National Aeronautics and
Space Administration

Washington, D.C.
20546

Reply to Attn of: SS

JUL 9 1992

TO: DISTRIBUTION

FROM: S/Associate Administrator for Space Science and Applications

SUBJECT: Transmittal of Geotail Prelaunch Mission Operation Report

I am pleased to forward with this memorandum the Prelaunch Mission Operation Report for Geotail, a joint project of the Institute of Space and Astronautical Science (ISAS) of Japan and NASA to investigate the geomagnetic tail region of the magnetosphere. The satellite was designed and developed by ISAS and will carry two ISAS, two NASA, and three joint ISAS/NASA instruments. The launch, on a Delta II expendable launch vehicle (ELV), will take place no earlier than July 14, 1992, from Cape Canaveral Air Force Station. This launch is the first under NASA's Medium ELV launch service contract with the McDonnell Douglas Corporation.

Geotail is an element in the International Solar Terrestrial Physics (ISTP) Program. The overall goal of the ISTP Program is to employ simultaneous and closely coordinated remote observations of the sun and *in situ* observations both in the undisturbed heliosphere near Earth and in Earth's magnetosphere to measure, model, and quantitatively assess the processes in the sun/Earth interaction chain. In the early phase of the Program, simultaneous measurements in the key regions of geospace from Geotail and the two U.S. satellites of the Global Geospace Science (GGS) Program, Wind and Polar, along with equatorial measurements, will be used to characterize global energy transfer. The current schedule includes, in addition to the July launch of Geotail, launches of Wind in August 1993 and Polar in May 1994. Launches of the European Space Agency's complementary Solar and Heliospheric Observatory (SOHO) and Cluster missions are scheduled for July 1995 and December 1995, respectively.

