Mr. French
P80-10016

NASA News

National Aeronautics and
Space Administration

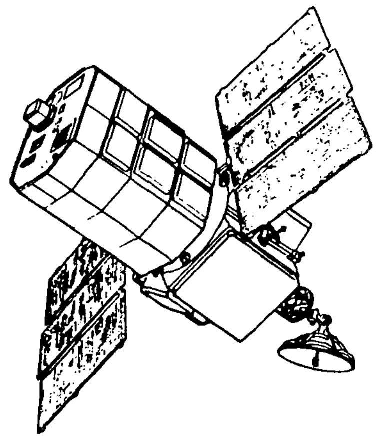
Washington, D.C. 20546
AC 202 755-8370

For Release IMMEDIATE

Press Kit

Project Solar Maximum Mission

RELEASE NO: 80-16



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February 6, 1980

NASA News

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Space Administration

Washington, D.C. 20546
AC 202 755-8370

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For Release:
IMMEDIATE

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NASA SET TO LAUNCH SOLAR FLARE SATELLITE

NASA is preparing to place in Earth orbit the first spacecraft designed specifically for the study of solar flares. The mission represents a major step toward a better understanding of the violent nature of the Sun and its effects on Earth.

The Solar Maximum Mission spacecraft will be launched from Cape Canaveral, Fla., about Feb 14.

The satellite, carrying seven scientific instruments, is designed to provide scientists with observations of solar flares -- violent eruptions on the Sun's surface -- over a wide band of wavelengths in the ultraviolet, X-ray and gamma-ray regions of the spectrum.

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Through coordinated observations at many different wavelengths, scientists expect to obtain many clues about the complex nature of solar flares and how they might be predicted.

The mission is designed to coincide with the solar maximum period, the peak of an 11-year sunspot cycle when particularly explosive activity disrupts the Sun's surface. The satellite will play the pivotal role in a coordinated program of spacecraft, sounding rocket and ground-based observations extending at least through February 1981.

Although the NASA spacecraft will concentrate on solar flare activity, one of the instruments is also expected to measure the Sun's total radiation output to within one-tenth of one percent over a period of one year. According to computer model predictions of the response of Earth's atmosphere to solar radiation, such a precise measurement should be sufficient to establish definitely whether changes in total solar heat output are sufficient to affect climate and weather.

Improved knowledge about flares and pre-flare conditions could help scientists predict the occurrence of these complex phenomena. On the basis of available evidence, however, scientists have inferred this much:

The magnetic field extending out through the surface of the Sun somehow gathers itself into an enormously compressed bundle to form a magnetic knot. This becomes visible as a sunspot, a region whose dimensions often are greater than the entire Earth, and, sometimes, as a looping cloud of dense gas, hundreds of thousands of miles long, known as a solar prominence.

Solar flares erupt close to but not exactly over the sunspots. It is not known precisely how or why the enormous energy release takes place. Theorists believe that the energy comes from the electric currents associated with the strong magnetic fields on the Sun.

This solar maximum period is expected to be the second most active since Galileo discovered sunspots in the early 1600s. Sunspots are relatively cool and quiet areas on the solar surface. Their temperature of 4000 degrees Celsius (7000 degrees Fahrenheit) is three-fourths as hot as that of the areas surrounding them. But, surrounding the sunspots we find active regions of the Sun which are the locations that most frequently produce the high energy eruptions known as solar flares; the more sunspots, the more solar flares.

Flares occur about 8000 kilometers (5000 miles) above the Sun's surface, a region where the temperature is about two million degrees C (3.5 million degrees F.). The largest flares release energy equivalent to 10 trillion one-megaton hydrogen bombs. The release of energy is sudden.

Earth gets only a relatively small portion of the released energy. But even this small amount has effects which can be seen and heard on our planet. When the flares of solar gases and radiation reach Earth's magnetic field and atmosphere, they can cause severe disruptions in radio and television communications, surges in power transmission lines, auroral displays and possible reductions in the lifetimes of some orbiting spacecraft. Some scientists suspect that increased solar activity also influences Earth's weather and climate.

The greatest recorded activity on the Sun was during the solar maximum of 1957. In September of that year, more than 200 sunspots were recorded. The calmest solar maximum on record occurred in 1907, with about 60 sunspots observed. The last solar maximum, in 1968-69, was relatively quiet.

Because of the new telescopes, remote-sensing instruments and spacecraft that were not generally available during past solar maxima, the 1980 Solar Maximum Year will be the most widely scrutinized in history.

Once the satellite achieves orbit of 574 kilometers (310 miles) altitude, all mission operations will be conducted from two buildings at NASA's Goddard Space Flight Center in Greenbelt, Md.: the Operations Control Center in Building 3 and the Experimenters Operations Facility in Building 7.

