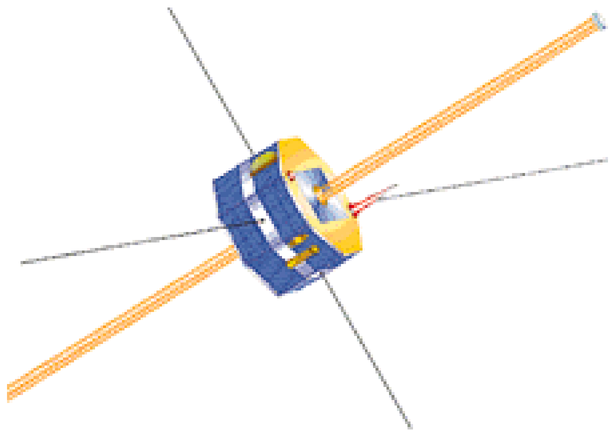
National Aeronautics and Space Administration
Press Kit



For
IMAGE Mission

March 2000

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Contents

For Release:
March 16, 2000

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RELEASE NO: 00-40

NASA SPACECRAFT TO STUDY IMPACT OF MAGNETIC STORMS

NASA is about to launch the first spacecraft dedicated to imaging the Earth's magnetosphere – an invisible magnetic field surrounding the planet that is strongly influenced by the solar wind.

A Delta II 7326 rocket is scheduled to launch the Imager for Magnetopause-to-Aurora Global Exploration, or IMAGE, satellite into orbit March 25 from the Western Range of Vandenberg Air Force Base, Calif. during an eight-minute launch window, which opens at
3:35 p.m. EST (12:35 p.m. PST).

IMAGE is the first of its kind, designed to actually "see" most of the major charged particle systems in the space surrounding Earth. Previous spacecraft explored the magnetosphere by detecting particles and fields they encountered as they passed through them. This technique limited their "vision" to small portions of this vast and dynamic field, which extends about 40,000 miles on Earth's day side and about 110,000 miles on Earth's night side. It would be similar to attempt understanding the nature of the world's oceans from a single buoy.

Just as taking a photograph of the night sky allows astronomers to count and study millions of stars at once, images returned by the IMAGE spacecraft will provide simultaneous measurements of the densities, energies and masses of charged particles throughout the inner magnetosphere using three-dimensional imaging techniques.

"IMAGE brings to space weather studies the kind of capability that geosynchronous weather satellites have brought to surface meteorology," said Dr. Thomas Moore, IMAGE Project Scientist at NASA's Goddard Space Flight Center, Greenbelt, Md. "We may soon be treated to evening news images of plasma clouds engulfing those weather satellites."

During its two-year mission, the half-ton IMAGE spacecraft will image remote particle populations in the magnetosphere. These "photographs" will then be linked together to make movies in real time. Their rapid two-minute cadence will allow detailed study of the interaction of the solar wind with the magnetosphere and the magnetosphere's response during a magnetic storm, which typically lasts a few days.

"In addition to stored data, IMAGE will implement a real-time down link that the National Oceanic and Atmospheric Administration intends to use for space weather forecasting," said Principal Investigator Dr. Jim Burch of the Southwest Research Institute (SwRI), San Antonio, Texas.

To fulfill its science goals, IMAGE will employ six state-of-the-art instruments along with a data processor. The instruments and their developers are:

- High Energy Neutral Atom (HENA) imager, developed by Johns Hopkins University Applied Physics Laboratory, Laurel, Md.;
- Medium Energy Neutral Atom (MENA) imager, developed by SwRI;
- Low Energy Neutral Atom (LENA) imager, developed by Goddard;
- Extreme Ultraviolet (EUV) imager, developed by the University of Arizona;
- Far Ultraviolet (FUV) imager, developed by the University of California at Berkeley;
- Radio Plasma Imager (RPI), developed by the University of Massachusetts at Lowell; and
- Central Instrument Data Processor (CIDP) developed by SwRI.

IMAGE is the first of two Medium-class Explorer missions NASA has scheduled for launch. The total cost of the mission, including spacecraft, launch vehicle and mission operations for the first two years is about $154 million. The IMAGE Project Office at Goddard will manage the mission for NASA's Office of Space Science in Washington, D.C., while the principal investigator at SwRI has overall responsibility for the science, instrumentation, spacecraft and data analyses.

