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Mission Operation Report

Office of Space Science

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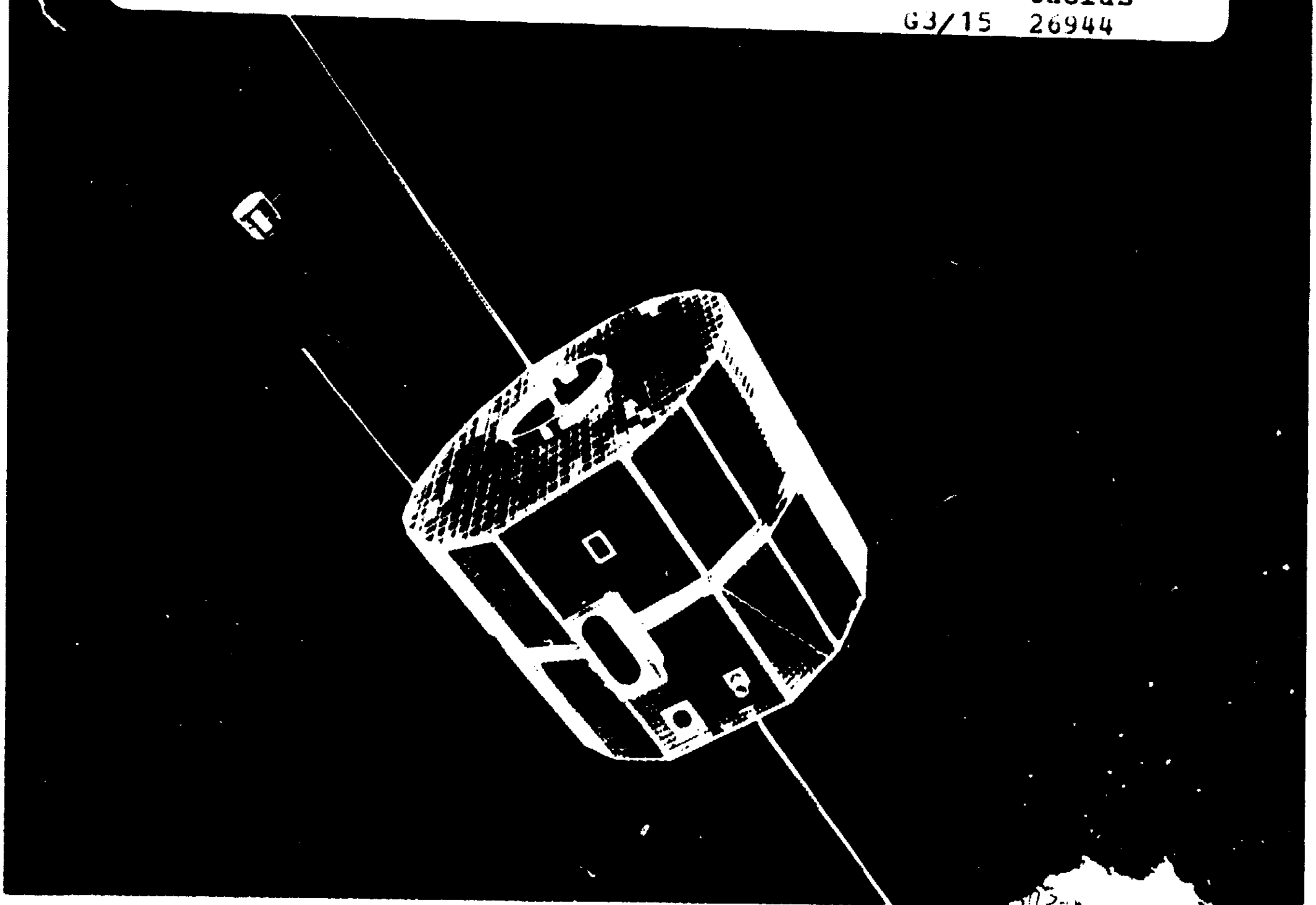

Dynamics Explorer

FOREWORD

MISSION OPERATION REPORTS are published expressly for the use of NASA Senior Management, as required by the Administrator in NASA Management Instruction HQMI 8610.1A, effective October 1, 1974. The purpose of these reports is to provide NASA Senior Management with timely, complete, and definitive information on flight mission plans, and to establish official Mission Objectives which provide the basis for assessment of mission accomplishment.

Prelaunch reports are prepared and issued for each flight project just prior to launch. Following launch, updating (Post Launch) reports for each mission are issued to keep General Management currently informed of definitive mission results as provided in NASA Management Instruction HQMI 8610.1A.

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Prelaunch
Mission Operation Report
No. S-850-81-03

TO: A/Administrator JUL 28 1981

FROM: S/Acting Associate Administrator for Space Science

SUBJECT: Dynamics Explorer Launch

The Dynamics Explorer (DE) Mission is scheduled to be launched from the Western Space and Missile Center, Vandenberg Air Force Base at Lompoc, California, by a three-stage Delta 3913 launch vehicle no earlier than July 31, 1981. The launch window is 5:55 a.m. to 6:15 a.m. EDT. A basic 13-month mission is planned, although the lifetime of the lower altitude DE-B spacecraft, based on current solar activity, is expected to be about 30 months before reentry will occur.

The DE program is designed to supply specific knowledge about the coupling of energy, electric currents, electric fields, and plasmas between the magnetosphere, the ionosphere, and the atmosphere.

The attached Mission Operation Report contains specific details pertinent to this mission. A total of 15 instruments and investigators and six non-flight hardware investigators, representing 10 institutions, were selected in response to an Announcement of Opportunity issued to carry out the science objectives. A science data processing system, located at GSFC, features an on-line central processing and analysis system to perform the majority of data reduction and analysis for the science investigations.

GSFC is responsible for overall project management, instrument development, data acquisition, and operation of the satellite, as well as data processing and management of the investigations program. RCA Astro Electronics Division was the spacecraft contractor.

Andrew J. Stofan

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GENERAL

The Dynamics Explorer (DE) program is an important part of a broad Solar-Terrestrial Physics program dedicated to achieving an understanding of the processes which control man's near space environment. This environment is dominated by energy from the Sun, which arrives in the vicinity of the Earth in two forms, as electromagnetic energy and as the plasma flow of the solar wind. This energy interacts with the Earth's magnetosphere and atmosphere in a variety of ways. It affects the state of the atmosphere, the ionosphere, and magnetosphere, as well as more familiar phenomena such as climate and weather, auroral displays, and radio disturbances.

New information on the effect of solar radiation on the lower thermosphere and upper atmosphere was obtained by the Atmosphere Explorers. New information on interactions between solar wind and the magnetosphere was obtained from the International Sun-Earth Explorer (ISEE) Program. Understanding the coupling phenomena between the Earth's lower thermosphere and the magnetosphere is essential to a comprehension of our immediate planetary environment. This is the purpose of the DE program.

NASA MISSION OBJECTIVES

The primary mission objective of the Dynamics Explorer mission is to investigate the strong interactive processes coupling the hot, tenuous convecting plasmas of the magnetosphere and the cooler, denser plasmas and gases co-rotating in the Earth's ionosphere, upper atmosphere and plasmasphere. To obtain this objective, measurements will be made in five general categories:

- electric field induced convection
- magnetosphere-ionosphere electric currents
- direct energy coupling between the magnetosphere and the ionosphere
- mass coupling between the ionosphere and the magnetosphere
- wave, particle, and plasma interactions.