The control center will manage all observatory operations, receiving real-time and recorded data 15 times a day.

At the experimenters facility, the seven principal investigators will participate jointly in a round-the-clock program of coordinated science. At their own computers, they will receive both ground-based and satellite data in near real time, and use the data to predict events on the Sun over the next 24 hours. Experiments will then be programmed and science activities planned for the following day on the basis of a consensus among investigative team members.

Personnel from the National Oceanic and Atmospheric Administration's Solar Forecast Center, Boulder, Colo., will participate at the facility to coordinate satellite observations with those from ground observations.

The launch of the satellite by a Delta rocket will mark the maiden flight of NASA's Multimission Modular Spacecraft , the basic structural frame, or bus, which will house the observatory's power, attitude control, communications and data handling systems.

The satellite is a three-axis inertially-stabilized platform providing precise stable pointing to any region on the solar disk to within 5 seconds of arc. The weight of the satellite is 2315.1 kilograms (5105 pounds), which includes 593.75 kg (1309 ob.) for scientific instruments. It is about 4 meters (13 feet) long and 2.3 m (7 ft.) in diameter.

Two fixed solar paddles are attached to a transition adaptor between the upper instrument module and the lower spacecraft bus. The paddles supply power to the spacecraft during the daylight portion of orbits while three rechargable batteries supply power while the spacecraft is in the Earth's shadow.

The mission's 8-minute launch window opens each day at about 11:00 a.m. EST. This constraint is to assure that the spacecraft will be launched into a full day of sunlight. Separation from the Delta will occur while the Guam tracking station is monitoring the satellite.

The Solar Maximum Mission is managed for NASA's Office of Space Science, Washington, D.C. by the Goddard center. Michael E. McDonald is program manager and Dr. Eric Chipman is program scientist. At Goddard, project manager is Peter T. Burr and Kenneth J. Frost is project scientist.

Estimated cost of the mission, exclusive of launch vehicle and tracking and data network operations, is approximately $79 million.

(END OF GENERAL RELEASE. BACKGROUND INFORMATION FOLLOWS.)

Note:

Photographs and drawings to illustrate this press kit will be distributed without charge only to media representatives in the United States. They may be obtained by writing or phoning:

Public Affairs Audio-Visual Office
Code LFD-10 NASA Headquarters
Washington, D.C. 20546

Telephone No: 202/755-8366

Photo Nos: 79-H-583
77-H-710
74-H-434

MISSION OBJECTIVES

The NASA Solar Maximum Mission will provide for the first time a means for coordinated studies of the solar phenomena called solar flares. Although our knowledge of the Sun has increased immensely since the launching of the first solar observatory in 1962, this is the first mission dedicated specifically to the study of the flaring process. The satellite will be operating cooperatively with other ground and space observatories during the International Solar Maximum Year which extends through February 1981.

The spacecraft's integrated package of seven different experiments will operate in selected wavelength bands (ultraviolet, infrared, X-ray and gamma ray), allowing investigative teams to monitor the active regions with their associated sunspots, and focus on flares.

An ultraviolet spectrometer/polarimeter will provide sharp pictures, well-resolved spectra, and measurement of velocities and strong magnetic fields in flares.

A visible light coronograph/polarimeter will trace coronal effects of flares that sometimes put a major fraction of their energy into plasmas ejected into interplanetary space.

Finally, a total solar irradiance monitor will measure the solar constant to an accuracy of $\pm$ 0.1 percent.

The NASA Solar Maximum Mission is designed to provide broad coverage of a flare's electromagnetic spectrum, backed up by simultaneous worldwide instrument observations -- performed on the ground and by other spacecraft -- of the composition and energy distribution of the fast radiation particles and plasma emitted from the flare into interplanetary space.

The primary scientific objectives of the Solar Maximum Mission are:

- To observe flare and flare-induced effects in the Sun's chromosphere, chromosphere-corona transition region and corona.
- To determine the fundamental characteristics of the solar plasma before, during and after solar flares.
- To study coronal evolution at the period of solar maximum activity point.

- To determine the temperature and density structure of the high energy flare plasma as a function of space and time.
- To investigate the position, structure and thermodynamic properties of hot thermal and non-thermal sources in flares.
- To investigate electron acceleration and very high temperature plasmas by observing high energy solar X-rays and gamma rays.

Scientists of many nations will participate in the coordinated observational program through an extensive Guest Investigator Program.

THE SPACECRAFT

The spacecraft weighs approximately 2,315 kilograms (5,105 pounds), is 4 meters (13 feet) in length and 1.2 m (4 ft.) wide.

Construction is modular. The instrument module houses all the solar payload instruments and the Fine Pointing Sun Sensor for pointing control.

Below the instrument module, separated by the transition adapter, is the supporting spacecraft. Three modules, each about 1.2 x 1.2 x 0.5 m (4 x 4 x 1.6 ft.), house essential spacecraft subsystems: Attitude Control System, Power and Communications and Data Handling.