Lockheed Martin Missiles and Space of Sunnyvale, Calif. built the IMAGE spacecraft, which is 7.38 feet in diameter and 4.99 feet high, under contract with SwRI. On orbit, the RPI antennas aboard IMAGE will extend 33 feet parallel to the spin axis and 820 feet in four directions perpendicular to the spin axis, making IMAGE the longest spacecraft currently on orbit. The IMAGE mission press kit is available at:

ftp://ftp.hq.nasa.gov/pub/pao/presskit/2000/image.pdf

For more information about the mission, go to: http://pluto.space.swri.edu/IMAGE/ and http://image.gsfc.nasa.gov

-end-

Media Services Information

NASA Launch Coverage

Live commentary of the launch on NASA TV will be available beginning at 11 a.m. PST (2 p.m. EST).

The launch of IMAGE will also be webcast via the NASA-KSC Home Page at: http://www.ksc.nasa.gov

Briefings

A pre-launch news conference will be held March 24 (L-1) from 11 a.m. to Noon PST (2 p.m. to 3 p.m. EST) at Vandenberg AFB in the second floor conference room of Bldg. 840. The briefing will be carried live on NASA TV.

News Center/Status Reports

The IMAGE News Center at the NASA Vandenberg Resident Office (phone: 805-605-3051) will open beginning March 23 (L-2). Recorded status reports will be available beginning March 23 by dialing either 805-734-2693 or 301-286-NEWS.

Launch Media Credentials

Media seeking launch accreditation should fax their request by COB two days before launch to:

Bruce Buckingham, KSC/PAO
NASA Vandenberg Resident Office
Vandenberg Air Force Base, CA
FAX: 805/605-3380

Requests must be submitted on the letterhead of the news organization and specify the editor making the assignment to cover the launch.

Internet Information

Detailed information about the IMAGE mission and science objectives can be found at the SwRI and NASA websites:

http://pluto.space.swri.edu/IMAGE/
http://image.gsfc.nasa.gov

IMAGE Quick Facts

This mission is the first of two Medium-class Explorer Missions (MIDEX) selected by NASA.

The IMAGE spacecraft consists of a science payload that was developed by principal investigator Dr. James L. Burch at the Southwest Research Institute (SwRI) in San Antonio, Texas. SwRI integrated the science payload into the IMAGE spacecraft, which was developed by Lockheed Martin Missiles and Space (LMMS) of Sunnyvale, Calif.

The SwRI science team developed the Medium Energy Neutral Atom (MENA) imager for IMAGE. The Low Energy Neutral Atom (LENA) imager instrument was developed by NASA's Goddard Space Flight Center, Greenbelt, Md. The remaining four instruments were developed by researchers from the University of Massachusetts at Lowell, University of Arizona, University of California at Berkeley and The Johns Hopkins University Applied Physics Laboratory in Laurel, Md. SwRI will plan and coordinate instruments operations for IMAGE, and the Science and Mission Operations Center (SMOC) at Goddard will command the IMAGE spacecraft and manage data acquisition during the mission.

Spacecraft:

Dimensions: 7.38 feet in diameter (2.25 meters) by 4.99 feet high (1.52 meters). The Radio Plasma Imager (RPI) antennas extend 33 feet (10 meters) parallel to the spin axis and 820 feet (250 meters) in four directions perpendicular to the spin axis.

Weight: 1,089 pounds (494 kilograms)
Science Instruments: LENA, MENA, HENA, FUV, EUV and RPI
Power: 286 Watts
Instrument Data Rate: 44 kilobits per second (5.5 kBaud)
Mission Lifetime: two years
Orbit: The IMAGE satellite's 14.5-hour polar orbit has a 90-degree inclination with a 640-mile (1,000-kilometer) perigee and a 28,503-mile (45,871-kilometer) (estimated) apogee.

Expendable Launch Vehicle: Delta II 7326, provided by Boeing Space Systems.
Launch Site: Western Range, Vandenberg AFB (VAFB), Calif., SLC-2
Launch Date and Time: March 25, 2000 at 3:35 EST (12:35 PST); 8-minute launch window.
Spacecraft Separation: Launch + 56 minutes.

First Acquisition of IMAGE Signal

Approximately 78 minutes after launch and occurring via NASA's Deep Space Network's 26-meter antenna located in Madrid, Spain.

Cost

Costs for IMAGE are estimated at $132 million, including the spacecraft, instruments and launch vehicle plus ground operations, mission operations and data analysis costs during – and for one year following the two-year mission – of an estimated $21.5 million for a total estimated cost of $154 million.

Mission Oversight

The principal investigator for IMAGE is Dr. James L. Burch of SwRI, who has overall responsibility for the science, instrumentation, spacecraft and data analysis. The IMAGE Project Manager at SwRI is William C. Gibson.