L. A. Fisk

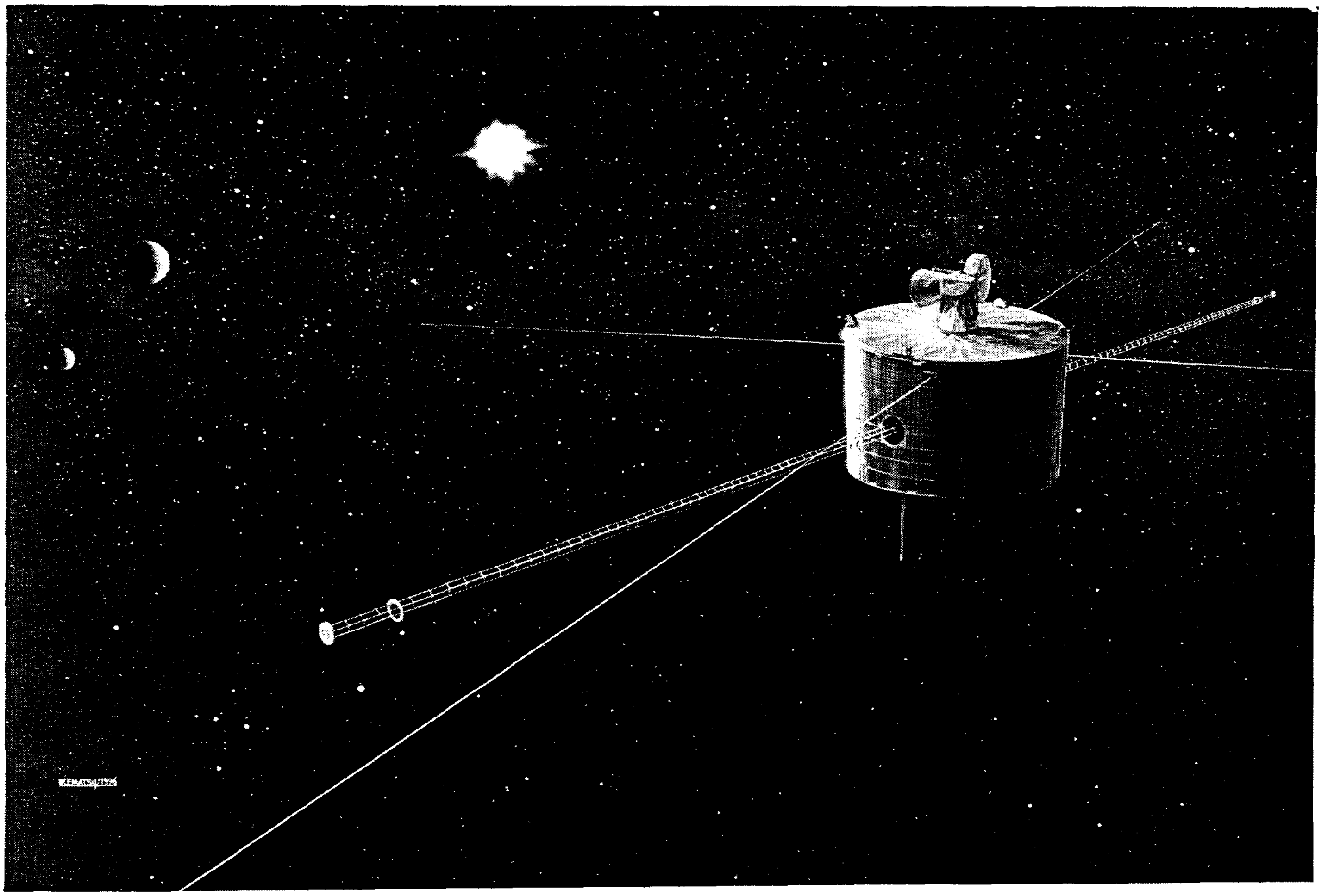
Enclosure

National Aeronautics and Space Administration

Mission Operation Report

OFFICE OF SPACE SCIENCE AND APPLICATIONS

Report No. S-418-92-01



International Solar-Terrestrial Physics Program (ISTP)

Geotail

Foreword

MISSION OPERATION REPORTS are published for the use of NASA Senior Management, as required by NASA Headquarters Management Instruction HQMI 8610.1C, effective November 26, 1991. The purpose of these reports is to document in advance critical discriminators selected to enable assessment of mission accomplishment.

Prelaunch reports are prepared and issued for each flight project just prior to launch. Following launch, updating (Post Launch) reports are issued to provide mission status and progress in meeting mission objectives.

This report is somewhat technical and is prepared for personnel having program/project management responsibilities. The Public Affairs Division publishes a comprehensive series of reports on NASA flight missions. These less technical reports are available for dissemination to the news media.

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NASA Headquarters

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EXECUTIVE SUMMARY

The Geotail mission is a joint effort between the Institute of Space and Astronautical Science (ISAS) of Japan and the National Aeronautics and Space Administration (NASA) to investigate the geomagnetic tail region of the magnetosphere. Geotail will measure global energy flow and transformation in the magnetotail to increase understanding of fundamental magnetospheric processes, including the physics of the magnetopause, the plasma sheet, and reconnection and neutral line formation. These objectives require spacecraft measurements in two orbits: a nightside double lunar swingby orbit out to distances of 220 Earth radii (R_E) and a mid-magnetosphere orbit of 8 x 32 R_E. Geotail will be placed into the initial distant tail orbit for approximately 2 1/4 years and then maneuvered to the 8 x 32 R_E orbit where it will operate for the remainder of its lifetime. The Geotail satellite has been designed and developed by ISAS, and will be launched under a NASA launch services contract with the McDonnell Douglas Corporation on a Delta II expendable launch vehicle (ELV) no earlier than July 14, 1992. The Geotail payload includes scientific instruments provided by ISAS and NASA.

The Memorandum of Understanding between ISAS and NASA for the Geotail mission was signed in December 1989, following the Exchange of Notes between the Governments of Japan and the U.S. in September 1989. Geotail, together with the two missions of NASA's Global Geospace Science (GGS) Program (Wind and Polar) and supporting equatorial measurements, will provide simultaneous data to enable study of the solar wind input to the magnetosphere and key elements of the magnetospheric response: geomagnetic tail energy storage, ring current energy storage, and ionospheric energy input. Two European Space Agency/NASA cooperative missions, Solar and Heliospheric Observatory (SOHO) and Cluster, to be launched in the mid-1990's, will complement these measurements and improve our understanding of the physics of solar-terrestrial relations. Programmatically, the NASA contributions to Geotail, SOHO, and Cluster are referred to as the Collaborative Solar-Terrestrial Research (COSTR) Program. Together, NASA's GGS and COSTR Programs are known as the International Solar-Terrestrial Physics (ISTP) Program.

MISSION OBJECTIVES

The objective of the Geotail mission is to acquire *in situ* data defining the fields and particles environments of the geomagnetic tail region of the magnetosphere. The planned mission lifetime is three years. Measurements will be made for approximately 2 1/4 years out to 220 R_E while the spacecraft is in a nightside double lunar swingby orbit. The spacecraft will then be maneuvered to an orbit of 8 x 32 R_E where it will acquire data in the near tail for the remainder of its lifetime.

The Geotail mission science objectives are:

- Determine the overall plasma electric and magnetic field characteristics of the distant and near geomagnetic tail.
- Help determine the role of the distant and near-earth tail in substorm phenomena and in the overall magnetospheric energy balance and relate these phenomena to external triggering mechanisms.
- Study the processes that initiate reconnection in the near-earth tail and observe the microscopic nature of the energy conversion mechanism in this reconnection region.
- Determine the composition and charge state of plasma in the geomagnetic tail at various energies during quiet and dynamic periods and distinguish between the ionosphere and solar wind as sources of this plasma.
- Study plasma entry, energization, and transport processes in interaction regions such as the inner edge of the plasma sheet, the magnetopause, and the bow shock, and investigate boundary layer regions.