Fulfillment of this objective will be accomplished by analyzing the measurements obtained from the two Dynamics Explorer satellites from co-planar orbits simultaneously at two altitudes near common magnetic flux tubes scanned from polar to equatorial latitudes.

Franklin D. Martin
Franklin D. Martin, Director
Solar Terrestrial and
Astrophysics Division

Date: 7/27/81

Andrew J. Stofan
Acting Associate Administrator
for Space Science

Date: 7/22/81

Marius Weinreb
Marius Weinreb, Program Manager
Dynamics Explorer

Date: July 17, 1981

MISSION DESCRIPTION

The DE mission consists of two spacecraft (S/C) to be launched simultaneously from the WSMC and placed into polar, coplanar orbits. The DE-A will be placed in an elliptical orbit with a perigee of approximately 675 km and apogee of 24,875 km. The DE-B will be placed in a lower elliptical orbit with a perigee of 305 km and an apogee of 1300 km. A minimum scientific lifetime of 1 year is planned for both spacecraft. Individually, each spacecraft is capable of contributing to scientific knowledge. However, the mission basically relies on correlative sets of measurements from the two S/C. DE-B will have a perigee lower than 350 km for neutral composition, and temperature and wind measurements, and an initial apogee of 1300 km to allow measurements above the interaction regions for suprathermal ions and plasma flow measurements at the feet of the magnetosphere field lines. DE-A will have an apogee of 4.95 Earth radii (geocentric) for global auroral imaging, wave measurements in the heart of the magnetosphere, and crossings of auroral field lines at several earth radii. The mission lifetime for the DE-B, based on orbital conditions, will range from 13 months to 34 months with an anticipated life of 18 to 24 months.

MISSION SEQUENCE

The launch sequence of events from liftoff through DE-A and DE-B separation that will be followed to achieve DE mission objectives are tabulated in Table 1. The orbit initiation for both DE-A and DE-B is shown in Figure 1. The sequence of various engine cutoff stages to acheive desired altitude for DE-B is shown in Figure 2.

TABLE 1

LAUNCH SEQUENCE OF EVENTS FOR DE-A AND DE-B

Event	Time (Sec.)
Liftoff	0.0
Solid Motor Burnout (6)	57.8
Solid Motor Ignition (3)	60.0
Jettison 6 Solids	78.0/79.0
Solid Motor Burnout (3)	118.0
Jettison 3 Solids	123.5
Main Engine Cutoff (MECO)	226.7
Stage II Ignition	239.7
Fairing Jettison	244.0
First Cutoff - Stage II (SBCO 1)	519.0
Restart Stage II	850.3
Final Cutoff - Stage II (SBCO 2)	875.3
Separate DE-B	1150.0
Separate DE-B PAF	1375.0
Fire Spin Rockets	2435.1
Jettison Stage II	2437.1
Stage III Ignition	2478.6
Stage III Burnout	2519.6
Stage DE-A	2595.1