Two fixed solar arrays, each having three panels, extend from the mission adapter and supply up to 3,000 watts of spacecraft power. Two other components are also supported: the Signal Conditioning and Control Unit, and the High Gain Antenna System. Three nickel-cadmium batteries supply power during eclipses, or when the spacecraft is operating in the Earth's shadow.

MISSION OPERATIONS

Once the satellite is in orbit, all mission operations will be conducted from two buildings at the Goddard Space Flight Center: the Operations Control Center and the Experimenters Operations Facility.

The control center will manage all observatory operations, including spacecraft commands for new mission sequences, tape recorder data "dumps" and the monitoring of information regarding the health of the spacecraft. This will start when the spacecraft separates from the Delta launch vehicle over Guam.

On-orbit alignment calibration of the instruments is critical to mission success. Because of this, one of the first tasks to be executed after arrival in orbit will be a sequence of spacecraft and instrument slews across the solar disc that will calibrate the alignment of each instrument with respect to the fine Sun sensor and provide the data necessary to command the instruments to the required coalignment.

Individual instrument raster systems will be used, when required, to construct small images of selected solar features by scanning the instrument across an area typically several arc minutes in extent.

Using satellite data and inputs from ground observatories worldwide, the seven principal investigators will take part each day in 10-to-12 orbits of coordinated science. At their own computers in the Goddard facility, they will receive both ground-based and satellite data in near real-time and use the data to predict events on the Sun over the next 24 hours. Programming of experiments and following-day science activities will be planned according to investigative team consensus.

The satellite will be operated round-the-clock.

SCIENTIFIC INVESTIGATIONS

Gamma Ray Spectrometer

Principal Investigator: Dr. E. L. Chupp, University of New Hampshire, Durham.

Objective: Study of solar gamma rays in the range 0.3 to 160 MeV for determination of solar flare/particle acceleration phenomena and the abundance of specific nuclides.

Description: The main gamma ray detector consists of seven high resolution sodium iodide integral line detectors surrounded by an active cesium iodide shield operating over the range 0.3 to 9 MeV. Auxiliary detectors consist of a thick cesium iodide crystal behind the main detector for use in detection of gamma rays with energies above 10 MeV and two sodium iodide X-ray detectors covering the range 10 to 180 KeV.

Hard X-Ray Burst Spectrometer

Principal Investigator: K. J. Frost, Goddard Space Flight Center, Greenbelt, Md.

Objective: Measurement of solar X-ray bursts in the range from 20 to 300 KeV to investigate the characteristics of particle acceleration in the solar flare process and to determine the role of accelerated particles in generation of the thermal phase of the flare process.

Description: The detector is an anti-coincidence shielded cesium iodide scintillator with a 16-channel pulse height spectra acquired once every 0.1 seconds over the 20 to 300 KeV energy range. A memory enables X-ray bursts to be searched for time structure with a resolution of 1 millisecond.

Hard X-Ray Imaging Spectrometer

Principal Investigator: Prof. C. deJager, Space Research Laboratory, Utrecht, The Netherlands.

Objective: Investigate the position, structure and thermodynamic properties of hot thermal and non-thermal sources in active and flaring regions by means of two-dimensional X-ray pictures with a spatial resolution of 8 arc seconds over the energy range from 3.5 to 30 KeV.

Description: The instrument consists of an imaging collimator and position sensitive detector system operating in 6 energy channels. The grid collimator has a total of 512 image elements; 304 fine elements (8" x 8") over a 2'40" diameter field of view, 128 coarse elements (32" x 32") over a 6'24" diameter field of view, and 80 slit elements (16" x 384"). Temporal resolution in the flare mode is 1.5 seconds.

Ultraviolet Spectrometer and Polarimeter

Principal Investigator: Dr. E. Tandberg-Hanssen, Marshall Space Flight Center, Huntsville, Ala.

Objective: Study the physical conditions of the coronal active regions and flares by means of high resolution spectroscopy to measure temperature, density, velocity and magnetic fields in these features by measuring line intensities and line profiles in the spectral range from 1,100 to 3,000 Angstroms.

Description: The instrument consists of a Gregorian telescope and an Ebert spectrometer. The telescope secondary mirror has a raster mechanism which allows up to a 4x4 arc minute scan size. Spatial resolution, which is determined by an entrance slit mechanism, is adjustable from 1x1 arc seconds to 30x30 arc seconds. Spectrometer spectral resolution is .01 Angstroms. To allow simultaneous measurements at different heights in the chromosphere and corona, any of three sets of four lines for spectroscopy and any of six line pairs for polarimetry may be selected.