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Space Physics Division

George L. Withbroe
Director
Space Physics Division

L. A. Fisk
Associate Administrator
Office of Space Science and Applications

MISSION DESCRIPTION

Geotail is scheduled for launch on a Delta II ELV no earlier than July 14, 1992, from Launch Complex-17 at Cape Canaveral Air Force Station (CCAFS). The Geotail spacecraft is a spin stabilized spacecraft (20 rpm nominal spin rate) designed and developed by ISAS. The spacecraft will be placed initially into a double lunar swingby orbit having a variable apogee radius up to 220 R_E on the nightside of the earth and then maneuvered to an orbit of 8 x 32 R_E with 8° inclination to the ecliptic plane. The double lunar swingby orbit will be maintained for approximately 27 months followed by at least 9 months in the 8 x 32 R_E orbit.

Baseline NASA mission operations will be conducted for approximately 27 months. However, extended operations support will be requested to coincide with the mission operation phases of the remaining Geotail mission and other ISTP mission elements, assuming the Geotail spacecraft and instruments remain healthy and funding is continued by ISAS and NASA. Following orbital operations, up to 2 years of additional data processing and analysis will be provided. End of mission is defined as the termination of mission operations.

The Geotail spacecraft will carry two ISAS-developed instruments, two NASA-developed instruments, and three joint NASA/ISAS instruments. The NASA and a subset of the ISAS instruments will be supported by the NASA ISTP Central Data Handling Facility (CDHF), located at the NASA Goddard Space Flight Center (GSFC), and Remote Data Analysis Facilities (RDAF), located at the NASA Principal Investigator (PI) facilities.

MISSION SEQUENCE

Geotail will be launched on a Delta II ELV from CCAFS into a 185x344 km (100x186 n mi) circular parking orbit with an inclination of 28.7 degrees. Table 1 shows the expected sequence of events from liftoff through spacecraft separation. The upper stage will be ignited at a predetermined location to boost the spacecraft into a transfer orbit. The first 72 hours after upper stage ignition is considered the early orbit phase.

The translunar phase follows the early orbit phase and continues until the first lunar swingby, which is planned for September 8, 1992. The actual duration of the translunar phase may vary depending on the launch date.

The first lunar swingby will be used to inject Geotail in a distant tail orbit aligned towards the nightside of the Earth. The orbital plane will be almost the same as that of the moon. During the distant tail phase the orbit apogee will vary from 80 to 220 R_E and the perigee will change from 5 to 10 R_E. The first half of the scientific observations will be performed in this phase, which is expected to last approximately 2 1/4 years.

The last lunar swingby will be used to inject Geotail into its near tail phase. During this time two corrective orbit maneuvers are scheduled: an orbit plane change and an apogee reduction. These maneuvers are expected to take less than a month. The insertion into the near tail is tentatively scheduled for October 1994.

The second half of the scientific observations will be performed in near tail phase. During this phase Geotail will be in a 8 x 32 R_E orbit inclined 7.5 degrees to the ecliptic plane. The near tail phase is scheduled to end in the summer of 1995, which corresponds to the Level 1 lifetime requirement of three years.

Table 1 Geotail Sequence of Events

Event	Time (seconds)
Liftoff	0.0
Mach 1	37.3
Maximum Dynamic Pressure	53.0
6 Solid Motors Burnout	55.5
3 Solid Motors Ignition	60.5
Jettison 3 Solid Motors	61.5
Jettison 3 Solid Motors	62.5
3 Solid Motors Burnout	116.1
Jettison 3 Solid Motors	122.0
Main Engine Cutoff	264.5
Stage I-II Separation	272.5
Stage II Ignition	278.0
Fairing Jettison	324.0
First Cutoff-Stage II	653.0
Begin Reorientation Maneuver	705.0
End Reorientation Maneuver	795.0
Stage II Restart Ignition	915.3
Second Cutoff-Stage II	948.5
Start Pulse Discrete for accelerometer	982.4
Fire Spin Rockets	998.5
Stage II-III Separation	1002.4
Stage III Ignition-Nutation Control System (NCS) Enable	1039.4
Stage III Burnout	1126.5
Spacecraft Separation-NCS Disable	1238.5
Yo Deployment	1241.4
Stage II Depletion Burn	5400.0

SPACECRAFT DESCRIPTION

The Geotail spacecraft is a spin stabilized spacecraft utilizing mechanically despun antennas. The diameter of the spacecraft is approximately 2.2 meters (7.2 ft) with a height of 1.6 meters (5.2 ft). The wet weight of the spacecraft is approximately 1009 kg (2220 lbs) including 360 kg (792 lbs) of hydrazine fuel. The design life of Geotail is three years. Figure 1 shows the Geotail spacecraft in its operational configuration.