DE-A and DE-B Orbital Initiation

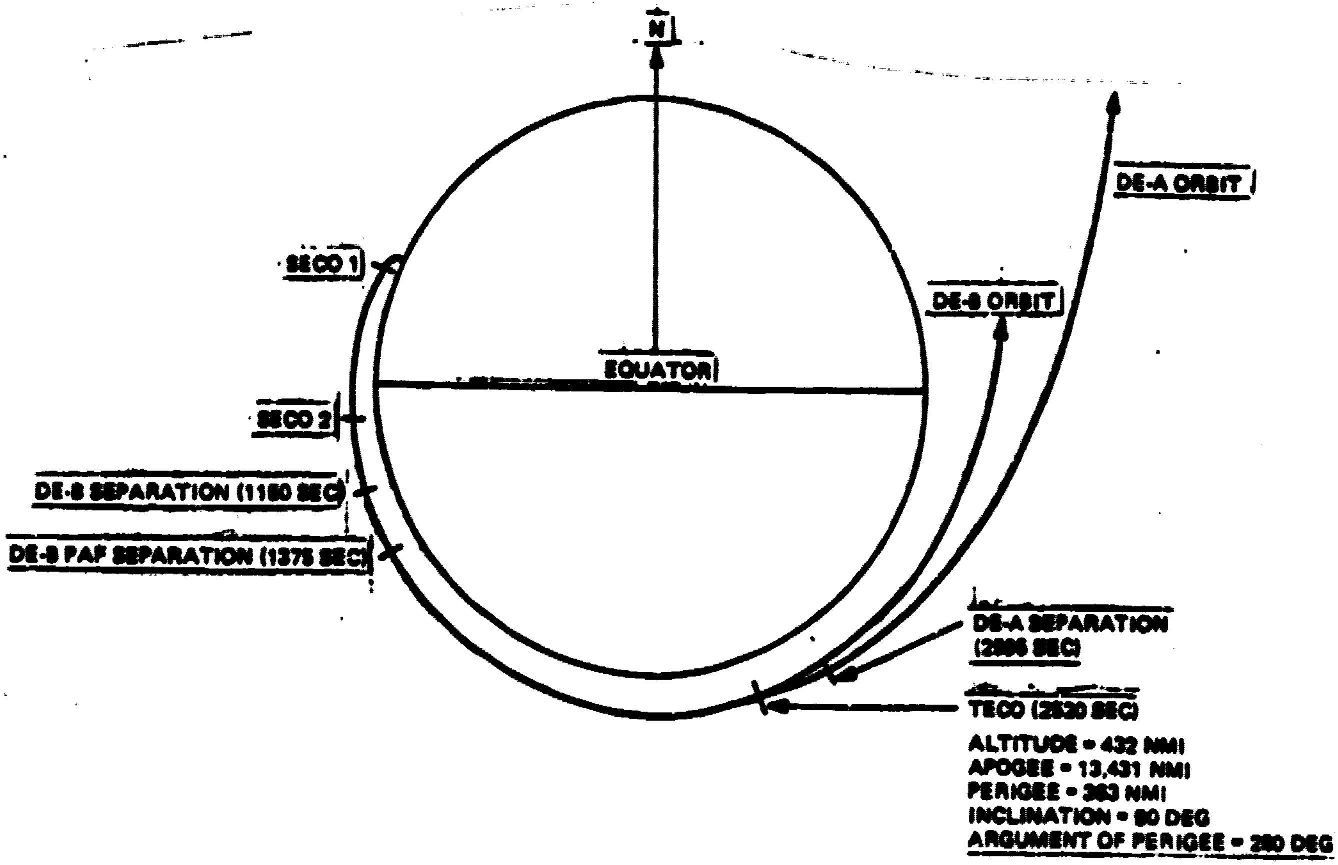

Fig. 1

DE-B Engine Cutoff Stages to Reach Orbital Altitude

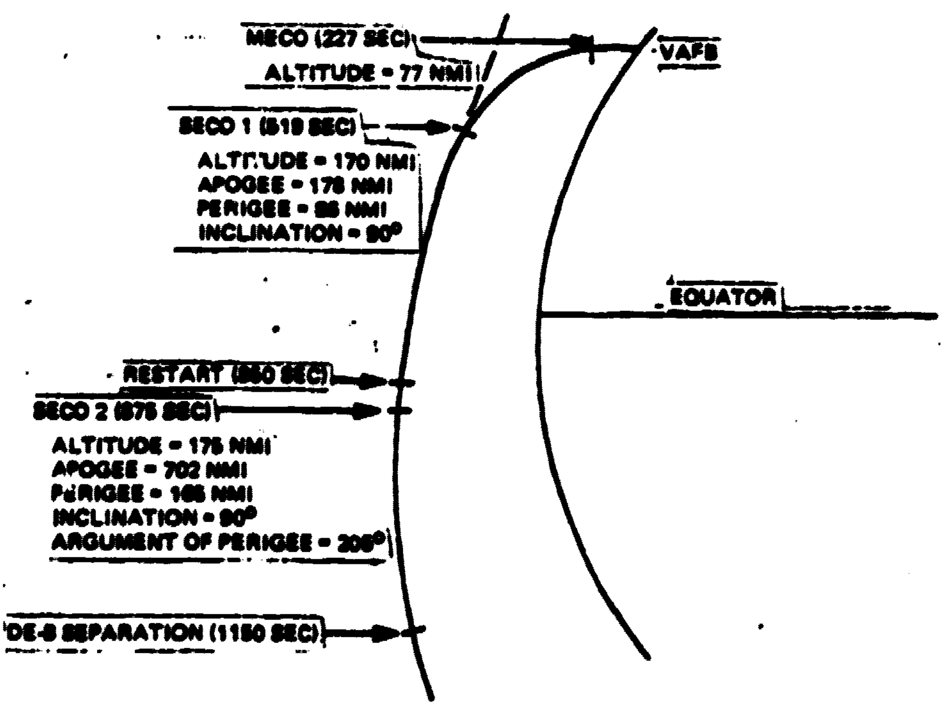

Fig. 2

SPACECRAFT DESCRIPTION

Each spacecraft structure is a 16-sided polygon, approximately 53 inches wide and 45 inches high, consisting of baseplates, center column, separation adapter, shear webs, and hat structure. The structure provides mounting surfaces for the outer shells, experiments, electronic packages, attitude control systems, S-band antenna, and launch vehicle adapter.

The top of the outer shell provides a mounting surface for the solar cells on both spacecraft. The bottom of the outer shell provides an additional solar cell mounting surface of DE-A only. To supply the necessary power, additional solar cells are mounted on the sides of the outer shell. Experiment-viewing ports are provided in various locations on the outer shell.

The solar array hats, upper and lower, used on each spacecraft, each interface with their respective baseplates and the center rings. The hats provide 7200 square inches of mounting area for the solar cells.

The DE-A spacecraft is estimated to weigh 424 kg, including 105 kg of instruments. The DE-B spacecraft is estimated to weigh 420 kg, including 111 kg of instruments.

Figure 3 shows the two spacecraft in the stacked launch configuration, while figures 4 and 5 show the location of the instruments on the respective spacecraft.

