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NASA News

National Aeronautics and
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Press Kit

Project ISEE 3

RELEASE NO: 78-118

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Immediate

Nicholas Panagakos
Headquarters, Washington, D.C.
(Phone: 202/755-3680)

Joseph McRoberts
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/982-5566)

RELEASE NO: 78-118

THIRD SUN-EARTH SATELLITE SET FOR LAUNCH

NASA this month for the first time will launch a spacecraft to the Sun-Earth libration point -- that point in space where the gravitational pull of the Sun just balances that of the Earth-Moon system -- about 1.6 million kilometers (one million miles) away.

ISEE 3, the third in a series of International Sun Earth Explorer spacecraft, will be launched toward the libration point atop a Delta rocket from NASA's Kennedy Space Center, Fla., about Aug. 12.

From its vantage point, ISEE 3 will measure the solar wind constantly emitted by the Sun and other solar phenomena such as sunspots and solar flares, unperturbed by the influence of Earth, while ISEE 1 and 2 -- in looping trajectories around the Earth since last fall -- measure the effect of these phenomena on the near-Earth environment.

The coordinated effort is expected to result in a better understanding of how the Sun controls the Earth's fluctuating near-space environment, and of a variety of solar-terrestrial phenomena, including weather and climate, energy production and ozone depletion in the atmosphere.

Because of its unusual trajectory and target position in space, ISEE 3 must be launched within a five-minute time period between Aug. 12 and 13 or between Aug. 21 and 25.

Once the 469-kilogram (1,033-pound) spacecraft reaches the libration point, some 78 days after liftoff, it will be injected into a "halo" orbit by an onboard hydrazine gas propellant system. The propellant will not only place the spacecraft in an orbit in the ecliptic plane (the plane in which all the planets circle the Sun), 150,000 km (93,200 mi.) above and below the Sun-Earth line, but it will keep it pointed properly to carry out its scientific investigations.

The orbit has been designed to pass slightly above and below the ecliptic plane so that it will avoid excessive solar interference with spacecraft communications back toward Earth. To an Earth-based observer, the spacecraft will appear to be orbiting the Sun. In fact, it will be tracing a halo above the Earth. It will take approximately six months to make one revolution.

The halo orbit path is the most unusual ever proposed for a NASA space mission. The plan to place ISEE 3 in this orbit was devised by Dr. Robert W. Farquhar of the Goddard Space Flight Center in Greenbelt, Md., who orginated the concept in his doctoral thesis.

The Delta rocket initially places the spacecraft in a trajectory aimed at the libration point, and in 20 days ISEE 3 will be very close to the halo orbital position. But the final insertion into orbit will occur about three months later. During the transfer phase from Earth orbit to halo orbit, several unusual trajectory maneuvers are required to accurately place the spacecraft at the insertion point.

After ISEE 3 has been placed into the proper orbit, small stationkeeping maneuvers will take place at irregular intervals. Approximately eight maneuvers per year will be required of the spacecraft hydrazine system to maintain the satellite's equilibrium along the orbital path. ISEE 3 will carry enough hydrazine propellant to assure an orbital lifetime of at least three years.

According to Project Manager Jeremiah J. Madden of Goddard, who is managing the ISEE 3 program for NASA, the unusual orbit was chosen for ISEE 3 "because of the relationship between ISEE 3 and the other two ISEE satellites that were launched from Cape Canaveral last October."

"In effect," says Madden, "ISEE 3 will be sort of an early warning satellite for activity on the Sun. It will pick up solar wind or particles speeding away from the Sun a full hour before the two other spacecraft do so. These spacecraft are in highly elliptical orbits ranging from about 480 km (300 mi.) to almost 144,800 km (90,000 mi. above Earth. This tells scientists a lot about the Sun and how it changes with time and distance. In fact; this will be the first time such correlated measurements will ever have been accomplished on a regular basis."

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ISEE 3, in addition to providing a far-out Sun-Earth measuring platform, will also be useful for research activities on the origin of galactic cosmic rays and recently discovered gamma ray bursts. All three spacecraft will be closely observing phenomena at solar maximum for the new 11-year solar cycle which began in June, 1976.

The three-spacecraft mission involves 117 scientific investigators representing 35 universities and 10 nations. ISEE 3 carries 13 different scientific instruments, three of them by foreign investigators in Holland, Germany and France.

ISEE 1, managed by Goddard, and ISEE 2, managed by the European Space Agency (ESA), were the first set of spacecraft designed to be used together to investigate Earth's immediate space environment.

The use of three spacecraft, separated by a variable distance, allows scientists to study the boundaries between interplanetary space and the space controlled by the Earth, and the nature of fluctuations in the boundaries.