The power supply subsystem consists of the body-mounted solar cell panel, the power converter and distributor, the Power Control Unit, Battery Charge Control Units for each battery, and Nickel-Cadmium (16 cells series) batteries (3x19AH). Total end of life available power for spacecraft operations will be 300 watts from the beginning of life average generating power of 350 watts.

The Communications Subsystem consists of two high gain antennas (HGA), two medium gain antennas (MGA-X, S), and two low gain antennas (LGA) that provide a total of three channels of communications through rotary joints (HGA-S, X, LGA-A) and radio frequency switches. The LGA-B and MGA-X, S are mounted on the lower side.

The command and data handling system (C&DHS) consists of the Command Decoder to demodulate the 1000 b/sec phase shift key commands, and the Data Handling Unit that processes the real-time discrete commands, block commands, programmed commands, and modulates the pulse code modulation telemetry (real-time and playback). Two data recorders and a housekeeping 128 channel status monitor are contained in the C&DHS.

The attitude and orbit control subsystem (AOCS) consists of spin-type sun aspect sensors, the star scanner, the steerable horizon crossing indicator, accelerometers, and reaction control system (RCS) actuators to keep the spacecraft spin-stabilized with the spin axis perpendicular to the ecliptic plane and to maintain a spin rate of 20 rpm. The AOCS also includes the attitude and orbit control electronics which contains the RCS thruster control, the attitude and orbit control processor, the nutation damper, the spin ripple damper, and the RCS with eight 23 Newton (5.2 lb) and four 3 Newton (0.7 lb) thrusters. Four tear drop type tanks hold about 332 kg (730 lbs) of N_2H_4 fuel.

The despun control system consists of direct current brushless motors to control the spin rate from 10 to 30 rpm with a pointing angle resolution of 0.08 degree. Primary use of this system is for pointing of the HGA antenna elements to maintain communications link margins with the ground system.

The structure and thermal control subsystem consists of the thrust tube and double flat deck materials such as carbon fiber reinforced plastics, and aluminum alloy with active (heaters) and passive (thermal blankets) thermal control system.