Dynamics Explorer Stacked Launch Configuration

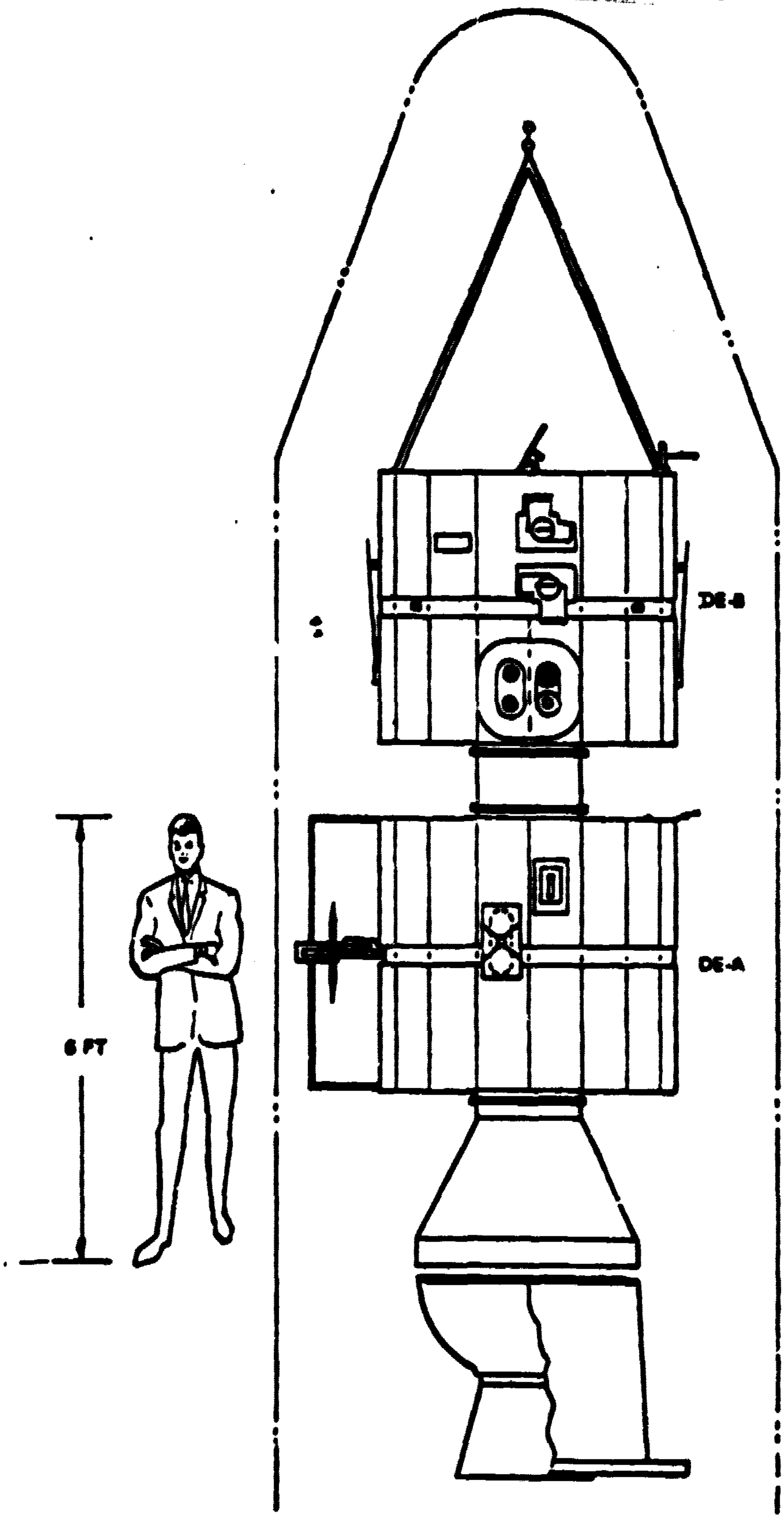

Fig. 3

DE-B Instruments Locations

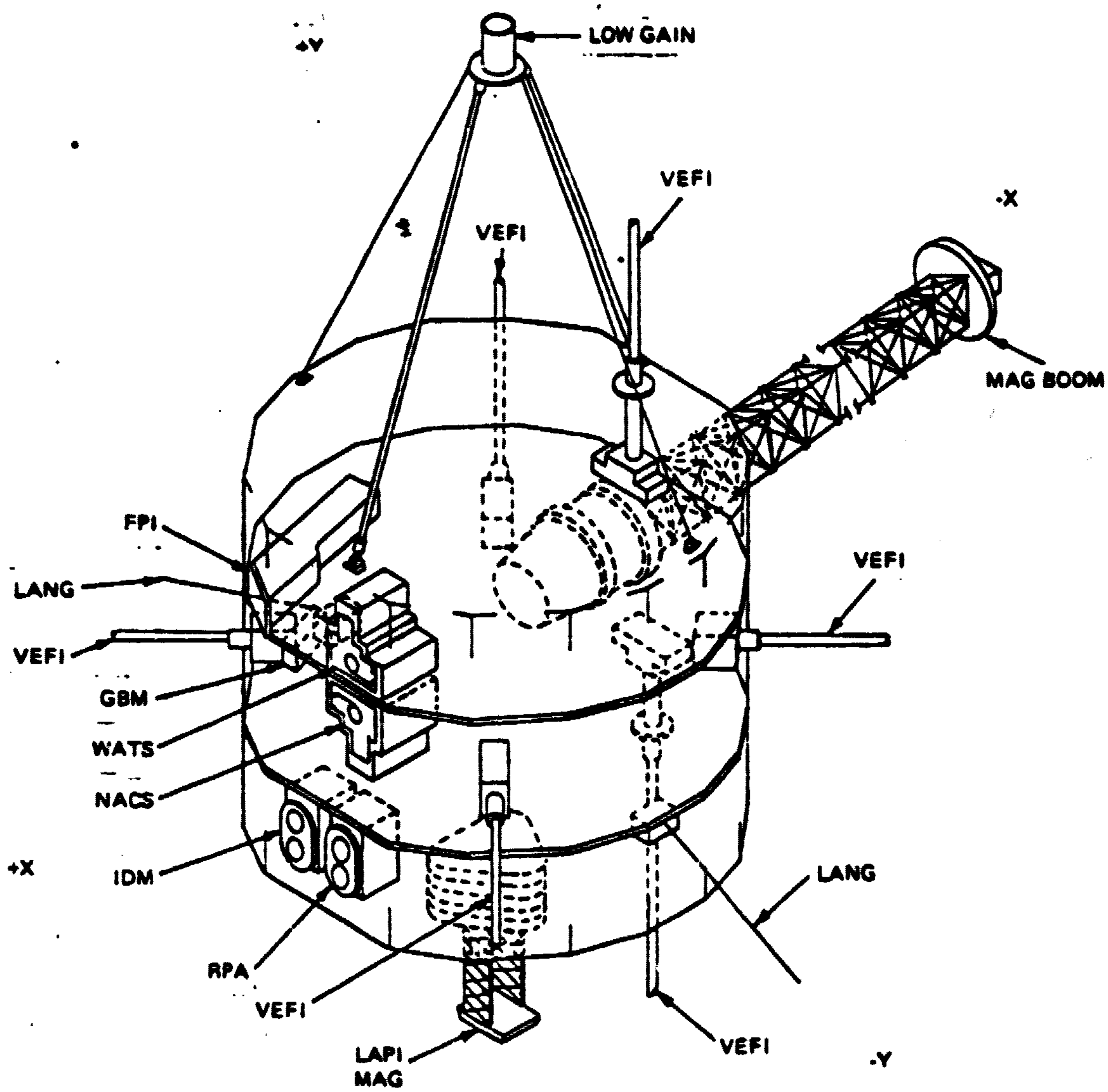

Fig. 4

DE-A Instruments Locations

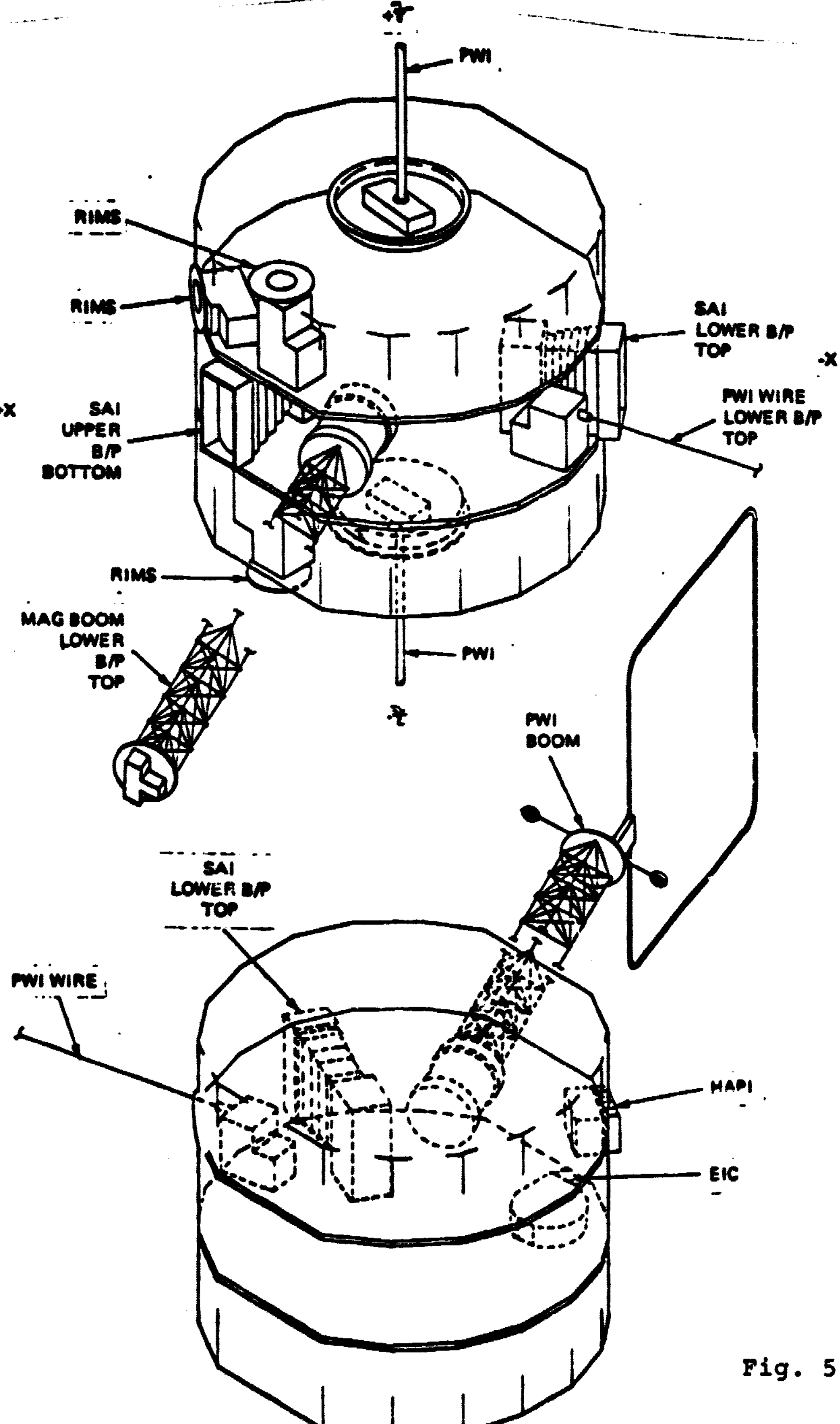

Fig. 5

INSTRUMENTS

The scientific objectives and a brief description of each instrument carried on-board the DE-A and B spacecraft are presented in the following paragraphs. The instruments, the principal investigators, and their contributing organizations are listed in Table 2.