These boundaries include the plasmapause, the position at which there is a dramatic drop in the density of the magnetosphere (the magnetic envelope which surrounds the Earth); the magnetopause, where the magnetic field of the Earth meets that of the solar wind; the bow shock, a sort of bow wave created by the motion of the solar wind past the Earth, and several less obvious features of the Earth's magnetic tail.

ISEE 3 will obtain nearly continuous data on the fluctuating solar wind, and on special solar phenomena such as solar flares and sunspots, which are appearing more frequently as the solar cycle moves into its most active state.

In certain instances, this will give scientists on the ground time to make inputs to onboard instrumentation on the mother-daughter (ISEE 1 and 2) spacecraft to look for correlating phenomena. At the same time, sounding rockets can be fired from any global location to investigate other aspects of onrushing solar wind.

ISEE coordination is designed to fit into the International Magnetospheric Study (IMS) program, a worldwide three-year investigation begun in 1976.

As part of this program, ground stations, sounding rockets, balloons, aircraft and satellites, including the ISEE spacecraft, will look at the same phenomenon simultaneously from different parts of the Earth, including polar areas and space. Data exchange offices have been established in Meudon, France and Boulder, Colo. Meanwhile a sophisticated Satellite Situation Center (SSC) at Goddard will calculate satellite orbits which will be published through the Boulder office. The published SSC orbits are designed for correlation with the various IMS systems to indicate when spacecraft data are likely to be especially fruitful.

Although numerous other spacecraft have been separately probing the magnetosphere since the early 1960s, the ISEE satellites carry instrumentation 10 times more sensitive than previously flown. As a result, much fine detail essential to understanding the range of Sun-Earth phenomena, the entire environmental system of Earth and the interactions between the two is now available for the first time.

NASA is responsible for ISEEs 1 and 3, the Delta launch vehicle, tracking and data acquisition and data processing. ESA is responsible for the ISEE 2 spacecraft and its operation.

Goddard will provide orbital computation, attitude determination and spacecraft control support to the ISEE missions during the planned three-year lifetime of the satellites. ESA, in coordination with Goddard, is responsible for operating the ISEE 2 spacecraft and software for maneuver determination and computation.

ISEE 3 is based on Goddard designs, but it was fabricated and tested by Fairchild Space and Electronics Co., Germantown, Md. Most of its components either were made at Goddard or supplied by industries and universities.

Goddard manages the Delta launch vehicle program for NASA's Office of Space Transportation Systems. McDonnell Douglas Astronautics Co., Huntington Beach, Calif., is the prime contractor.

(END OF GENERAL RELEASE. BACKGROUND INFORMATION FOLLOWS)

ISEE 3 SCIENTIFIC EXPERIMENTS

Instrument	Principal Investigator	Affiliation
Solar Wind Plasma	S. J. Bame	Los Alamos Scientific Lab., Los Alamos, N.M.
Magnetometer	E. J. Smith	NASA Jet Propulsion Lab., Pasadena, Calif.
Low Energy Cosmic Ray	D. Hovestadt	Max Planck Institute Garching, Germany
Medium Energy Cosmic Ray	T. von Rosenvinge	GSFC
High Energy Cosmic Ray	H. H. Heckman	University of California
Plasma Waves	F. L. Scarf	TRW Redondo Beach, Calif.
Cosmic Ray Electrons	P. Meyer	University of Chicago
Protons	R. Hynds	Imperial College of Science and Technology, London
X-rays and Electrons	K. A. Anderson	University of California
Radio Mapping	J. L. Steinberg	Paris Observatory Meudon, France
Plasma Composition	K. W. Ogilvie	GSFC
High Energy Cosmic Ray	E. C. Stone	California Institute of Technology, Pasadena, Calif.
Ground Based Solar Studies	J. M. Wilcox	Stanford University Palo Alto, Calif.

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ISEE 3 SCIENTIFIC INSTRUMENTS

Solar Wind Plasma. This instrument is designed to provide solar wind ion and electron parameters on a continuous basis, to study the origin and evolution of structures in the interplanetary medium, and to study the thermal state of the interplanetary plasma unperturbed by the Earth's bow shock. Principal Investigator: S. J. Bame, Los Alamos Scientific Laboratory, N. M.

Magnetometer. The magnetometer is used to study solar interplanetary phenomena such as the influence on the interplanetary field of heliographic latitude, differential solar rotation, and changing photospheric magnetic fields. The effects of the interplanetary field on the Earth's magnetosphere -- such as the triggering of magnetospheric storms-- is also a major interest. Principal Investigator: Dr. E.J. Smith, Jet Propulsion Laboratory, Pasadena, Calif.