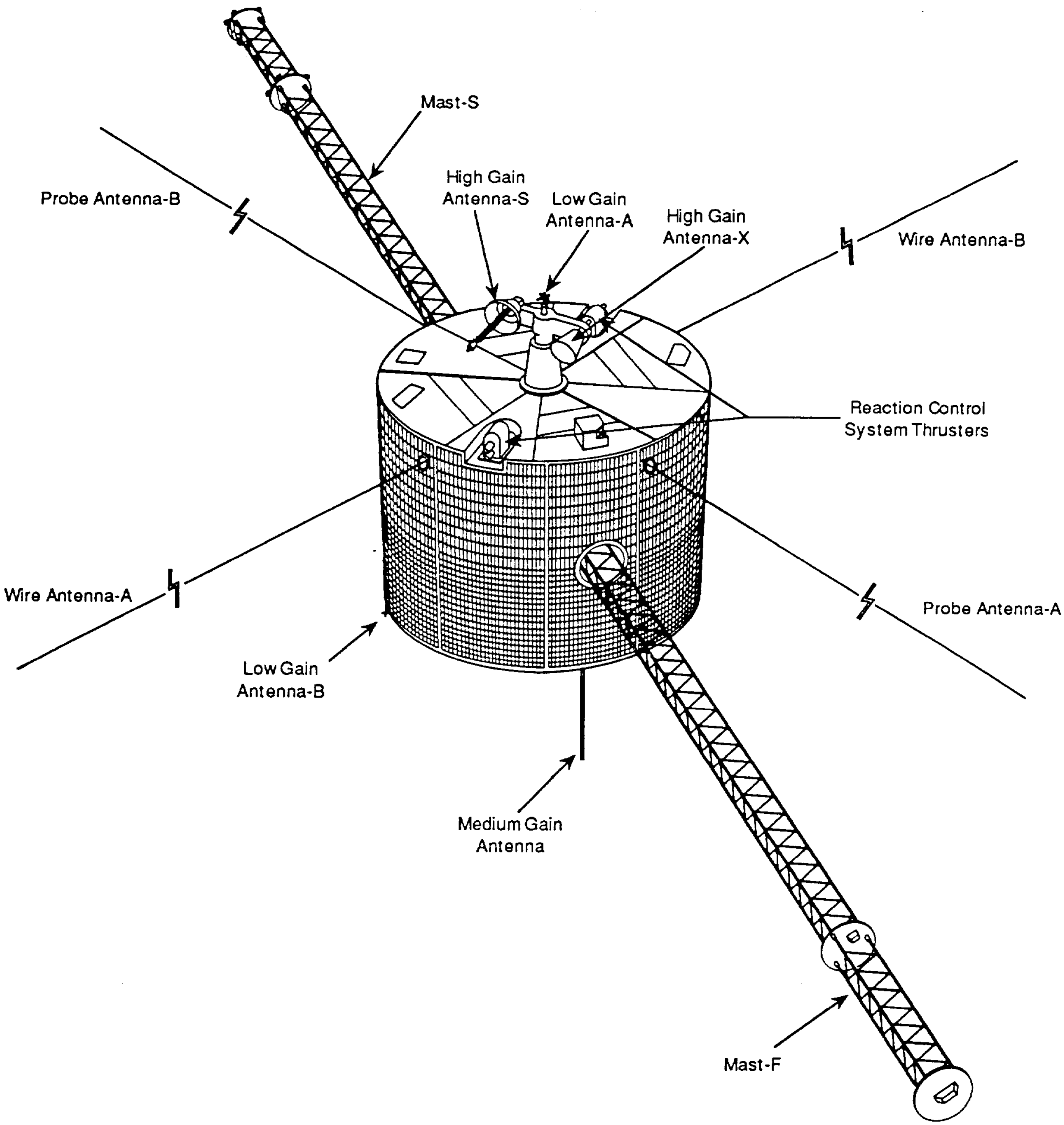

Figure 1 Geotail Spacecraft

INSTRUMENT DESCRIPTIONS

The Geotail mission will provide a full range of plasma physics fields and particles instrumentation to measure the flow of energy and its transformation in the geomagnetotail. The mission will also clarify the mechanisms of input, transport, storage, release, and conversion of mass, momentum, and energy in the geomagnetotail. Geotail will carry seven instruments, including two ISAS instruments, two NASA instruments and three joint ISAS/NASA instruments. Each Geotail instrument is described below.

ISAS INSTRUMENTS

High-Energy Particles (HEP)
M. Doke, Waseda University

Measurements of high-energy particles of up to 2.5 MeV for electrons, 3.5 MeV for protons, and 210 MeV per charge for ions can indicate plasma boundary surfaces and reflect whether magnetic field lines are open or closed. The composition and charge state of energetic particles provide rich information on where particles originate, and different solar events produce different energetic-particle signatures. Small, hot sites in the corona produce samples rich in helium ions, for example. The origin and acceleration of galactic cosmic rays and their modulation in our galaxy will also be investigated.

Low-Energy Particles (LEP)
Principal Investigator: T. Mukai, ISAS

Low-energy electrons from 6 eV to 36 keV and ions from 7 eV to 42 keV per charge will be observed in the magnetotail and in the interplanetary medium to study the nature and dynamics of magnetotail plasmas, analyze the plasma conditions under which particle acceleration takes place, and study plasma circulation and its variability in response to fluctuations in the solar wind and in the interplanetary medium. Particles from Earth's ionosphere will be identified, and the entry of plasmas into the magnetosphere from the magnetosheath will be studied to improve our understanding of open versus closed magnetospheres.

NASA INSTRUMENTS

Comprehensive Plasma Investigation (CPI)
Principal Investigator: L. Frank, University of Iowa

CPI will obtain complete three-dimensional plasma measurements in Earth's magnetotail. Plasma parameters—density, temperatures parallel and perpendicular to the magnetic field, flow velocity, heat flux, and field-aligned current density—will be correlated with the magnetic field, plasma waves, energetic particles, and auroral imaging data to determine the magnetotail plasma dynamics. Studies of composition will be made to distinguish the plasma source and the mechanisms and efficiency of the coupling of the solar-wind energy (measured by Wind instruments) into the magnetosphere as a function of the upstream solar-wind conditions.

Energetic Particle and Ion Composition (EPIC)
Principal Investigator: D. Williams, Applied Physics Laboratory

The EPIC investigation uses an ion composition spectrometer and a telescope to measure charge state, mass, and energy of ions. One part of the investigation measures ions from 50 keV to 3 MeV, and the other part measures ions from 10 to 230 keV per charge. These measurements will be used to study the relative importance of ion sources and mechanisms for acceleration, transport, and loss of particles. The formation and dynamics of magnetospheric boundary layers and their influence on magnetospheric behavior will be studied. Especially important will be determination of particle sources in large-scale structures such as plasmoids.