MAGNETIC FIELD OBSERVATIONS (MAG-A and MAG-B)

The magnetic field instruments consist of a fluxgate magnetometer on each of the two satellites to obtain magnetic field data essential to the studies of the magnetosphere-ionosphere-atmosphere coupling. The primary objectives of the instruments are measurements of field-aligned currents in the auroral oval and over the polar cap at two different altitudes using the two spacecraft and correlations of these measurements with observations of electric fields, plasma waves, suprathermal particles, and thermal plasmas, and with auroral images obtained from the high altitude spacecraft.

VECTOR ELECTRIC FIELD INSTRUMENT (VEFI)

A vector electric field instrument on DE-B employs triaxial antennas with 20-meter baselines for vector measurements of dc electric fields. The system is designed to provide the data necessary to meet the following objectives:

- Obtain accurate and comprehensive vector electric field measurements at ionosphere altitudes.

- Study to what degree and in what regions the electric field maps between the ionosphere and magnetosphere.

- Obtain measurements of extremely-low-frequency (ELF) and lower-frequency ionosphere irregularities.

PLASMA WAVE INSTRUMENT (PWI)

The objectives of this instrument on DE-A are to measure the spatial, temporal, spectral, and wave characteristics, particularly the Poynting vector component along the magnetic field line and the wave polarization for ELF, very low frequency (VLF) and high frequency (HF) noise phenomena. Auroral kilometric radiation and VLF hiss, and a variety of electrostatic waves that may cause field-aligned acceleration of particles are of special interest.

NEUTRAL ATMOSPHERE COMPOSITION SPECTROMETER (NACS)

The neutral atmosphere composition instrument on DE-B is a mass spectro-meter designed to obtain insitu measurements of the composition of the neutral atmosphere and to study the variations of the neutral atmosphere in response to energy coupled into it from the magnetosphere. The energy inputs produce temperature enhancements, large scale circulation cells, and wave propagation in the neutral atmosphere, each of which possesses a rather specific signature in composition variations. Measurements of these variations will permit study of the partition, flow, and disposition of the energy from the magnetosphere.

TABLE 2

DYNAMICS EXPLORER INSTRUMENT COMPLEMENT

Instrument	Mnemonic	Responsible Investigator	Institution
DE-A (High-Altitude Mission)			
Fields			
1. Magnetometer-A	MAG	Sugiura	Goddard Space Flight Center
2. Plasma Wave Instrument	PWI	Shawhan	University of Iowa
Optical Emissions			
3. Spin-Scan Auroral Imager	SAI	Frank	University of Iowa
Charged Particles			
4. Retarding Ion Mass Spectrometer	RIMS	Chappell	Marshall Space Flight Center
5. High Altitude Plasma Instrument	HAPI	Burch	Southwest Research Institute
6. Energetic Ion Composition Spectrometer	EICS	Shelly	Lockheed

TABLE 2. DYNAMICS EXPLORER INSTRUMENT COMPLEMENT (Cont'd)

Instrument	Mnemonic	Responsible Investigator	Institution
DE-B (Low-Altitude Mission)			
Fields			
1. Magnetometer-B	MAG	Sugiura	Goddard Space Flight Center
2. Vector Electric Field Instrument	VEFI	Maynard	Goddard Space Flight Center
Neutral Particles			
3. Neutral Atmopshere Composition Spectrometer	NACS	Carignan	University of Michigan
4. Wind and Temperature Spectrometer	WATS	Spencer	Goddard Space Flight Center
Optical Emissions			
5. Fabray-Periot Interferometer	FPI	Hays	University of Michigan
Charged Particles			
6. Ion Drift	IDM	Heelis	University of Texas at Dallas
7. Retarding Potential Analyzer	RPA	Hanson	University of Texas at Dallas
8. Low Altitude Plasma Instrument	LAPI	Winningham	Southwest Research Institute
9. Langmuir Probe Instrument	LANG	Brace	Goddard Space Flight Center

WIND AND TEMPERATURE SPECTROMETER (WATS)

The neutral wind and temperature measurement instrument on DE-B will use a mass spectrometer to measure the in-situ neutral winds, the neutral particle temperatures, and the concentration of selected gases on the DE-B mission. The science objective is to study the interrelationships between the winds, the temperature plasma drift, electric fields, and other properties of the thermosphere which are expected to be measured by other instruments on the spacecraft. Knowing how these properties are interrelated will help explain the consequences of the acceleration of ions by neutrals creating electric fields, and the related energy transfer between the ionosphere and the magnetosphere.

Three components of the winds, one normal to the satellite velocity vector in the horizontal plane, one vertical, and one in the satellite direction will be measured. From these quantitative measurements, the wind vector will be computed.

SPIN-SCAN AURORAL IMAGER (SAI)

The global auroral imaging instrumentation on the DE-A spacecraft comprises spin-scan imaging photometers for acquiring:

- Images of the aurora at several visible wavelengths.
- Images within a vacuum ultraviolet 'window' which allows usable imaging of the aurora in the sunlit ionosphere.
- photometric measurements of the hydrogen corona.

FABRY-PEROT INTERFEROMETER (FPI)

The Fabry-Perot interferometer on the DE-B spacecraft is a high resolution instrument designed to measure the drift and temperature of neutral ionic atomic oxygen using the Doppler technique. Zeniths angle scanning provides wind determinations at various altitudes below the spacecraft. The information obtained from these measurements will be used to study the dynamical response of the thermosphere to the energy source due to magnetospheric electric fields and by the absorption of solar ultraviolet light in the thermosphere.

ION DRIFT METER (IDM)

The ion drift meter on the DE-B spacecraft will measure the bulk motions of the ionospheric plasma perpendicular to the satellite velocity vector. It is anticipated that these measurements will yield valuable information on:

- The ion convection (electric field) pattern in the auroral and polar ionosphere

- The flow of plasma along magnetic field lines within the plasmasphere determining whether this motion is simply a breathing of the protonosphere, a refilling of this region after a storm, or an interhemisphere transport of plasma

- The thermal ion contribution to field-aligned electric currents

- The magnitude and variation of the total ion concentration along the orbital flight path.

RETARDING POTENTIAL ANALYZER (RPA)

The retarding potential analyzer on the DE-B spacecraft will provide data on ion temperature, ion composition, ion concentration, and the ion bulk velocity nominally parallel to the vehicle velocity. The measured parameters are basic to the understanding of mechanisms that influence the plasma; i.e., to the understanding of the coupling between the solar wind and the Earth's atmosphere. It is anticipated that the instrument will define the ion temperature in the regions where N(1) is greater than 100 ions cm^{-3}, and will determine the value of N(1) from its maximum value down to approximately 10 ions cm^{-3}.

RETARDING ION MASS SPECTROMETER (RIMS)

The retarding ion mass spectrometer instrument on the DE-A spacecraft utilizes a retarding potential analyzer for energy analysis in series with a magnetic ion mass spectrometer for mass analysis. The instrument is designed to operate in two basic commandable modes: a high altitude mode in which the density, temperature, and the bulk flow characteristics of H^+, He^+, and O^+ ions are measured and a low altitude mode which concentrates on the composition in the 1-64 amu range.