X-Ray Polychromator

Principal Investigators: Dr. L. W. Acton, Lockheed Palo Alto Research Laboratory, Palo Alto, Calif.; Dr. J. L. Culhane, Mullard Space Science Laboratory, England; and Dr. A. H. Gabriel, Appleton Laboratory, England.

Objective: Measurement of X-ray emission lines in the 1.4 to 22.4 Angstroms spectral interval for the investigation of those aspects of solar activity which lead to production of plasma with temperatures up to 50 million degrees. This includes the pre-flare, flaring and post-flare plasmas.

Description: The instrument consists of two systems, a Flat Crystal Spectrometer and a Bent Crystal Spectrometer. The flat crystal instrument consists of seven collimated crystal spectrometers which are operated simultaneously in a raster scan or spectral scan mode. The spatial resolution is 10 arc seconds with a raster field of view of 7x7 arc minutes. The bent crystal unit consists of eight fixed crystal spectrometers which give simultaneous spectral scan information with a time resolution of 0.1 seconds. Spatial resolution is 6 arc minutes.

Coronagraph/Polarimeter

Principal Investigator: Dr. L. L. House, High Altitude Observatory, Boulder, Colo.

Objective: Study of coronal evolution and coronal transient activity with emphasis on determination of electron density and magnetic fields in response to transient events.

Description: The instrument is an externally occulted coronagraph using an SEC vidicon detector. Field of view is from 1.5 to 6.0 solar radii with a resolution of 6.4 arc seconds. Measurement range is from 4,000 to 7,000 Angstroms in seven wavelength bands including polarization filters. The instrument is mounted on a pointing platform which maintains instrument boresight at Sun center.

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Active Cavity Radiometer Irradiance Monitor

Principal Investigator: Dr. R. C. Willson, Jet Propulsion Laboratory, Pasadena, Calif.

Objective: Measurement of the total solar irradiance with state-of-the-art accuracy and precision (less than 0.5 percent) to determine the magnitude and direction of variations in the total solar output of optical energy.

Description: Solar irradiance from the far ultraviolet through far.infrared wavelengths are measured by three active cavity and radiometer detectors individually shuttered. These detectors are electrically self-calibrated, conical cavity pyroheliometers, capable of defining the solar flux with an uncertainty of 0.1 percent and a precision of 0.2 percent. One detector is used routinely to monitor the Sun, a second detector is intermittently exposed to the Sun to establish the long-term stability of the first detector, and the third detector is used for resolving ambiguities in the performance of the first two detectors.

THE SUN

Earth is one of nine planets circling around our star, one of some two hundred billion stars in our galaxy. The Sun is a middle-aged, middle-sized star in the galaxy, with a remaining lifetime of about five billion years. It has nearly 1,000 times the mass of all the planets combined, and 300,000 times the mass of Earth. Its diameter is about 100 times that of Earth. Some stars are hundreds of times larger than the Sun; most are much smaller.

Composition

Although the Sun is composed of the same basic elements as Earth, its relative proportions are quite different. For example, about 80 percent of the mass of the Sun is hydrogen, the lightest element, and most of the remainder is helium, the second lightest. Heavier elements such as carbon, nitrogen, oxygen and silicon constitute only 1 percent of the solar mass.

The Sun has a surface temperature of nearly 6,000 degrees Kelvin (11,000 degrees Fahrenheit) with much higher temperatures below its surface (reaching more than 10 million degrees K (18 million degrees F.) at the center). The energy output of the Sun is equivalent to the conversion of nearly 5 million tons of matter into energy every second. For comparison, a 10-megaton hydrogen bomb explosion is equivalent to the conversion of slightly more than one pound of matter into energy.

The Solar Surface

The visible surface of the Sun, the photosphere, transmits most of the Sun's light and heat. The photosphere is not a true surface, but represents the lowest gas layer from which visible light can be radiated into space. Other parts of the Sun include the middle atmosphere or chromosphere, which extends a few thousand miles above its surface, and the outer atmosphere, or corona, extending several solar radii into space and merging into the solar wind in interplanetary space.

The corona is a very thin, very hot gas, up to 2 million degrees K (3.5 million degrees F.). The fact that the corona is so much hotter than the photosphere cannot be explained by heating due to photospheric radiation, but is thought to result from shock waves or magnetic waves propagating outward through the solar atmosphere. These waves are produced by turbulent, convective motions in the lower atmosphere. The corona is also the source of the solar wind, which provides the interplanetary gas and magnetic field environment which surrounds the Earth.

Sunspots

Although the Sun appears extremely stable when viewed from Earth, its surface does have variations such as sunspots and the immense solar flares that hurl solar plasma outward for millions of miles.

The first solar variation or change to be recognized was seen by the Italian scientist Galileo in 1610 when he observed and described spots on the Sun's surface with his newly invented telescope.

