SHORT SWEEP	ENABLE BIT
223	F05 VA LONG SWEEP	ENABLE BIT
205	F05 STEER 1	ENABLE BIT
225	F05 VS STEER 2	ENABLE BIT
206	F05 STEER 3	ENABLE BIT
226	F05 VS STEER 4	ENABLE BIT
204	F05 VS STOP	ENABLE BIT
224	F05 VS AUTO	ENABLE BIT
230	F05 FIL STBY OFF	ENABLE BIT
210	F05 FIL STDBY	ENABLE BIT
130	H F05 PRESET	ENABLE BIT
115	H F05 EXECUTE	ENABLE BIT
EXP F06		
211	F06 ON	S1-090 = 120 TO 377 OCTAL
231	F06 OFF	S1-090 = 000 TO 117 OCTAL
175	A F06 MODE	ENABLE BIT
314	A F06 APERTURE POT	ENABLE BIT
170	G F06 ORD FIRE	ENABLE BIT
133	H F06 RED ORD FIRE	ENABLE BIT
EXP F07		
212	F07 ON	MC-042 = 100 TO 777 OCTAL
232	F07 OFF	MC-042 = 000 TO 015 OCTAL
EXP F08		
213	F08 ON	S1-117 = 010 TO 377 OCTAL
233	F08 OFF	S1-117 = 000 TO 007 OCTAL
334	A F08 S FIXED GAIN	ENABLE BIT
373	A F08 R FIXED GAIN	ENABLE BIT
353	A F08 IFC	ENABLE BIT
EXP F09		
214	F09 ON	MC-050 = 010 TO 777 OCTAL
234	F09 OFF	MC-050 = 000 TO 007 OCTAL
154	B F09 HVPS 1	ENABLE BIT
170	B F09 HVPS 2	ENABLE BIT
133	B F09 MODE INVER	ENABLE BIT
135	B F09 RESET/LG SWP	ENABLE BIT
115	B F09 SAMPLE CHG A	ENABLE BIT
130	B F09 SAMPLE CHG B	ENABLE BIT
110	B F09 SHORT SCAN 1	ENABLE BIT
113	B F09 SHORT SCAN 2	ENABLE BIT
150	B F09 SHORT SCAN 3	ENABLE BIT
153	B F09 SHORT SCAN 4	ENABLE BIT
EXP F10		
215	F10 ON	S1-091 = 010 TO 377 OCTAL
235	F10 OFF	S1-091 = 000 TO 007 OCTAL
135	H F10 SEQ STAR/STP	ENABLE BIT
150	H F10 MOD/CAL LAMP	ENABLE BIT
EXP F11		
216	F11 ON	S1-027 = 010 TO 377 OCTAL
236	F11 OFF	S1-027 = 000 TO 007 OCTAL

334	B F11 6300 A FIXED	ENABLE BIT
353	B F11 3914 A FIXED	ENABLE BIT
174	B F11 NORM MODE	ENABLE BIT
373	B F11 MIRROR STOP	ENABLE BIT
175	B F11 ZERO PLUS.25	ENABLE BIT
314	B F11 ZERO-.25	ENABLE BIT
EXP F12		
304	F12 ON	S1-044 = 030 TO 377 OCTAL
324	F12 OFF	S1-044 = 000 TO 027 OCTAL
303	F12 FIL ON	ENABLE BIT
323	F12 FIL OFF	ENABLE BIT
110	C F12 CAL INHIBIT	ENABLE BIT
113	C F12 FIL CHANGE	ENABLE BIT
115	C F12 FIL LEV CHG	ENABLE BIT
173	G F12 ORD FIRE	ENABLE BIT
153	H F12 RED ORD FIRE	ENABLE BIT
EXP F13		
241	F13 ON	S1-109 = 020 TO 377 OCTAL
261	F13 OFF	S1-109 = 000 TO 017 OCTAL
242	F13 DOOR CLOSE	ENABLE BIT
263	F13 DOOR LATCH	ENABLE BIT
243	F13 DOOR UNLATCH	ENABLE BIT
262	F13 DOOR OPEN	ENABLE BIT
EXP F14		
244	F14 ON	S1-061 = 010 TO 377 OCTAL
264	F14 OFF	S1-061 = 000 TO 007 OCTAL
153	C F14 HVPS ON	ENABLE BIT
150	C F14 HVPS OFF	ENABLE BIT
133	C F14 NORM MODE	ENABLE BIT
334	C F14 HORZ SCAN B	ENABLE BIT
314	C F14 HORZ SCAN D	ENABLE BIT
175	C F14 SMP SCAN 30D	ENABLE BIT
170	C F14 SCAN SHIFT 2	ENABLE BIT
154	C F14 SCAN SHIFT 4	ENABLE BIT
173	C F14 SCAN SHIFT-2	ENABLE BIT
174	C F14 SCAN SHIFT-4	ENABLE BIT
135	C F14 THER REG OFF	ENABLE BIT
130	C F14 IFC	ENABLE BIT
EXP F15		
245	F15 ON	S1-097 = 016 TO 377 OCTAL
265	F15 OFF	S1-097 = 000 TO 015 OCTAL
135	D F15 SUP DATA MOD	ENABLE BIT
150	D F15 FAIL MODE	ENABLE BIT
175	D F15 LIFTOFF MODE	ENABLE BIT
133	D F15 TR DATA MODE	ENABLE BIT
154	D F15 IMPULSE ARM	ENABLE BIT
130	D F15 ANALZ V REV	ENABLE BIT
110	D F15 ORB PER TRAN	ENABLE BIT
113	D F15 REPHASE	ENABLE BIT
115	D F15 TR PB	ENABLE BIT
EXP F16		
246	F16 ON	S1-020 = 020 TO 377 OCTAL
266	F16 OFF	S1-020 = 000 TO 017 OCTAL
373	C F16 NORM MODE	S1-020 = 010 TO 177 OCTAL
353	C F16 ENERGY MODE	S1-120 = 200 TO 377 OCTAL
EXP F17		
250	F17 ON	S1-073 = 015 TO 377 OCTAL
270	F17 OFF	S1-073 = 000 TO 014 OCTAL