LOW ALTITUDE PLASMA INSTRUMENT (LAPI)

The low altitude plasma instrument on the DE-B spacecraft provides high-resolution measurements of positive ions and electrons from 5 eV to 25 keV. Analysis of data from this particular instrument along with supporting measurements will be primarily concerned with:

- The identification and intensities of field alingned currents

- The study of the acceleration of particles which produce the Aurora

- The effect on charged particles of wave-particle interactions

- Ionospheric effects of parti le precipitation

ENERGETIC ION COMPOSITION SPECTROMETER (EICS)

The hot plasma composition instrument on the DE-A spacecraft is a high sensitivity, high resolution, energetic ion mass spectrometer which will cover the energy range from 0 to 17 keV per unit charge and the mass range from 1 to 138 amu per unit charge. The measurements obtained from this instrument will be used:

- To investigate the strong coupling mechanism between the magnetosphere and the ionosphere that results in large fluxes of energetic O^+ ions being accelerated from the ionosphere and injected into the magnetosphere during magnetic storms.

- To study the properties of the minor ionic species such as He^+ and He^{++} relative to the major constituents of the energetic magnetosphere plasma in order to evaluate the relative importance of the different sources of the plasma and of various energization, transport, and loss processes which may be mass or charge dependent.

HIGH ALTITUDE PLASMA INSTRUMENT (HAPI)

The high altitude plasma instrument on the DE-A spacecraft consists of an array of five electrostatic analyzers capable of making measurements of the phase-space distributions of electrons and positive ions from 5 eV to 25 keV as a function of pitch angle. Analysis of the data from this instrument will contribute to the studies of:

- Auroral particle source regions and acceleration mechanisms

- Transport of plasma within and through the magnetospheric clefts

- Wave-particle interactions

- Hot-cold plasma interactions

LANGMUIR PROBE (LANG)

The Langmuir probe instrument is a cylindrical electrostatic probe that will obtain measurements of electron temperature, Te, and electron or ion concentration, Ne or Ni, on the DE-A spacecraft. These data will be used to provide temperature and density measurements along magnetic field lines related to thermal energy and particle flows within the magnetosphere-ionosphere system, to provide thermal plasma conditions for wave-particle-plasma interactions, and to measure large scale and fine structure ionosphere effects of energy deposition in the ionosphere.

DEPLOYED SYSTEMS

The DE-A spacecraft has a single communications S-band antenna. It is folded during launch and deployed prior to third spinup. The antenna is approximately 1.5 meters long and is erected in the direction of, but offset from, the -Z axis.

The DE-A spacecraft also has six instrument appendages, as follows:

- The PWI contributes five of these:
  - Two furlable, 4-meter, tubular antennas, to be deployed coincident with the ±Z axis.
  - Two wires, 100 meters long, to be deployed opposite one another in the XY plane.
  - A triangular truss boom, 5.9 meters long, mounting three antennas: a loop, a search-coil, and a short electric antenna. The boom is to be deployed in the XY plane.
- The magnetometer instrument also requires a triangular truss boom, 5.9 meters long, deployable, with a magnetometer mounted to the end, the boom being located 180 degrees from the PWI boom.

The DE-B spacecraft has a single 1.5 meter, low-gain S-band antenna. It is mounted on a fixed bipod with guy wire supports approximately 1.5 meters from the solar array hat on the -Z axis.

The DE-B spacecraft also has nine instrument appendages, as follows:

- The VEFI contributes six of these:
  - Four tubular antennas, 11 meters long, to be deployed 90 degrees apart in the XY plane.
  - Two tubular antennas, 11 meters long, to be deployed parallel, but offset, from the Z axis.
- The magnetometer requires a 5.9 meter truss boom, as on DE-A, to be deployed parallel to the -X axis in the XY plane and angles out of the XY plane toward the -Z axis be approximately 5 degrees.
- The LANG uses two deployable probes approximately 0.7 meters long, located along ±Y and canted 20 degrees toward the +Z axis.

Thermal Control

The spacecraft thermal control design for DE-A and DE-B utilizes a combination of active louvers, baseplate heaters, and appropriate insulation and thermal finishes to meet the design objective of 0 to 25°C.

The DE-B utilizes a rotating-type-louver active controller on the -Z end of the spacecraft directly viewing space. In order to keep this designated end of the spacecraft away from the Sun, a seasonal 180-degree yaw reorientation maneuver is performed.

On DE-A the large spin-axis moment-of-inertia created by the two wore antennas and the two 6-meter booms make it impractical to perform the 180-degree yaw reorientation maneuver, therefore rotating type louver active controllers are utilized under the solar array on both ends of the spacecraft.

DE-A Attitude Sensing and Control Subsystem

The high-orbit spacecraft (DE-A) will be spin-stabilized at 10 rpm ±0.1 rpm with the spin (pitch) axis normal to the orbit plane within ±1 degree. The roll/yaw attitude of the spacecraft will be measured near apogee by V-mounted body horizon scanners. The same horizon scanners will precisely measure the Earth crossing envelope relative to the local vertical within ±0.2 degree, and will be aligned to the spacecraft spin axis within ±0.1 degree. Additional attitude information and horizon-scanner calibration will be provided by precision Sun sensors. The output of the Body Horizon Sensor (BHS) will be used to generate the nadir-related sync signals. Spacecraft orientation and spin rate will be maintained by aircore magnetic coils that are pulsed at the appropriate times to interact with the Earth's magnetic field to provide required control torques. Nutation damping is provided by liquid-filled loop dampers. Additional damping of pitch disturbances resulting from non-rigid body behavior of the wire antennas and the spacecraft core is provided, also by a liquid-filled loop damper.

DE-B Attitude Sensing and Control Subsystem

The low-orbit spacecraft (DE-B) will use an Atmosphere Explorer derived rotating wheel momentum bias system. The momentum bias will be 500 in-lb-sec about the spacecraft pitch (Z) axis which will be maintained normal to the orbit plane to within 1 degree. Normally the spacecraft yaw (+Y or -Y) axis will be aligned to within 1 degree of local vertical and the roll (X) axis will point parallel to the velocity vector within 1 degree. Ground commands may select other orientations about the pitch axis in 0.3515625-degree increments. The spacecraft can also be operated in a slow scan mode in support of the science mission with the body rotating at approximately 1 rpm.

The Earth crossing envelope relative to the local vertical will be measured by the horizon sensors of the momentum wheel to within +0.2 degree and will be aligned to the spacecraft spin axis within +0.1 degree. Additional information will be supplied from an IUE type Sun sensor.

Passive and active damping on the despun portion of the spacecraft will damp spacecraft nutational oscillations induced by vehicle separation, aerodynamic drag, and other disturbing forces. Infrared, wheel-mounted, horizon scanners and body-mounted solar aspect sensors will provide spacecraft attitude sensing to within 0.2 to 0.3 degree in each axis.

Power Subsystem

The basic power source for DE-A and DE-B is supplied from solar cell arrays on the sides and ends of the spacecraft. They provide a total area of approximately 40 square feet on each spacecraft. Each of the two nickle-cadmium batteries on each spacecraft has a nominal storage capacity of 6 ampere hours. The -24.5 V $\pm$ 2 percent instrument bus voltage is obtained from either of two pulse width modulated (PWM) regulators. A shunt limiter regulates the maximum arary voltage of less than -39 volts.