Two centuries later Heinrich Schwabe, a German pharmacist whose hobby was astronomy, began watching the Sun and discovered that sunspot activity varies over an 11-year cycle. Scientists began taking this phenomenon seriously and indeed determined that every 10.7 years, on the average, there is a "sunspot maximum" which lasts two or three years.

In 1862, the German scientist Johann von Lamont found that Earth's magnetic field intensity rises and falls in an 11-year cycle, matching the sunspot cycle.

In 1908, the American astronomer George Ellery Hale detected strong magnetic fields inside the sunspots.

Energy Output

Direct measurements of solar energy output are relatively recent, the first known measurements having been made in 1837. It was not until 1923 that scientists at the Smithsonian Institution in Washington began daily observations. These observations are important because fluctuations in the Sun's brightness of as little as 0.2 percent can affect Earth's climate.

In 1958, the American astronomer Eugene Norman Parker theoretically predicted an outflow of electrically-charged subatomic particles from the Sun, and called this the "solar wind." The particles are deflected and trapped by the Earth's magnetic field, collecting in a vast doughnut of space tens of thousands of miles above the Earth's surface. The energy of collision of these particles with the atoms of the upper atmosphere near Earth's magnetic poles produces light -- the auroras.

Since the incidence of auroral activity rises and falls with the sunspot cycle, scientists believe that the solar wind does also. Thus, the more sunspots the greater the variations of the solar wind. This variability is reflected in the appearance of the corona.

The Solar Flare

In 1958, the British astronomer Richard Christopher Carrington, observed the appearance of a sudden point of brightness on the Sun's surface, that lasted five minutes, and then subsided. Carrington had seen the first recorded "solar flare."

A solar flare is an explosion on the Sun's surface which sends a vast burst of material outward. The section of the solar wind immediately outward from the solar flare is much denser and more intense than it would ordinarily be, creating a "solar gust." A large solar gust can reach Earth in a matter of a few days creating an electric storm causing auroral fluctuations along with disturbances and malfunctions in compasses and electronic equipment.

Solar flares occur in the Sun's upper chromosphere and lower corona and generally occur near sunspots. Such active regions are also the sources of prominences (jets of hot gas which sometimes shoot high into the corona) and are characterized by locally intense magnetic fields.

Scientific fascination with flares stems from their enormous power. A major surface flare will release in a few minutes more energy than man can produce in a million years at present rates.

SUN-EARTH RELATIONSHIP

The Sun literally controls the behavior of the Earth's atmosphere and provides a continuous source of energy necessary to support life on Earth. Thus, it affects our weather, climate, communications and environment in fundamental ways.

For example, a loss of radio communications or surges in power transmission lines on the ground often result from changes in solar activity. Many meteorologists believe the same is true of our weather.

The ultraviolet and X-rays emitted by the Sun are responsible for the terrestrial ionosphere, which is vital to long-distance radio communication. Another vital product of solar ultraviolet radiation is the terrestrial ozone layer. Ozone absorbs ultraviolet light and prevents it from reaching the surface of the Earth. Without its protection, life as we know it would be difficult or impossible. Hence, variations of the solar ionizing radiation are of great practical importance.

Therefore, it is of considerable practical interest to monitor the Sun for disturbances and attempt to predict them.

LAUNCH VEHICLE

The Solar Maximum Mission spacecraft will be launched by NASA's two-stage Delta 3910 launch vehicle. This will be the 151st flight for Delta.

Delta is managed for NASA's Office of Space Transportation Systems Operations by the Goddard Space Flight Center, Greenbelt, Md. Kennedy Space Center's Expendable Vehicle Operations Division is responsible for launch operations management. The McDonnell Douglas Astronautics Corp., Huntington Beach, Calif., is the Delta prime contractor for the vehicle and launch services.

The Delta 3910 is 35.5 m (116 ft.) long including the spacecraft shroud. Liftoff weight is 190,000 kg (418,000 lb.) and liftoff thrust is 462,714 lb. including the initial thrust of five of the nine solid motor strap-ons (the remaining strap-ons are ignited at 64 seconds after liftoff).

The first stage booster will be an extended McDonnell Douglas long-tank Thor powered by the Rocketdyne RS-27 engine system which uses hydrazine (RP-1) and liquid oxygen propellants. Pitch and yaw steering is provided by gimballing the main engine. The vernier engines provide roll control during powered flight and total control during coast.

The McDonnell Douglas second stage is powered by the TRW TR-201 liquid bipropellant engine, using nitrogen tetroxide as the oxidizer and Aerozene-50 as the fuel. Pitch and yaw steering during powered flight are provided by gimballing the engine. Roll steering during powered flight and all steering during the coast are provided by a cold gas system.

The guidance and control system of the vehicle is located on top of the second stage. The strapdown Delta Inertial Guidance System provides guidance and control for the total vehicle from liftoff through attitude orientation and separation of the spacecraft.