The Explorer Project Office at Goddard provides management oversight for the IMAGE mission. Frank Volpe serves as the IMAGE project manager at Goddard and Dr. Thomas E. Moore is the IMAGE project scientist and co-investigator at Goddard.

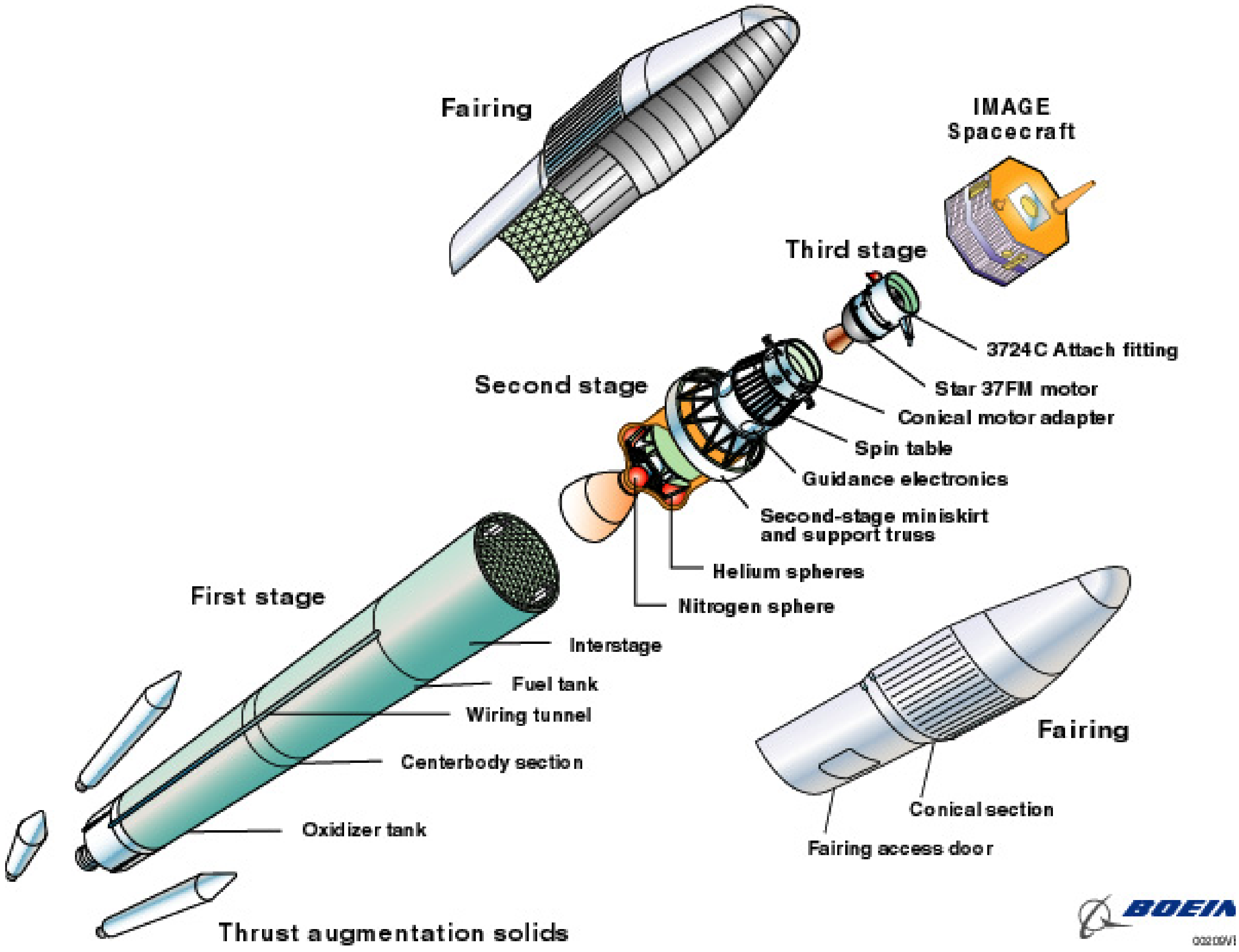
POETRY

IMAGE was the first space science mission to formally include an education and public outreach program as part of its proposal to NASA, specifically setting aside a budget for such activities. The outreach function is called the "Public Outreach, Education, Teaching and Reaching Youth," or POETRY, program. The director of POETRY is Dr. Bill Taylor of Goddard and Dr. Sten Odenwald of Goddard manages the program.