Communications

The DE Communications Subsystem includes equivalents of S-band NASA Standard (STDN and TDRSS) transponders; medium gain antenna (DE-A); low-gain antenna (DE-B); and appropriate coupling networks. The S-band transponders are used for command reception, real-time data transmission, playback data transmission, and turnaround ranging signals. The transponders are GSTDN-compatible.

On the DE-A spacecraft, a medium-gain antenna having a 40-by-360-degree beam width will be used for all operations to GSTDN ground stations.

The DE-B tape recorder playback (approximately 131 or 65.5 kbps), real-time science data (165 kbps), housekeeping and control data (1 kbps), will use the equivalent of a NASA standard transmitter (5 watts), and will be returned to GSTDN through a low-gain antenna system. The forward link (commands and ranging) will also use the low-gain antenna system.

Tracking will be accomplished using the GSTDN compatible transponders with the GSTDN Ranging Equipment.

Command and Data Handling

The DE command subystem for each spacecraft includes the following three units:

. Command and Telemetry Processor (CTP)

- Remote Telemetry Module (RTM)
- Command Distribution Unit (CDU)

The command format conforms to the network S-band command system standards and is compatible with GSTDN and TDRSS. Spacecraft commands are implemented to provide real-time and delayed commands for the following:

- Spacecraft equipment and instrument turn-on and turn-off
- Instrument operational mode control
- Turn-on periods for delayed and real-time spacecraft operations

The remote command system is capable of varying the delay time of spacecraft and instrument command execution up to 73 hours in 4-second increments. The decoder can decode 512 unique pulse commands (either relay-driving pulse or logic-level pulse) as well as any 32-bit serial minor-mode command. Any of the 512 commands can be executed in remote time except those which control the memory. All commands can be executed in real time.

The DE Telemetry Subsystem has the capability of handling both digital and dc-varying signals. DC-varying signals (0.0 Vdc to +5.12 Vdc or 0.0. Vdc to -5.12 Vdc) are processed by an analog-to-digital (A/D) converter into 8-bit data words prior to transmission via normal telemetry. The principal downlink modulation modes will be pulse code modulated subcarriers, phase modulated on the RF carrier (PCM/PSK/PM). The wide-band analog data from the PWI on the tape recorder playback signal will directly modulate the carrier wave of the DE-A transmitter.

Scan Platform

The DE-B spacecraft will carry a single-axis platform on which will be mounted the Low Altitude Plasma Instrument (LAPI). The platform will be mounted within the +Z end of the spacecraft separation adapter and will rotate about the Z (pitch) axis. Control of azimuth orientation will be in response to a magnetometer included in the LAPI instrument or by overriding ground commands.

LAUNCH VEHICLE INTERFACE

The Delta 3913 Launch Vehicle interface to the stacked spacecraft assembly is achieved via a Delta 1828 adapter between the 364-14 Engine and the separation plane of the DE-A Spacecraft.

An electrical interface from the Delta Control System to the interstage adapter (1809A) between the DE-A and DE-B Spacecraft is carried through the DE-A Spacecraft. An umbilical interface providing external power for the spacecraft exists from the blockhouse to each spacecraft utilizing the second stage umbilical.

LAUNCH VEHICLE DESCRIPTION

The DE-A and DE-B spacecraft will be launched in a stacked configuration on one Delta 3913 launch vehicle (See Figure 3). The launch vehicle characteristics are listed in Table 3.

The first stage is a McDonnell-Douglas Astronautics Corporation (MDAC) modified Thor booster incorporating nine Thiokol strap-on solid fuel rocket motors. The booster is powered by a Rocketdyne engine. The main engine is gimbal-mounted to provide pitch and yaw control from liftoff to main engine cutoff (MECO). Two liquid-propellant vernier engines provide roll control throughout first-stage operations and pitch and yaw control from MECO to first-stage separation.

The second stage is powered by a TRW Systems TR-201 liquid-fuel, pressured engine which is also gimbal-mounted to provide pitch and yaw control through second-stage burn. A nitrogen gas system using six fixed nozzles provides roll control during powered and coast flight, as well as yaw and pitch control after second-stage cutoff (SECO). Propellant settling before restart of the second stage is achieved by thrust from nitrogen gas jets. Two fixed nozzles fed by the propellant-tank helium pressurization system provide retro-thrust after DE-B spacecraft separation.

The DE-A spacecraft will be attached to the Delta third stage by means of a payload attach fitting (PAF) which incorporates the separation system. The Delta fairing is attached to the forward face of the second stage and measures 312 inches long and 96 inches wide.

An all-inertial guidance system controls the vehicle and sequence of operations from liftoff to spacecraft sepration. This guidance system consists of an inertial sensor package and digital guidance computer.

The low-altitude spacecraft (DE-B) will be separated first into its orbit and will be spin stabilized at separation from the Delta vehicle. The high-altitude spacecraft (DE-A) will be spun up by the Delta spin table before the Delta third stage injects it into orbit.

TABLE 3

Characteristics of Delta 3913 Launch Vehicle

Item	First Stage*	Second State	Third Stage
Name	MDAC Model DSV-3P-1B	TRW TR-201	TE 364-14
Thrust (N)	912,000	44,482	38,400
Fuel Type	LOX RJ-1	N_2O_4 & Aerozine 50	Solid propellant
Fuel weight (kg)	80,740	4729	558
Gross w:oght (kg)	85,276	6085	622
Guidance	Inertial (on 2nd stage)	Inertial	Spin stabilized
Tracking aids	None (uses 2nd stage TRK aid)	C-band transponder	TLM-S band

*First stage is augmented by nine Thiokol TX 526-2 Castor IV solid motors, each with the following characteristics:

Thurst (N) 329,000

Gross Weight (kg) 10,840

Fuel Weight (kg) 9,373

Six motors burn from liftoff to 58 seconds, and three motors burn from 64 to 122 seconds.

SCIENCE DATA PROCESSING SYSTEM (SDPS)

The SDPS, located at the Goddard Space Flight Center, Greenbelt, Md., features an on-line central processing and analysis system to perform the majority of data reduction and analysis for the science investigations. The data system permits adaptive mission planning to be implemented by providing data for selected science problems in near-real time and enabling the science operations to be planned in accordance with earlier results. This approach ensures that the specified data required for each of the studies associated with the mission objectives are acquired, processed, and made accessible to the science team in an expeditious manner and used to optimize the configuration of the instruments. The SDPS provides the following capabilities:

- Receive time-smoothed telemetry data from the OPS and make on-line access available to all participants.

- Receive predictive orbit data weekly, definitive-orbit, and definitive-attitude data daily, over a hardwire line at the rate of 56 kbps with tape backup capability provided.

- Process the data in an orderly manner and build up a data base in physical units accessible "on-line" by all participants.

- Process science command sequences generated via remote terminals (EOC) over a hardwire line and transmit to the CMS with a tape backup capability.

- Provide a data management system for creating, updating, and facilitating access to the data base by investigator programs, both interactively and in batch mode. The following files will be maintained throughout the mission life:

  - Time-smoothed telemetry data.

  - Orbit data (predictive and definitive, predictive data storage must be limited to current information).

  - Definitive attitude results--both constant attitude solutions for DE-A and -B and deterministic attitude solutions for DE-B.

  - Mission analysis files of measured quantities in physical units (temperature, magnetic field, particle flux, etc).

- Provide a query and retrieval system so that investigators may interrogate the data base via remote terminals.

- Complete processing data from a particular orbit, including definitive orbit and definite attitude data, within 7 days of data collection.