LAUNCH OPERATIONS

Delta 151, carrying the Solar Maximum Mission spacecraft, will be launched from Pad A at Complex 17, Cape Canaveral Air Force Station, Fla.

The Delta vehicle assembly on Pad A was completed in December and the spacecraft was received in January for preflight processing and mating with the Delta 151 second stage in early February. The payload shroud, which will protect the spacecraft during its flight through the atmosphere, was to be installed about four days prior to launch.

LAUNCH SUPPORT

Range Safety: Command destruct receivers are located in the first and second stages and are tuned to the same radio frequency. In the event of erratic flight, both systems will respond to the same modulated signal sent by a ground transmitting system upon initiation by the range safety officer.

Launch Support: The Air Force Eastern Space and Missile Center, the launch vehicle contractor, McDonnell Douglas, and NASA will supply all personnel and equipment required for the assembly, prelaunch checkout and launch of the Delta vehicle.

Tracking and Data Support: Air Force Eastern Space and Missile Center stations and the NASA Space Tracking and Data Network stations at Merritt Island, Fla., Guam, Hawaii and Australia will track the vehicle during ascent and insertion into orbit.

MAJOR LAUNCH EVENTS

Event	Time	Altitude Kilometers	(Miles)	Velocity Km/Hr	(Mph)
Liftoff (5 Solid Motors Ignition)	0 sec.	0	(0)	0	(0)
5 Solid Motor Burnout	57.2 sec.	10.0	(6.2)	1,626	(1,011)
Jettison 3 Solid Motor Casings	1 min. 4 sec.	12.4	(7.7)	1,560	(969)
4 Solid Motor Ignition	1 min. 4 sec.	12.4	(7.7)	1,560	(969)
Jettison 2 Solid Motor Casings	1 min. 5 sec.	12.7	(7.9)	1,591	(989)
4 Solid Motors Burnout	2 min. 1 sec.	42.6	(26.5)	6,970	(4,332)
Jettison 4 Solid Motor Casings	2 min. 8 sec.	47.0	(29.2)	7,294	(4,533)
Main Engine Cutoff	3 min. 45 sec.	110.7	(68.8)	19,386	(12,049)
Stage I/II Separation	3 min. 53 sec.	115.5	(71.8)	19,417	(12,068)
Stage II Ignition	3 min. 58 sec.	118.3	(73.5)	19,398	(12,056)
Jettison Shroud	4 min. 55 sec.	144.3	(89.7)	20,370	(12,660)
First Cutoff - Stage II	8 min. 41 sec.	166.7	(103.6)	27,029	(16,799)
Restart Stage II	54 min. 41 sec.	577.7	(359.1)	25,249	(15,693)
Final Cutoff - Stage II	54 min. 53 sec.	577.7	(359.1)	25,652	(15,943)
Stage II/Spacecraft Separation	1 hr. 11 min.	571.5	(355.2)	25,687	(15,961)

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SOLAR MAXIMUM MISSION TEAM

NASA Headquarters

Dr. Thomas A. Mutch	Associate Administrator for Space Science
Andrew J. Stofan	Deputy Associate Administrator for Space Science
Dr. Adrienne F. Timothy	Assistant Associate Administrator for Space Science
Dr. Harold Glaser	Director, Solar Terrestrial Division
Michael E. McDonald	Manager, Solar Terrestrial Satellites
Dr. Eric G. Chipman	Program Scientist
Dr. Glynn S. Lunney	Acting Associate Administrator for Space Transportation Systems Operations
Joseph B. Mahon	Director, Expendable Launch Vehicles Systems
Peter T. Eaton	Manager, Delta Program
Dr. William C. Schneider	Associate Administrator for Space Tracking and Data Systems
Charles A. Taylor	Director, Network Operations and Communications Programs

Goddard Space Flight Center

A. Thomas Young	Director
Peter T. Burr	Solar Maximum Mission Project Manager
Kenneth J. Frost	Solar Maximum Mission Project Scientist
Frank J. Ceppolina	Multimission Spacecraft Project Manager

Goddard (cont'd.)