Launch Operations

NASA's Kennedy Space Center will conduct launch operations at the Western Range located at VAFB.

7326 Delta II Launch Vehicle



(Exploded view of the Delta II launch vehicle with the IMAGE spacecraft onboard. Illustration courtesy of Boeing Space Systems.)

Imager for Magnetopause-to-Aurora Global Exploration (IMAGE)

Introduction

The space environment of the Earth and the nearby solar wind, where the effects of the Earth's presence are felt, are called geospace. Within geospace the Earth's magnetic field is compressed on its dayside by the solar wind and extended millions of miles into a long comet-like tail on the night side. This magnetosphere contains a complex collection of charged particle populations. The best known of these populations are the Van Allen belts discovered in 1958 by the first orbiting satellite of the United States, known as Explorer 1. The Van Allen belts are the principal, energetic charged particle residents of the inner magnetosphere, which extends from the upper atmosphere and ionosphere outward to about 10 Earth radii (38,000 miles) from the center of the Earth.

Another important charged particle population in the inner magnetosphere is the ring current. This system consists of negatively charged particles (energetic electrons) that drift eastward, and positively charged particles (mostly energetic hydrogen and oxygen ions) that drift westward, forming two great rivers of plasma that produce a westward ring of current around the Earth. Overlapping the Van Allen belts and extending into the inner reaches of the ring current is a higher density region known as the plasmasphere. The plasmasphere is the high-altitude extension of the Earth's ionosphere and contains a very low-energy population of hydrogen and helium ions.

The inner magnetosphere is buffeted on the day side by the solar wind and on the night side by the Earth's own plasma sheet, which contains particles with energies between those of the plasmasphere and ring current. The plasma sheet is an important source of the ring current and of particles that produce the aurora. The inner magnetosphere is where the dynamical interactions among the solar wind, the outer magnetosphere and ionosphere are ultimately focused. Since the early days of the Space Age, scientists have recognized that these interactions can often cause auroras, trigger electrical blackouts and cause satellites to malfunction.

During the past 40 years, NASA has launched numerous satellites in an attempt to measure this near-Earth environment. However, the earlier satellites could only detect particles and fields from moment to moment along their orbits. While scientists have succeeded in understanding what the major processes are that make geospace such a dynamic system, a deeper understanding is crucial to creating powerful 'space weather' forecasting tools than can protect our satellites and the health of astronauts in space.

What is IMAGE?

NASA's Imager for Magnetosphere-to-Auroral Global Exploration (IMAGE) satellite is the first of its kind, designed to actually 'see' most of the major charged particle systems in the space surrounding Earth. Just as a photograph of the night sky allows astronomers to count and study millions of stars at once, and the intensities and wavelengths of the light allows them to determine the make-up of the stars, images returned by the IMAGE satellite will provide simultaneous measurements of the densities, energies and masses of charged particles throughout the inner magnetosphere. The two-minute cadence of the IMAGE "photographs" will provide dynamic imaging on a time scale that will allow the interaction of the solar wind with the magnetosphere to be viewed in movie form.

The data from IMAGE will allow scientists to see how remote populations of particles change throughout the region surrounding Earth, a region encompassing nearly one trillion cubic miles. Instruments onboard the satellite will follow the flows of matter and energy from distant regions of the Earth's magnetic field, through the auroral regions and into the Van Allen belts and ring currents. Such tracking will help scientists resolve many mysteries in geospace physics such as the sequence of events connecting solar disturbances in the magnetosphere to aurora and geomagnetic storms, and determining how particles from the ionosphere accelerate and take up residence in the plasmasphere.

IMAGE Science Objectives

Accurate space weather forecasting requires a detailed understanding of how solar storm effects are transmitted into the near-Earth environment where satellites and human space activity take place. The IMAGE mission is designed to provide *in situ* and remote imaging measurements of the changes in the high-energy particles and plasmas during solar storms, and non-storm, periods. From this new knowledge of the global changes in the geospace system, greatly improved models of the dynamics of the near-Earth environment will be created, which will improve the accuracy of space weather forecasts. This will improve the accuracy of adverse weather warnings for satellites and human activities.

In the past, space physicists had to rely on many research and weather satellites to measure the magnitudes and changes in the energetic particles in the magnetosphere. These measurements were always of particles and fields located where the spacecraft was in its orbit. Not all of the satellites available at a given time observed exactly the same conditions and their orbital locations were often so radically different that the near-Earth environment was very sparsely sampled. A similar situation once existed with terrestrial weather forecasting before the advent of weather satellites, which now provide global views of clouds in various temperature ranges.