Low Energy Cosmic Ray and Gamma Ray Burst. This instrument will measure ultra low-energy charged particles accelerated at the Sun in the Earth's vicinity in the interplanetary medium and beyond the solar system. Principal Investigator: Dr. D. Hovestadt, Max Planck Institute, Garching, Germany. Co-Investigators: Dr. G. Gloeckler and Dr. B. Teegarden, University of Maryland.

Medium Energy Cosmic Ray. The MECR instrument will study the composition of solar cosmic rays from hydrogen through iron over an energy interval from 0.5 to 500 MeV/nucleon. It will also study elemental abundance of galactic cosmic rays with special emphasis on the region from z = 16-26 and the isotopic composition from hydrogen to nitrogen, and will be used to obtain a comprehensive understanding of galactic and solar cosmic rays by measuring their streaming patterns over a broad range of 0.5 to 150 MeV. Principal investigator: T. von Rosenvinge (also Project Scientist) GSFC.

High Energy Cosmic Ray. This instrument will measure the isotopic compositions in the primary cosmic rays, hydrogen through iron. It has unprecedented isotope resolution. Principal Investigator: H. H. Heckman, University of California.

Plasma Waves (ISEE 3). It will study the behavior of the solar wind and determine the roles that plasma waves play at interplanetary discontinuities; also physical effects associated with wave-particle scattering in the solar wind. Principal Investigator: F. L. Scarf, TRW Systems Group, Redondo Beach, Calif.

Cosmic Ray Electron Instrument. This instrument will measure the energy spectrum of electrons in the range from 5 to 400 MeV. These particles are known to originate in the Sun, come from Jupiter and the galaxy, will interfere with the Gamma Ray Burst experiment (Hovestadt). Principal Investigator: P. Meyer, University of Chicago.

Protons. The instrument will study the transport of low-energy solar protons through interplanetary space and their transport from the flare site; the co-rotating interplanetary protons streams associated with specific solar active regions; the effects of shock waves and other types of interplanetary discontinuities on low-energy proton populations. Quiet-time low energy protons also will be explored. Principal Investigator: Dr. R. Hynds, Imperial College, London.

X-Rays, Electrons and Gamma Ray Bursts. This instrument consists of two separate sensor systems and their associated electronics. The objective of the X-ray system is to study the time variation of the spectrum of 6 to 228 keV X-ray emission from solar flares with a time resolution of 1 second. Extremely short (10 seconds) bursts of gamma rays from beyond the solar system will also be observed. The electron sensor is designed to study electrons in the energy range between solar wind and galactic cosmic rays. Between these two particle populations the energy spectrum, anisotropy, and propagation characteristics of the particles change drastically from bulk plasma to single particle characteristics. This instrument will identify and measure the flux of electrons from 2 to 800 keV. These low energy particles are particularly sensitive to the amount of matter traversed in terms of energy loss. Thus they can be used as probes of the solar electron acceleration mechanisms and of the electron storage and propagation processes in the solar corona and interplanetary medium. Principal Investigator: Dr. K. A. Anderson, University of California. Co-Investigator: Dr. W. Evans, Los Alamos Scientific Laboratory, Los Alamos, N.M.

Radio Mapping. The direction (two angles) of type III solar bursts at several frequencies will be measured. When using a second spacecraft similarly instrumented or relying on solar rotation, one can obtain the 3-D map of the magnetic lines of force which guide the electrons which produce type III's from 10 solar radii to 1 AU in or out of the ecliptic. Principal Investigator: J. L. Steinberg, Paris Observatory, Meudon, France.

Plasma Composition. The relative abundance of ions in the solar wind at a distance of 1 AU and the relative population of their charge rates will be measured. The relative abundances are related to the solar abundances and the charge states to the coronal temperature structure since the interplanetary medium is collisionless. The abundance measurements will yield information about the mechanism of fractionation in the corona and acceleration into the solar wind; the charge state measurements will also provide information on the acceleration of heavy ions from the corona into the solar wind. The "shock piston" phenomenon will be further explored, and used as an indicator of the processes in the lower corona. The composition of the magnetospheric plasma will be simultaneously measured by another instrument, so that a comparison may make the phenomena governing the entry of plasma to the magnetosphere clearer. Principal Investigator: K. W. Ogilvie, Goddard Space Flight Center.