JOINT ISAS/NASA INSTRUMENTS

Magnetic Fields Measurement (MGF)
Principal Investigator: S. Kokobun, University of Tokyo
Lead U.S. Co-Investigator: M. Acuna, NASA/GSFC

Information about the dynamics of the transport of mass, momentum, and energy between the magnetospheric and ionospheric plasma can be inferred from monitoring changes in the magnetic-field configuration in various regions. MGF measurements as rapid as 16 samples per second in the near-Earth tail plasma should provide more information about mechanisms (for example, field-line merging) that transfer energy and trigger substorms. MGF will investigate magnetic merging in the magnetotail, which is thought to produce a bubble of plasma, called a plasmoid, that flows down the tail during the active periods. Also, MGF will observe the distant tail to determine its magnetic-field structure—whether well ordered or filamentary, for example—and its dynamic changes associated with substorms. MGF contains the Geotail Inboard Magnetometer provided by the United States.

Plasma Waves Investigation (PWI)
Principal Investigator: H. Matsumoto, Kyoto University
Lead U.S. Co-Investigator: R. Anderson, U. of Iowa

During Geotail's excursions from the near Earth to the distant tail regions, PWI will measure plasma waves in the frequency range from 5 Hz to 800 kHz to sample wave phenomena related to plasma dynamics in the different regions on various scales within its range. These phenomena include magnetic-field-line merging, moving plasmoids, and particle acceleration via wave-particle interaction within the magnetotail. PWI contains the Multi-Channel Analyzer provided by the United States.

Electric Fields Detector (EFD),
Principal Investigator: K. Tsuruda, ISAS
U.S. Co-Investigator: F. Mozer, U. of Cal., Berkeley

Geotail's measurement of the electric field in the tail is key to developing a theory about the formulation of the magnetotail. Electric fields in the near-Earth magnetosphere are closely coupled with the ionospheric electric field. EFD will study the coupling of these fields, especially during substorms, using electric-field antennas sampling at 64 samples per second and an electron beam technique at 2 samples per spin. In addition, the merging of magnetic fields in the plasma sheet generates inductive and stochastic electric fields that help to accelerate particles, which can be measured by other instruments on board the spacecraft.

LAUNCH VEHICLE DESCRIPTION

A Delta II 6925 ELV, as shown in Figure 2, will be used to launch the Geotail spacecraft. The Delta II provides three stages to insert the spacecraft into the proper transfer orbit. The first stage Rocketdyne RS-27 liquid propellant engine is augmented by nine Thiokol Castor IV-A solid rocket motors. The second stage is powered by an Aerojet AJ10-118K pressure-fed propulsion system. The first and second stage engines are gimbal mounted for attitude control. A guidance compartment in the second stage contains flight control, inertial guidance, instrumentation, range safety, tracking, and power equipment. A cold-gas system is installed on the second stage to provide roll control for the entire flight and pitch and yaw control during coast flight. The Delta II second-to-third stage interstage provides a spin table to which the third stage is mounted. The third stage is a Morton Thiokol (PAM-D) Star 48B solid propellant rocket motor. The Geotail spacecraft is secured to the Delta II third stage by the use of a 3712A Spacecraft Attach Fitting. The spacecraft will be mounted to the 3712A with a two piece V-block type clamp assembly.

A 2.9 meter (9.5 ft) diameter, aluminum fairing assembly encapsulates the spacecraft during launch. The fairing is jettisoned during second stage powered flight. Acoustic blankets of 3.8 cm (1.5 in) thickness are mounted to the fairing nose section and to the upper portion of the 2.4 m (8 ft) diameter cylindrical section; acoustic blankets mounted to the 2.9 m (9.5 ft) diameter cylindrical section of the fairing are 7.6 cm (3 in) thick. Fairing access doors are located to allow access to safety critical spacecraft components. Delta II 6925 ELV characteristics are summarized in Table 2.