The IMAGE spacecraft will make remote measurements of particle populations within the entire magnetosphere and update the information every two to 10 minutes. This will allow scientists, for the first time, see the 'big picture' all at once, rather than very limited local measurements at far-flung points in space. The IMAGE data can still be compared to the local *in situ* observations made by existing satellites, but it will provide a global point of view, allowing IMAGE to monitor large-scale changes and flows of particles.

IMAGE is designed to provide new insights to some of these space physics questions:

How is plasma injected into the magnetosphere during magnetic storms?
The solar wind particles impact the day-side magnetosphere causing a bow shock, like a supersonic jet flying through the atmosphere. They enter the magnetosphere along its boundary layers, but especially in magnetic indentations known as polar cusps. Ions and electrons from the Earth's ionosphere flow into the magnetosphere, especially from regions heated by auroras and the polar cusps. Scientists do not understand the details of how these two sources contribute to the storm-time plasmas of the magnetosphere. The IMAGE satellite will study how particles flow in and out of the magnetosphere and ionosphere using its ENA and RPI instruments.

How is the magnetosphere changed by its interaction with the solar wind?
When the magnetic field in the incoming solar wind has the same polarity as the geomagnetic field on the day side of the Earth, the geomagnetic field connects

mainly from the northern to southern hemisphere. When the polarity is opposite to the Earth's field, violent changes occur as field lines merge with solar wind magnetic field lines and are stretched into a long magnetotail, causing currents to flow into the magnetopause boundary and throughout the magnetosphere. These violent changes spawn geomagnetic storms, cause aurora and can affect satellites and electric power grids on Earth. To determine how the solar wind interaction produces space storms, IMAGE will monitor boundary motions, auroral brightenings and ring current increases.

How are the plasmas within the magnetosphere accelerated? Scientists do not fully understand how low-energy ions from the polar fountain – with energies of only a few electron volts – accelerate to thousands of electron volts in the magnetosphere. IMAGE will help scientists determine where, how and why low energy particles are accelerated to form the energetic ring current plasmas.

How are the plasmas transported from place to place within the magnetosphere? The favored methods include a variety of currents that are generated by the magnetic field of the Earth like an electric dynamo, or by some process involving diffusion. The details of what mechanism is dominant in a particular system at a particular time are not well understood. IMAGE will detect structural changes in the plasmasphere and ring current regions, as well as study the outflow of ions from the atmosphere into the plasmasphere, revealing the paths taken by these plasmas.

What causes magnetospheric plasmas to be lost from the system during storms? If the magnetosphere operated as a true magnetic bottle, it would continue to store particles indefinitely as they flow in from various sources. Because this does not happen, there must be one or more processes that act to remove energetic particles from the magnetosphere. One of these is highlighted by the aurora, where currents of particles from the outer magnetosphere collide with atmospheric atoms and give up their energy. At the outer edge of the magnetosphere, charged particles may also diffuse back into the solar wind as it passes by the Earth in its travels to the outer solar system. IMAGE will monitor the loss processes that moderate and quell magnetic storms.

IMAGE Instrument Payload

The IMAGE team consists of 24 co-investigators, and includes instrument leads and representatives from major contributing institutions. A similar number of participating scientists were involved in the development of the IMAGE spacecraft.

There are three classes of imaging systems onboard IMAGE: Energetic Neutral Atom (ENA) imagers; Ultraviolet imagers (FUV and EUV), and the Radio Plasma Imager (RPI). The ENA imagers use hydrogen atoms in the Earth's outer atmosphere, called the exosphere, to form images of energetic ions in the geospace environment. Although energetic ions cannot be directly detected from the orbit of the IMAGE satellite, they do collide with uncharged, neutral hydrogen atoms. A few percent of the ions take the electron away from the hydrogen atoms and become energetic neutral atoms (ENA's). The ENA's have no electrical charge and are unaffected by the Earth's magnetic field, traveling in straight lines as they escape from it. Suitable cameras can form images of these atoms just like a telescope forms images of light rays. Advanced ENA cameras, like those onboard IMAGE, will determine the properties of the parent ions, including their masses, energies and direction of motion at the time they were neutralized. The ENA imagers can resolve details as small as eight degrees over a 90-degree by 360-degree swath of sky, with updates provided every two minutes. These instruments also will detect different neutral atoms such as hydrogen, helium and oxygen.