John H. Boeckel	Acting Director, Project Management Directorate
Joseph Purcell	Deputy Director, Project Management Directorate
Robert C. Baumann	Associate Director, Project Management Directorate
James Kupperian	Associate Director for Projects, Project Management Directorate
Paul A. Mowatt	Associate Director for Projects, Project Management Directorate
Henry K. Arneson	Assistant Director for Resources, Project Management Directorate
Paul G. Marcotte	Assistant Director for Engineering, Project Management Directorate

Kennedy Space Center

Richard G. Smith	Director
Charles D. Gay	Director, Deployable Payloads Operations
D. C. Sheppard	Chief, Automated Payloads Division
Wayne L. McCall	Chief, Delta Operations Division
John Dunn	Spacecraft Coordinator

CONTRACTORS

Hughes Aircraft Co. Los Angeles, Calif.	Solar Array System
Sperry Flight Systems Phoenix, Ariz.	High Gain Antenna System
Adcol Corp. Waltham, Mass.	Fine Pointing Sun Sensor
Ball Corp. Boulder, Colo.	Co-Alignment Adjustment System
McDonnell Douglas Corp. St. Louis, Mo.	Power Module Subsystem
General Electric Co. Valley Forge, Pa.	Attitude Control Subsystem
Fairchild Industries, Inc. Germantown, Md.	Command and Data Handling Subsystem
Grumman Aerospace Corp. Bethpage, Long Island, N.Y.	Flight Operations
McDonnell Douglas Astronautics Corp. Huntington Beach, Calif.	Delta Launch Vehicle

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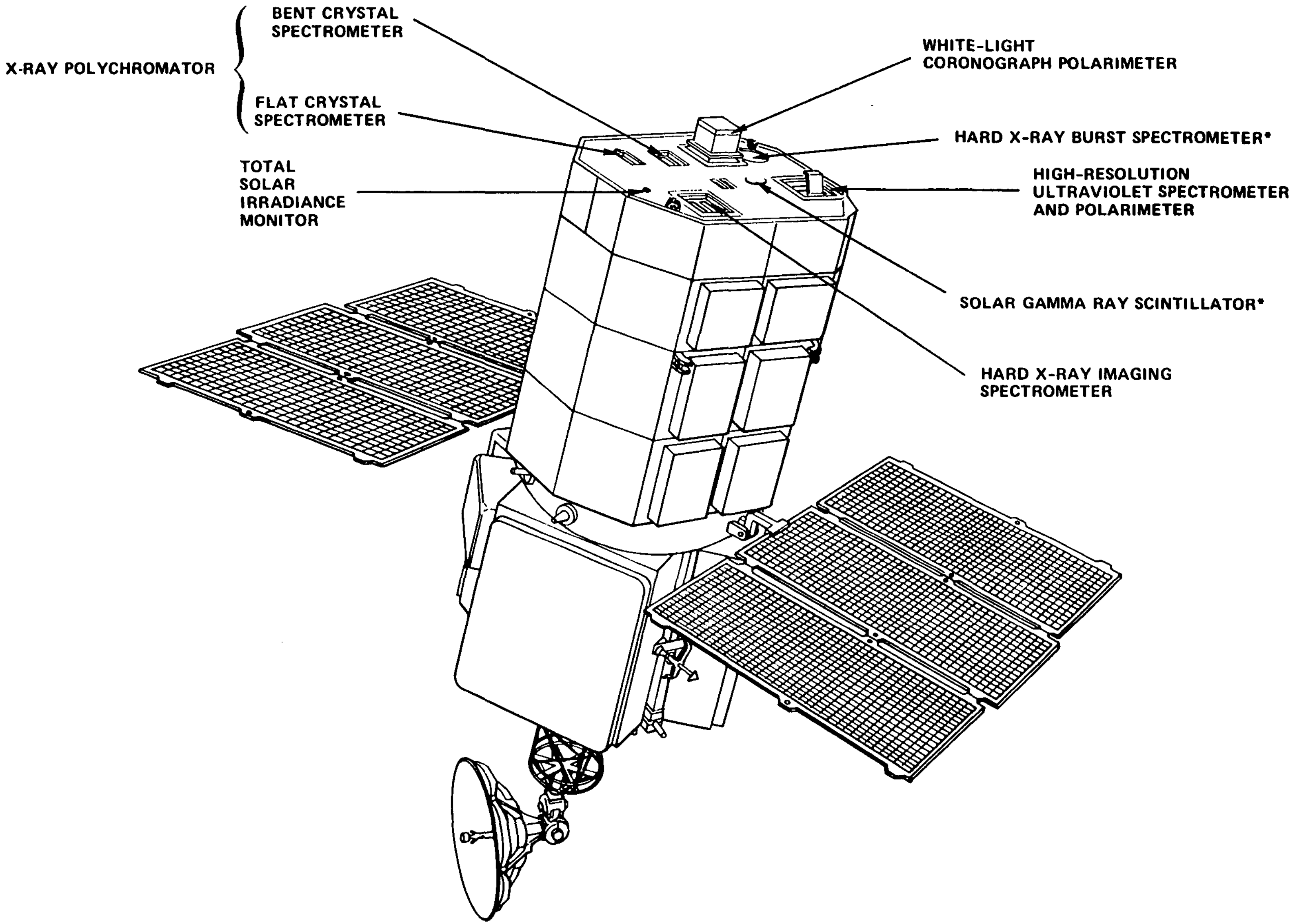
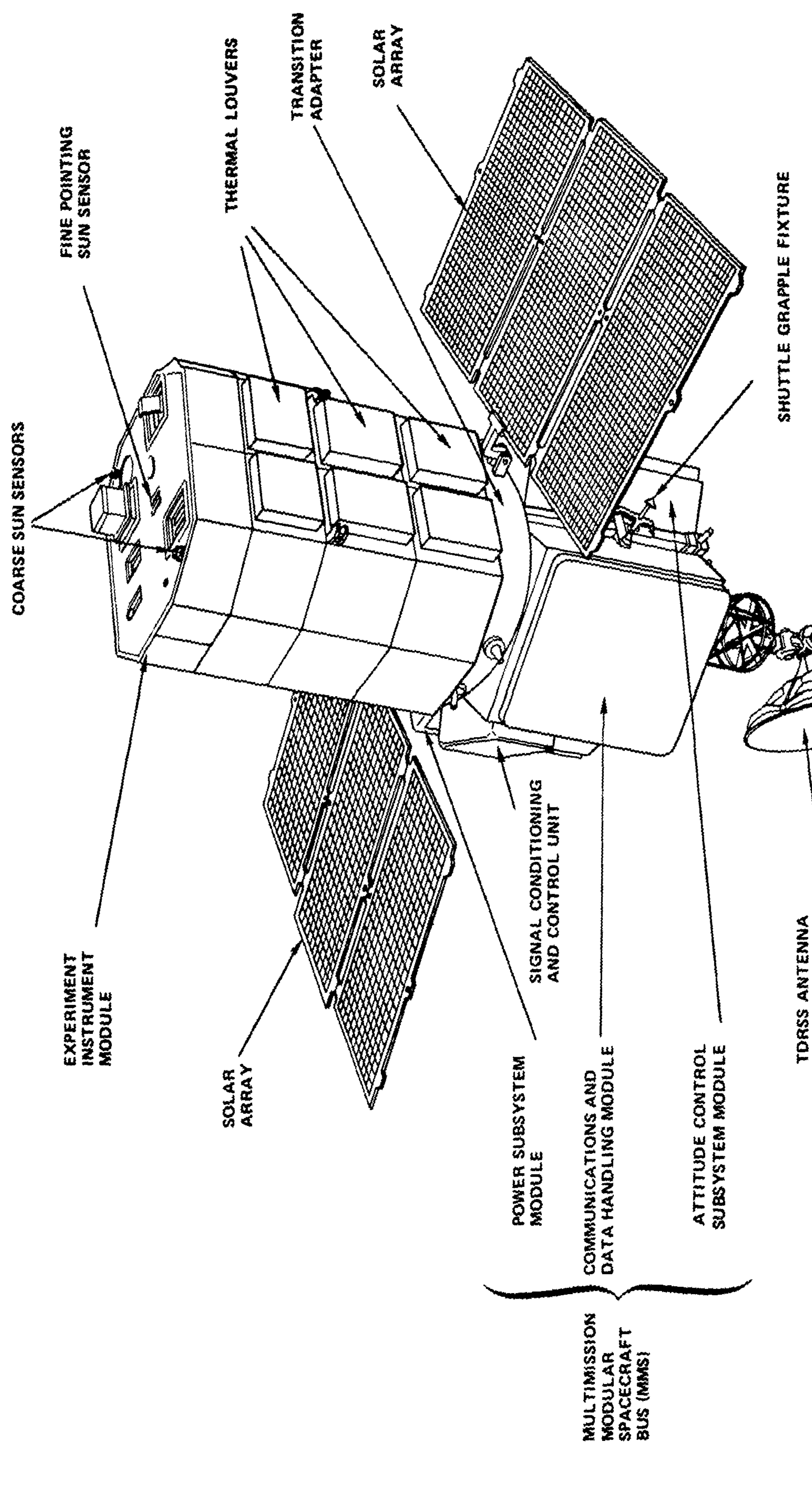


*THESE INSTRUMENTS HAVE NO APERTURE HOLE IN THE FORWARD CLOSEOUT. THEY VIEW THROUGH AN OPAQUE CLOSEOUT PLATE.


COARSE SUN SENSORS
FINE POINTING SUN SENSOR
THERMAL LOUVERS
TRANSITION ADAPTER
SOLAR ARRAY
SHUTTLE GRAPPLE FIXTURE
EXPERIMENT INSTRUMENT MODULE
SOLAR ARRAY
SIGNAL CONDITIONING AND CONTROL UNIT
TDRSS ANTENNA (HIGH-GAIN ANTENNA SYSTEM)
POWER SUBSYSTEM MODULE
COMMUNICATIONS AND DATA HANDLING MODULE
ATTITUDE CONTROL SUBSYSTEM MODULE
MULTIMISSION MODULAR SPACECRAFT BUS (MMS)