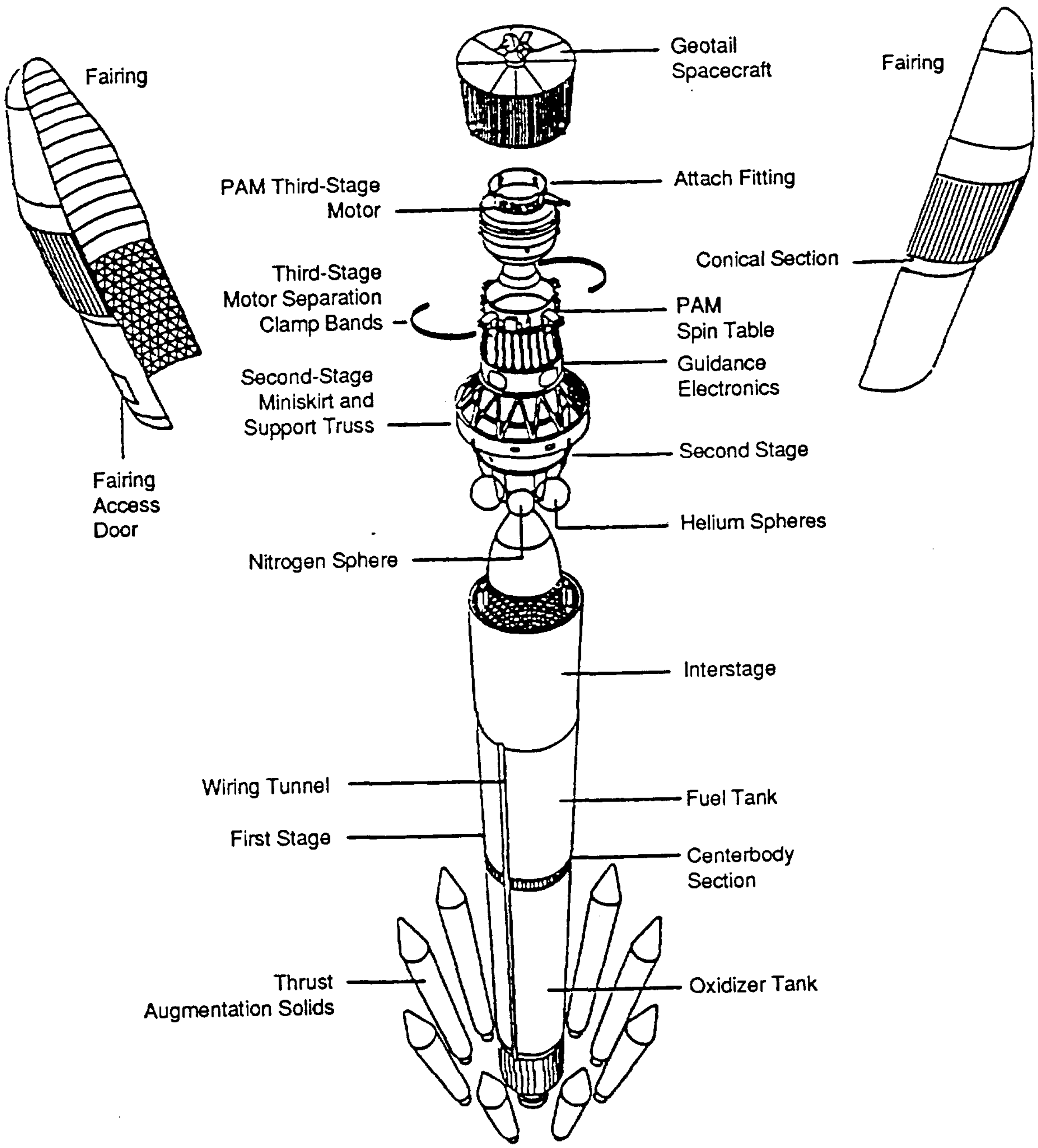

Figure 2 Delta II 6925 Launch Vehicle

Table 2. Delta II 6925 Vehicle Characteristics

	Strap-On solids	First stage	Second stage	Third stage
Length, m (ft)	11.2 (36.6)	26.1 (85.6)	6 (19.6)	2 (6.7)
Diameter, m (ft)	1 (3.3)	2.4 (8)	2.4 (8)	1.25 (4.1)
Total weight, kg (lbs)	11,737 (25,822) GL* 11,872 (26,118) AL**	101,747 (223,843)	6,997 (15,394)	2,146 (4,721)
Engine/motor	Castor IVA	RS-270/B	AJ10-118K	Star-48B
Manufacturer	MTI	Rocketdyne	Aerojet	MTI
Quantity	9	1	1	1
Propellants	Solid	LOX/RP-1	N_2O_4/A-50	Solid
Propellant wt, kg (lb)	10,133 (22,292) ea	96,062 (211,337)	6,076 (13,367)	2,014 (4,430)
Thrust, kN (lb) – SL	432 (97,070) ea	921 (207,000)	—	—
– VAC	484 (108,700) ea	1,031 (231,700)	42.9 (9,645)	67.2 (15,100)
I_{sp} (sec) – SL	237.3	263.2	—	—
– VAC	265.7	295.0	319.4	292.6
Burn time (sec)	56.2	264.9	439.7	87.1
Expansion ratio	8.29	8.1	65	54.8

*Ground lit

**Air lit

Control of the Geotail spacecraft is the responsibility of ISAS. The Sagamihara Spacecraft Operations Center (SSOC), which is an ISAS facility, will be responsible for all on-orbit spacecraft control, following completion of the launch phase and separation from the launch vehicle upper stage. The SSOC will monitor the performance of the spacecraft, maintain flight data bases, and perform command activities associated with the spacecraft. In addition, the SSOC will support and coordinate investigator operations and monitor instrument status from a safety viewpoint, and take corrective action when necessary.