The Low Energy Neutral Atom (LENA) imager detects neutral atoms at energies from 10 electron volts up to 500 electron volts. The primary goal is to image the outflow of low-energy ions from polar regions in the ionosphere, which appear to be a significant source of charged particles for the plasma sheet and radiation belts. The instrument was developed by a team led by Dr. Thomas E. Moore, NASA's Goddard Space Flight Center.

The Medium Energy Neutral Atom (MENA) imager detects neutral ions with energies between 1,000 and 30,000 electron volts, providing images of the ring current, the near-Earth plasma sheet and the night-side injection boundary. These are believed to be regions where mixtures of solar wind ions and low-energy polar fountain ions take up residence or are accelerated. The experiment will also image the ion population residing in the 'cusp' region of the magnetosphere. The instrument was developed by a team led by Dr. Craig J. Pollock of SwRI.

The High Energy Neutral Atom (HENA) imager detects energetic neutral atoms with energies between 10,000 to 500,000 electron volts, focusing mainly on the ring-current, inner plasma sheet and substorm injection boundary. (This instrument is a modified version of one previously flown on the Cassini mission, which will image energetic neutral atoms from Saturn's magnetospheric ion populations.) The instrument was developed by a team led by Dr. Donald G. Mitchell of the Johns Hopkins University Applied Physics Laboratory.

The Extreme Ultraviolet (EUV) imager detects light from helium atoms in Earth’s plasmasphere. The atoms absorb sunlight at a wavelength of 304 Angstroms, and re-emit this light back into space to reveal where the atoms are located. The EUV will have a resolution equal to the size of the full Moon (about 0.5 degree), and measure changes in the plasmasphere region as it exchanges energy with the other particles and fields in the Earth's environment. The instrument was developed by Dr. Bill R. Sandel of the University of Arizona.

The Far Ultraviolet (FUV) imaging system employs three detectors. The Wideband Imaging Camera (WIC) will image the aurora in broad band for maximum spatial resolution day and night. The Spectrographic Imager (SI) will measure different types of aurora, separating them by wavelength, and measure proton induced aurora by removing the bright geocorona emissions. The Geocorona photometers (GEO) will observe the distribution of the geocorona emissions to determine the magnetospheric hydrogen content responsible for neutral atom generation in the magnetosphere. The instrument was developed by a team led by Dr. Stephen B. Mende, University of California at Berkeley.

The Radio Plasma Imager (RPI) uses pulses of radio waves to 'sound' nearly the entire volume of the Earth's magnetic field. With its 1,652 foot (502-meter) tip to tip antenna, it is one of the biggest sensors ever flown in space. Like a policeman's radar detector, the RPI's 10-watt transmitter will send out a burst of radio waves, which will reflect off of clouds of charged particles between the plasmasphere's outer boundary all the way out to the boundary where the Earth's magnetic field is impacted by the solar wind. The RPI ‘radar’ will scan across a spectrum from 3 kilohertz (cycles per second) up to 3 megahertz, spanning the entire AM radio band and beyond. Every five minutes, an image will be built from the returned radio signals that will contain information about the direction, speed and density of distant plasma clouds. The instrument was developed by a team led by Dr. Bodo Reinisch, University of Massachusetts at Lowell.

The Central Instrument Data Processor (CIDP) provides acquisition, compression, storage and telemetry formatting of science data from all imagers, routes commands to the imagers and interfaces with the spacecraft systems. The CIDP was developed by SwRI.

Data Processing and Distribution

During the first 40 days following the launch of IMAGE, the spacecraft will be readied for taking data. Instruments will be powered on and checked. Among these is the Radio Plasma Imager (RPI), which has four antennas that are each 821 feet (250 meters) long. These will be deployed by carefully spinning the satellite and letting 100 gram weights at the ends of the antenna wires slowly reel-out the wires to their full extent. When deployment is complete, the satellite will measure 1,652 feet (502 meters) from tip to tip, making IMAGE the longest artificial structure in space – 180 feet (55 meters) taller than the Empire State building.

The information will be available in near real time to any scientist who wishes to use it in their research because the mission scientists have waived their right to embargo the IMAGE science data.

After the initial 40-day period, the spacecraft will begin taking in data continuously, storing it in a memory system capable of handling up to two gigabits of data. Every eight hours, the five-watt transmitter onboard IMAGE will download its memory contents at a rate of two megabits per second. This data stream will be received by NASA's Deep Space Network for about 15 minutes during each 14.5-hour orbit and relayed directly to the Science and Mission Operations Center at Goddard. IMAGE also will transmit its entire 44 kilobits per second data stream in real time for use in space weather forecasting. Although the reception of this real-time data is not part of the IMAGE mission, several laboratories plan to receive the data, process it with software provided by IMAGE and provide the results to the National Oceanic and Atmospheric Administration's Space Weather Operations branch for space forecasting purposes.