- Make mission analysis files available to the investigators via remote terminals.

- Make tapes for micrographics processing.

- Maintain magnetic tapes for all data base files.

As noted above, the entire DE data processing system is required to complete processing of data from a particular orbit, including definitive orbit and definitive attitude data, within 7 days of data collection. The input processing function is responsible for making instrument status telemetry available to the science team within 6 hours. Science data processing consists of three levels of processing, defined as follows:

- Summary Plot Production-Involves the extraction of key geophysical parameters from the telemetry data. The results are summarized in plot form for access by investigators, where the prime display medium is microfilm plots.

- Production Processing--Executed in the production mode using investigator supplied programs. No investigator interaction is required for these programs to be executed. The output from this level is initial geophysical data that are used as input for custom processing and are stored in the mission analysis files.

- Custom Processing-Performed by the investigators on an interactive basis from their terminals. Input is any of the files in the data base. Output is stored in the mission analysis files and may be accessed by the other investigators.

MISSION SUPPORT

The following stations will be scheduled, as available, for tracking, data acquisition, and command support of the DE-A and -B spacecraft:

ASCENSION (ACN)

SANTIAGO (AGO)

BERMUDA (BDA)

GODDARD (ETC)

GOLDSTONE (GDS)

GUAM (GWM)

HAWAII (HAW)

MADRID (MAD)

MERRITT ISL. (MIL)

ORRORAL (ORR)

QUITO (QUI)

ALASKA (ULA)

All stations will utilize 9 meter antennas in support of both spacecraft. In addition DE-A will utilize 26 meter antennas at Goldstone, Madrid, Orroral, and Alaska for Tape Recorder dumps near apogee and for PWI wideband analog data.

Figure 6 shows the DE Functional Data Flow in block diagram form.

DE Functional Data Flow

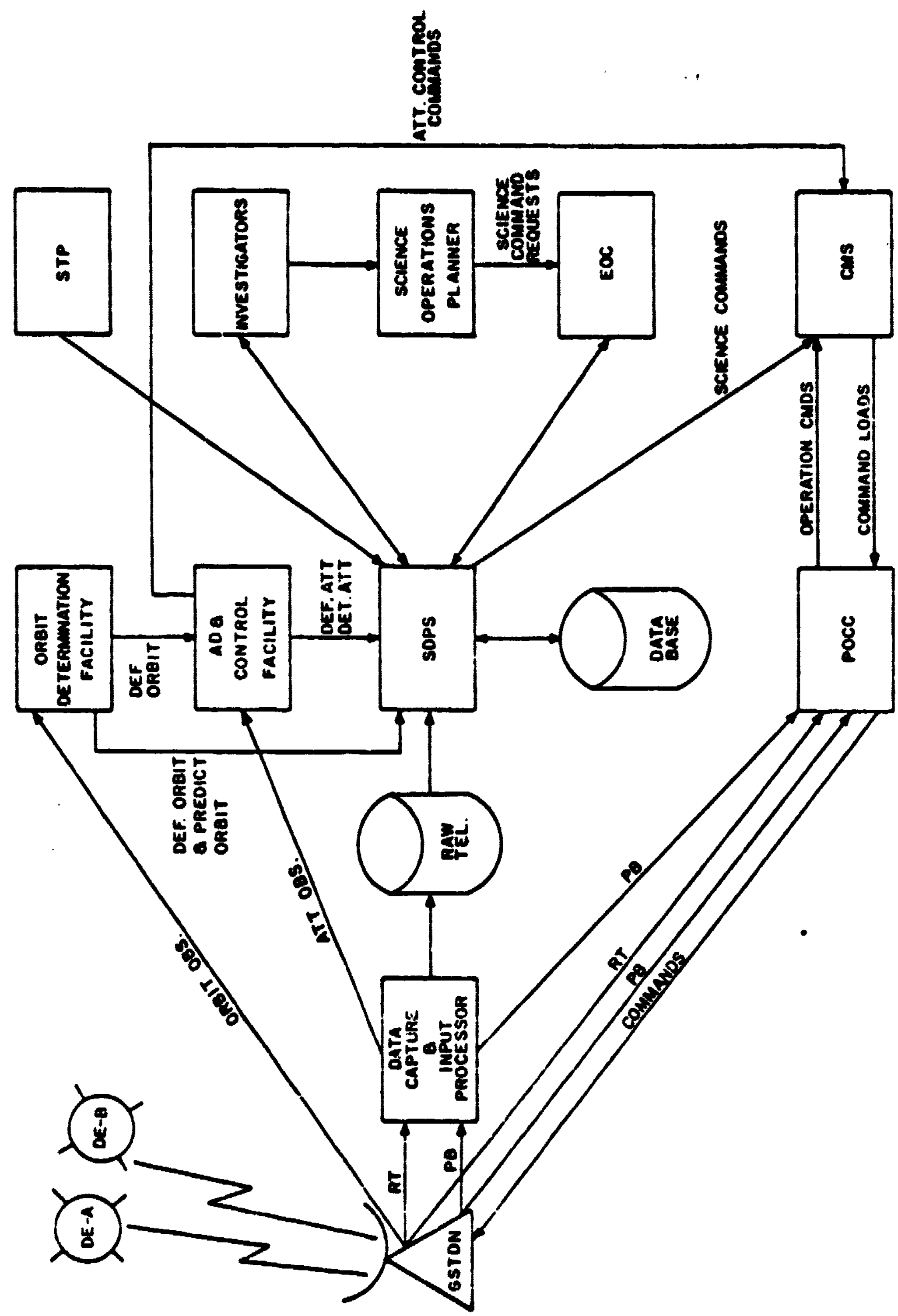

Fig. 6

DYNAMICS EXPLORER/DELTA TEAM

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Richard Halpern	Chief of Research Flight Programs Development Branch
Marius Weinreb	Dynamics Explorer Program Manager
Erwin R. Schmerling	Dynamics Explorer Program Scientist
Stanley I. Weiss	Associate Administrator, Office of Space Transportation Operations
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Joseph B. Mahon	Director, Expendable Launch Vehicle Program
Pete Eaton	Manager, Delta Launch Vehicles

Goddard Space Flight Center

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John H. McElroy	Deputy Director
William C. Keathley	Director of Flight Projects
Robert Lynn	Deputy Director of Flight Projects
David W. Grimes	Delta Project Manager
William Russell	Deputy Delta Project Manager, Technical
William Burrowbridge	Delta Mission Integration Manager
George D. Hogan	Project Manager, Dynamics Explorer

James Moore	Deputy Project Manager
Charles Rhoads	Deputy Project Manager, Resources
Robert A. Hoffman	Project Scientist, Dynamics Explorer
Warner Hood	Spacecraft Manager
Keith Fellerman	Instrument Manager
Carl E. Gustafson	Mission Operations Manager
Eugene Willingham	Project Operations Director
Joseph Ryan	Project Launch Operations Manager
Robert I. Seiders	Network Support Manager
John B. Zegalla	Mission Support Manager
Clyde Freeman	Science Data Processing Systems Manager

<u>Kennedy Space Center</u>

Richard G. Smith	Director
Tom Walton	Director of Cargo Operations
Charles Gay	Director, Deployable Payloads Operations
D.C. Sheppard	Chief, Automated Payloads Division
Wayne McCall	Chief, Delta Operations Division
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