Prime ISAS ground station support for Geotail command uplink and real-time telemetry downlink will be provided by the Usuda Deep Space Center. Backup support in Japan will be provided by the Kagoshima Space Center. Communication with the spacecraft will be via S-band for uplink/downlink and X-band for downlink. The NASA Deep Space Network (DSN) will receive all onboard recorded dump telemetry data via S-band (and X-band if necessary in some contingency situations). During the first month of operations and periodically thereafter, the DSN stations (Goldstone, CA, Canberra, Australia, and Madrid, Spain), support facilities, and the Network Operations Control Center (NOCC) will also provide S-band tracking (radiometric) and orbit determination support.

The GSFC Mission Operations and Data Systems Directorate (Code 500) will provide and operate the necessary ground systems for the capture, processing and distribution of the on-board recorded science instrument telemetry data. Data received by the DSN stations will be routed from the DSN NOCC via the NASA Communications System to the GSFC Code 500 Data Capture Facility, where it will be captured and processed to Level 0. Instrument key parameter data processing for the playback data and on-line data access will be furnished by the ISTP dedicated CDHF, located at GSFC. Data analysis and theoretical studies will be conducted by members of the ISTP science team through the PIs and Co-Investigators of the Geotail science instruments. U.S. instrument operation plans and command sequences will be electronically provided to ISAS from the PI RDAFs.

The ISTP Science Planning and Operations Facility (SPOF) under the direction of the ISTP Project Scientist will generate coordinated science plan recommendations for all ISTP spacecraft. These plans will be made available to the Geotail science planners at ISAS for consideration in Geotail spacecraft operations. The SPOF is not a requirement for the Geotail launch.

Initially, scheduling of DSN coverage for Geotail will be arranged directly by ISAS. After the launch of the Wind spacecraft (August 1993), an ISTP-unique DSN scheduling group, located within the GGS Payload Operations Control Center, will receive DSN schedule requests from various ISTP mission participants. The group will generate ISTP conflict-free schedule requests through coordination with existing standard scheduling elements, DSN, and the ISTP mission participants. This scheduling group will be staffed by the ISTP Wind/Polar Flight Operations Team and will act as a focal point for all project problem solving.

Geotail measurements will be combined with fields and particles data from existing IMP-8, GOES, and Los Alamos National Laboratory missions, along with ground-based observations and theoretical models to provide a prototype of GGS/CDHF science operations prior to the launch of Wind and Polar.

MISSION MANAGEMENT RESPONSIBILITY

Overall direction and evaluation of the NASA space physics program is the responsibility of the NASA Associate Administrator for Space Science and Applications, who has delegated authority for the direct management of this program to the Director, Space Physics Division . The NASA Geotail Program Manager, in turn, has been delegated the authority by the Director, Space Physics Division for ensuring the performance of all functions necessary to fulfill NASA responsibilities with respect to the Geotail mission. The NASA Program Manager's counterpart at ISAS is the Geotail Project Manager, who is responsible for all ISAS responsibilities with respect to the Geotail mission.

The lead NASA center for Geotail is the Goddard Space Flight Center. Responsibility for management of the Project has been assigned to the ISTP Project Office within the Flight Projects Directorate.

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MISSION COSTS

NASA project costs of the Geotail project will total approximately $80 million, including about $34 million for instrument development and the balance covering launch services, ground system, and data analysis. ISAS project costs total approximately the same amount, including about $51 million for spacecraft development (including protomodel), $11 million for science instruments, and the balance for mission operations, data acquisition, and data analysis.

LIST OF ACRONYMS

AOCS	Attitude and Orbit Control System
C&DHS	Command and Data Handling System
CCAFS	Cape Canaveral Air Force Station
CDHF	Central Data Handling Facility
CoI	Co-Investigator
CPI	Comprehensive Plasma Investigation
COSTR	Collaborative Solar-terrestrial Research
DSN	Deep Space Network
EFP	Electric Fields Detector
EPIC	Energetic Particle and Ion Composition
ELV	Expendable Launch Vehicle
GSFC	Goddard Space Flight Center
GGS	Global Geospace Science
HEP	High-Energy Particles
HGA	High Gain Antenna
ISAS	Institute of Space and Astronautical Science (Japan)
ISTP	International Solar-terrestrial Physics
LEP	Low-Energy Particles
LGA	Low Gain Antenna
MGA	Medium Gain Antenna
MGF	Magnetic Fields Measurement
NASA	National Aeronautics and Space Administration
NCS	Nutation Control System
NOCC	Network Operations Control Center
PI	Principal Investigator
PWI	Plasma Waves Investigation
RCS	Reaction Control System
RDAF	Remote Data Analysis Facilities
R_E	Earth Radii
SOHO	Solar and Heliospheric Observatory
SPOF	Science Planning and Operations Facility
SSOC	Sagamihara Spacecraft Operations Center