Although good magnetospheric imaging can be performed throughout the two-year mission from an apogee above the North Pole, the movement of apogee in latitude and local time will provide optimum conditions for certain investigations at various times. Examples of these opportunities in terms of time segments during the first year after launch include:

Segment 1: Day side Science (40-100 days after launch). Closest approach to the magnetopause where the solar wind impacts the Earth's magnetosphere on its Sun-side hemisphere. IMAGE has been designed to study the 'cusp' region through which solar wind plasma enters the magnetosphere. There will be an opportunity at this time to explore the affects of coronal mass ejections upon the flows of particles. The RPI will be most important during this observing segment as it gathers data on the dynamics of the magnetopause.

Segment 2: Dawn side Science (100-160 days after launch). This will be the best opportunity to investigate the so-called ion fountain where atmospheric atoms are pumped into the plasmasphere. This is the beginning of the high latitude apogee phase, allowing longer observations of the polar regions. IMAGE also will study magnetic substorms, their causes and how particles are lost from the magnetosphere.

Segment 3: Night side Science (160-280 days after launch). Orbit apogee has rotated into the nighttime sector, allowing excellent observations of the injection of particles from the geotail region into the inner magnetosphere.

Segment 4: Dusk side/Day side Science (280-370 days after launch). Nearly identical day side and dusk-side conditions encountered as at the start of mission in Segments 1 and 2. This period is important for studies of long-term changes of the entire system and to check for consistency.

Education and Public Outreach

POETRY began operations in 1996, setting up educational resources for teachers along with an award-winning web site http://image.gsfc.nasa.gov/poetry/ that helps serve the needs of both educators and the general public. Bill Taylor and Sten Odenwald of Goddard worked closely with a core group of teacher-consultants to develop several classroom products, which include three workbooks, lithographs, posters and a video that describes how solar storms affect the Earth's space environment and impact our technology. POETRY's educational products have received high accolades from NASA's Sun-Earth Connection Education Forum, which is responsible for surveying all of NASA's Space science education products.

The following teachers involved in POETRY are:

* Annie DiMarco of Holy Redeemer School, Kensington, Md. who developed “Northern Lights and Solar Sprites" for K-6 teachers.

* Susan Higley of Cherry Hill Middle School, Elkton, Md. who developed “Solar Storms and You” for middle school science and math teachers. Higley also was selected as the 1999 Maryland Teacher of the Year.

* William Pine of Chaffey High School, Ontario, Calif. who developed “The Instruments and Science of IMAGE,” a high school-level problem book about space science.

* Thomas Smith of Briggs-Cheney Middle School, Silver Spring, Md. who developed the “Blackout!” video and designed a curriculum module for the National Science Foundation funded Event-Based Science program, which is based on IMAGE science.

Program/Project Management

NASA Management:

Headquarters Office of Space Science:
Dr. George Withbroe, Science Program Director, Sun-Earth Connection
Dr. Mary Mellott, IMAGE Mission Scientist
William Huddleston, IMAGE Program Executive

NASA's Goddard Space Flight Center:
Frank Volpe, IMAGE Project Manager
Dr. Thomas Moore, IMAGE Project Scientist
Dr. James Green, IMAGE Deputy Project Scientist

Southwest Research Institute Management:

Dr. James Burch, Principal Investigator
William Gibson, IMAGE Project Manager

IMAGE Co-Investigators and Affiliation:

Dr. Stephen Fuselier	Lockheed Palo Alto Research Center FUV, LENA
Dr. Dennis Gallagher	NASA's Marshall Space Flight Center EUV, RPI
Dr. James Green	NASA's Goddard Space Flight Center RPI
Prof. Douglas Hamilton	University of Maryland HENA, LENA
Prof. K. Hsieh	University of Arizona HENA
Dr. David McComas	Los Alamos (N.M.) Laboratory MENA
Dr. Stephen Mende	University of California, Berkeley FUV
Dr. Donald Mitchell	Applied Physics Laboratory HENA
Dr. Tom Moore	NASA's Goddard Space Flight Center LENA
Dr. Craig Pollock	Southwest Research Institute MENA
Prof. Bodo Reinisch	University of Massachusetts, Lowell RPI
Prof. Patricia Reiff	Rice University RPI, Outreach
Dr. Bill Sandel	University of Arizona EUV
Dr. William Taylor	Raytheon ITSS, Goddard PI, Education