251	F17 HVPS ON	ENABLE BIT
271	F17 HVPS OFF	ENABLE BIT
174	D F17 HVPS OUTPUT	ENABLE BIT
173	D F17 IFC MODE SEL	ENABLE BIT
170	D F17 DISC THRSHLD	ENABLE BIT
EXP F18		
252	F18 ON	S1-054 = 005 TO 377 OCTAL
272	F18 OFF	S1-054 = 000 TO 004 OCTAL
353	D F18 HVPS ON/OFF	ENABLE BIT
373	D F18 PM CAL EN/DS	ENABLE BIT
334	D F18 IFC ON/OFF	ENABLE BIT
EXP F19		
253	F19 ON	S1-036 = 020 TO 377 OCTAL
273	F19 OFF	S1-036 = 000 TO 017 OCTAL
170	H F19 COINC DISABLE	ENABLE BIT
154	H F19 IFC INHIBIT	ENABLE BIT
EXP F20		
305	F20 ON	S1-100 = 010 TO 377 OCTAL
325	F20 OFF	S1-106 = 000 TO 007 OCTAL
130	E F20 D1 ANALYS	ENABLE BIT
135	E F20 D2 ANALYS	ENABLE BIT
133	E F20 D3 ANALYS	ENABLE BIT
113	E F20 D1/D3 ANALYS	ENABLE BIT
115	E F20 D2/D3 ANALYS	ENABLE BIT
110	E F20 D5/D6 ANALYS	ENABLE BIT
150	E F20 MODE RESET	ENABLE BIT
EXP F21		
255	F21 RB A ON	S1-101 = 160 TO 377 OCTAL
275	F21 RB A OFF	S1-101 = 000 TO 157 OCTAL
300	F21 RB B ON	S1-126 = 160 TO 377 OCTAL
320	F21 RB B OFF	S1-126 = 000 TO 157 OCTAL
256	F21 SCLR A ON	S1-101 = 110 TO 157 OR 254 TO 377 OCTAL
276	F21 SCLR A OFF	S1-101 = 000 TO 107 OR 160 TO 253 OCTAL
301	F21 SCLR B ON	S1-126 = 110 TO 157 OR 254 TO 377 OCTAL
321	F21 SCLR B OFF	S1-126 = 000 TO 107 OR 160 TO 253 OCTAL
277	F21 A IGN ON	ENABLE BIT
257	F21 A IGN INHIBIT	ENABLE BIT
322	F21 B IGN ON	ENABLE BIT
302	F21 B IGN INHIBIT	ENABLE BIT
EXP F22		
340	F22 ON	S1-128 = 030 TO 377 OCTAL
360	F22 OFF	S1-128 = 000 TO 027 OCTAL
174	E F22 MODE CHANGE	ENABLE BIT
173	E F22 SPECTRM GAIN	ENABLE BIT
170	E F22 WAVFORM GAIN	ENABLE BIT
175	E F22 SP ON/OFF	ENABLE BIT
154	E F22 IFC ON/OFF	ENABLE BIT
EXP F23		
341	F23 ON	MC-D62 = 030 TO 377 OCTAL
361	F23 OFF	MC-062 = 000 TO 027 OCTAL
373	G F23 ANT HTR OFF	ENABLE BIT
373	H F23 ANT HTR ON	ENABLE BIT
174	G F23 ANT 400HZ ON	ENABLE BIT
153	D F23 ANT 400H OFF	ENABLE BIT
353	E F23 GAIN SHIFT	ENABLE BIT
373	E F23 MODE SHIFT	ENABLE BIT
174	H F23 PLUS ANT SEL	ENABLE BIT
314	G F23 -X ANT SEL	ENABLE BIT

175	H F23 ANT EXTEND	ENABLE BIT
334	G F23 ANT RETRACT	ENABLE BIT
175	G F23 EJECT ARM 1	ENABLE BIT
135	A F23 EJECT ARM 2	ENABLE BIT
353	H F23 ANT EJECT	ENABLE BIT
EXP F24		
254	F24 ON	MC-069 = 005 TO 377 OCTAL
274	F24 OFF	MC-069 = 000 TO 004 OCTAL
306	F24 IC GATING ON	ENABLE BIT
326	F24 IC GATING OFF	ENABLE BIT
343	F24 SP ON	ENABLE BIT
363	F24 SP OFF	ENABLE BIT
110	F F24 PH RECV-1 INJ	ENABLE BIT
113	F F24 PH REC 1 SWP	ENABLE BIT
115	F F24 PH REC 2 SWP	ENABLE BIT
133	F F24 ANT BIAS	ENABLE BIT
154	F F24 CMD ZERO	ENABLE BIT
153	F F24 CMD ONE	ENABLE BIT
170	F F24 CMD EXECUTE	ENABLE BIT
150	F F24 ADD ZERO	ENABLE BIT
135	F F24 ADD ONE	ENABLE BIT
130	F F24 PH REC 2 INJ	ENABLE BIT
373	F F24 ARM EJEC ORD	ENABLE BIT
353	G F24 ORD FIRE	ENABLE BIT
314	H F24 RED DEP ARM	ENABLE BIT
EXP F25		
344	F25 ON	S1-043 = 030 TO 377 OCTAL
364	F25 OFF	S1-043 = 000 TO 027 OCTAL
334	F F25 SP ON/OFF	ENABLE BIT
353	F F25 IMPED ON/OFF	ENABLE BIT
175	F F25 BAND CMD/CYC	ENABLE BIT
314	F F25 BAND ADV	ENABLE BIT
EXP F26		
345	F26 ON	S1-018 = 010 TO 377 OCTAL
365	F26 OFF	S1-018 = 000 TO 007 OCTAL
133	G F26 5577 A FIXED	ENABLE BIT
130	G F26 5890 A FIXED	ENABLE BIT
110	G F26 NORM MODE	ENABLE BIT
113	G F26 ZERO PLUS.25	ENABLE BIT
115	G F26 ZERO -.25	ENABLE BIT
150	G F26 MIRROR STOP	ENABLE BIT

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APPENDIX-F

RADIOACTIVE SOURCES

Table F-1

OGO-F Experiment Radioactivity Source

Experiment No.	Isotope	Original Activity	Use
F-08	Fe 55 Am 241	240μc 1μc	Internal, calibration
F-09	A3 (2 each)	50μc each	Internal, calibration
F-16	Am 241 (7 each)	.02μc each 10μc each	Internal, calibration
F-18	Am 241 Am 241 Am 241 Co 60	10 mCi .0058μc .00675μc 10.7μc	Testing Internal Internal Testing
F-19	Am 241 (2 each)	.01μc each	Internal
F-20	Co 60 (2 each)	23μc each	External, calibration

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APPENDIX G
ORDNANCE

Table G-1
OGO-F Experiment Ordnances

Item	Exp.	Location	Type	Quantity	Purpose
1	F-01	OPEP-1	Holex 6299A Plunger	1	Cage release
2	F-04	OPEP-2	Conax 1617-031-01	2	Open chamber door (ejects mechansim)
3	F-06	OPEP-1	Hercules Powder BA31K3	2	Open vacuum chamber (ejects mechansim)
4	F-12	-Z Door	Atlantic Research Bellows Motor 5 ± 2 ohms 0.3 ± 0.1 amp NN-D-5	2	Open scanner door
5	F-24	EP-5	Highshear SL-10-36 Line Cutter	2	Antenna deploy
			Holex 2802	1	Antenna eject
6	F-23	ASEP-1	Holex 2801	1	Antenna eject
		ASEP-2	Holex 2801	1	Antenna eject

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APPENDIX H

NOMINAL OGO-F ORBITAL ELEMENTS

Perigee - 400 km

Apogee - 1100 km

Inclination - 82 Degrees Prograde

Nodal Regression - Plus 0.945 Deg/Day

Latitude of Perigee - +21 Degrees

Argument of Perigee - 159 Degrees

Motion - Minus 3.07 Deg/Day

Anomalistic Period - 99.79 Minutes

Eccentricity - 0.0493

Semi-major Axis - 7127 km

Approx Launch Time - 1500Z

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