International collaborators and Affiliations:

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Dr. J.-L. Bougeret	Observatory of Paris, Meudon RPI
Dr. J.-C. Gerard	University of Liege, Belgium FUV
Dr. M. Grande	Rutherford Appleton Laboratory, U.K. MENA
Dr. C. Jamar	University of Leige, Belgium FUV
Dr. H. Lauche	Max Planck, Germany FUV,GEO

Dr. S. Livi	Max Planck, Germany HENA
Prof. T. Mukai	ISAS, Japan MENA
Prof. J. Murphree	University of Calgary, Canada FUV
Dr. P. Wurz	University of Bern, Switzerland LENA

IMAGE Glossary

Cusp Region: The Earth's magnetic field is shaped like a simple bar magnet, but the field lines that exit near the day-side polar regions diverge owing to the influence of the solar wind. Above a particular latitude, magnetic field lines no longer connect from the North to the South Pole on the day-side, but are swept over the poles and into the geotail. This divergence of magnetic field lines forms a kind of funnel-shaped region known as the polar cusp. The cusp is a channel or magnetic pipeline that leads directly from the upper atmosphere to the magnetopause, and is a main entryway for solar wind particles into the atmosphere. It is also a channel in which atoms from the atmosphere can leak out into the magnetosphere via so-called 'polar fountains'.

Geocorona: The atmosphere of the Earth extends up to about 50,000 miles from the Earth in a tenuous cloud of gas, consisting of mostly hydrogen atoms. This part of the atmosphere is known as the exosphere. The hydrogen atoms absorb ultraviolet light from the Sun and re-emit the light, forming a glow that is called the geocorona. The geocorona was first detected during the Apollo missions to the moon when astronauts photographed the light from the hydrogen atoms using a special camera.

Geospace: A region of space surrounding the Earth that is inside the magnetosphere of the Earth.

Geotail: The region of the Earth's comet-like magnetosphere that forms the long tail opposite from the direction to the Sun. The geotail region extends millions of miles from the Earth. It is a reservoir of charged particles that enter the region from the solar wind and the Earth's ionosphere. It is characterized by opposing magnetic fields and varying particle densities and flows. During magnetic disturbances (storms and substorms) particle and field energy in this region increase. Currents of charged particles flow in this region and are directed along the Earth's magnetic field into the polar regions where they cause aurora.

Ionosphere: A layer of charged particles in the upper atmosphere found at altitudes of about 50 to 300 miles. Radio waves bounce off of this region and are used for radio communication between widely separated geographic points on Earth. The ionosphere also provides a medium for allowing currents carried by charged particles in the magnetosphere to complete a vast electrical circuit.

Magnetosphere: The volume of space surrounding the Earth which contains the magnetic field, where particles are primarily influenced by the Earth's field rather than other forces. It is a comet-shaped region with the Earth at the 'head' and a long 'tail' trailing behind the Earth opposite in direction to the Sun. This means that the magnetosphere on the daytime side of the Earth is compressed by the solar wind, and the nighttime hemisphere contains the so-called 'geotail' region.

Magnetopause: The outer boundary of the magnetosphere where the solar wind is in pressure balance with the Earth's magnetic field. It is a narrow, but complex region in which magnetic fields can change shape, liberate energy, and cause a variety of turbulent conditions that accelerate particles.

Plasma: The fourth state of matter where heated gases collide so briskly that electrons are ejected a gas consisting of charged atoms called ions and free electrons is formed.

Plasmasphere: This is a region of trapped plasma particles near the Earth, where the magnetic field is strong enough that it sweeps through space as the Earth rotates and drags charged particles along with it so that they rotate they rotate with the Earth.

Precipitation: This is a process in which energetic, charged particles flow down into the upper atmosphere and cause aurora and other upper atmosphere phenomena.

Ring Current: Inside the inner magnetosphere trapped particles bounce from North to South and back along the magnetic field lines. As the particles move closer to the Earth, they begin to drift onto neighboring field lines. Positively charged particles drift westward while negatively charged particles drift eastward. This causes a westward current to flow around the Earth.

Trapped Particles: When the Earth's magnetic field is strong enough, charged particles can get captured or 'trapped' on magnetic field lines. Typically, they spiral back and forth along these field lines between the northern and southern hemispheres as though they were confined inside a magnetic bottle.