High Energy Cosmic Rays. The isotopic abundances of all elements from Li (1=3) to Ni (z=28) and their energy spectra in a range from several MeV/nucleon to several hundred MeV/nucleon, outside the Earth's magnetosphere, will be determined. The Heavy Isotope Spectrometer Telescope (HIST) will determine the isotopic abundances of solar and galactic cosmic ray nuclei in the 2 to 200 MeV/nucleon energy range for all elements from lithium to nickle. This unique instrument complements the Hechman experiment. Principal Investigator: E. C. Stone, California Institute of Technology.

Ground-Based Solar Studies. Real-time observations of large-scale solar magnetic and velocity fields made with the Stanford Solar Telescope will be compared with observations from the Heliocentric spacecraft. Since the Heliocentric spacecraft will observe during an appreciable portion of a sunspot cycle, new observational knowledge of the magnetic aspects of the sunspot cycle will be gained.

Since solar flares have been shown to be most likely to occur near a solar sector boundary, it is very possible that an understanding of the large-scale solar magnetic field improves the physical understanding of the flare mechanism and the causes of solar activity may also improve. The mean solar field that will be observed with the Stanford Solar Telescope is usually very similar to the interplanetary magnetic field observed with spacecraft near the Earth. In particular, when the polarity of the mean solar field changes sign, a sector boundary is usually observed near the Earth four or five days later. This prediction capability could enhance the spacecraft observations of sector boundaries, and in particular newly formed boundaries which may contain interesting magnetic loop structures. In addition, the preference of large solar flares and shock waves for positions near boundaries can be utilized in the day-to-day planning of the spacecraft observations. The Stanford Solar Telescope will also have the capability to observe the average amplitude of the photospheric velocity fields within an area near the center of the visible solar disk. Some theories of the solar wind suggest that the solar wind velocity should be related to the amplitude of these photospheric velocity fields, and therefore, to the flux of wave energy going up into the corona. Continuous correlative observations over many solar rotations will be necessary to test these theoretical ideas. Principal Investigator: Dr. J. Wilcox, Stanford University.

MISSION SUPPORT

GODDARD NETWORK SUPPORT

The Goddard Space Flight Tracking and Data Network (STDN) is responsible for all tracking and data acquisition for the ISEE 3 spacecraft.

Only three stations (Madrid, Orroral and Goldstone) are presently planned for use for the ISEE 3 during the orbital phase where a 26-m (85-ft.) antenna is needed to receive telemetry. A data acquisition objective of 90 per cent recovery of spacecraft data during the 36-month initial mission life is set as a goal.

ISEE PROGRAM MANAGEMENT

The memorandum of understanding between the European Space Agency and NASA, dated March 17, 1975, divides the project responsibilities and provides for an international management organization. NASA is responsible for the ISEE 1 and 3 spacecraft, Delta launch vehicle, tracking, data acquisition and data processing. ESA is responsible for the ISEE 2 spacecraft and its operation.

NASA's Office of Space Science is responsible for overall direction and evaluation of the NASA portion of the program. The Office of Tracking and Data Acquisition has overall tracking and data processing responsibility.

Goddard Space Flight Center has management responsibility for ISEE 3 and is directly responsible for tracking and data acquisition and data processing.

ISEE 3 is a Goddard-designed spacecraft with all its components supplied by United States industry. Integration and testing was done by Fairchild Space & Electronics Co.

Goddard directs the Delta rocket program and McDonnell Douglas Astronautics Co., Huntington Beach, Calif., is the prime contractor.

DELTA LAUNCH VEHICLE (2914)

ISEE 3 will be launched by a three-stage Delta 2914 rocket. The launch vehicle has an overall length of approximately 35 meters (115 feet) and a maximum body diameter of 2.4 m (7.8 ft.). A brief description of the vehicle's major characteristics follow:

First Stage

The first stage is a McDonnell Douglas modified Thor booster incorporating nine strap-on Thiokol solid-fuel rocket motors. The booster is powered by a Rocketdyne engine using liquid oxygen and liquid hydrocarbon propellants. The main engine is gimbal-mounted to provide pitch and yaw control from liftoff to main engine cutoff (MECO).

Second Stage

The second stage is powered by a TRW liquid fuel, pressure-fed engine that also is gimbal-mounted to provide pitch and yaw control through the second stage burn. A nitrogen gas system uses eight fixed nozzles for roll control during powered and coast flight as well as pitch and yaw control during coast and after second stage cutoff (SECO). Two fixed nozzles, fed by the propellant tank helium pressurization system, provide retrothrust after third stage separation.

Third Stage

The third stage is the TE-364-4 spin-stabilized, solid propellant Thiokol motor. It is secured in the spin table mounted to the second stage. The firing of eight solid propellant rockets fixed to the spin table accomplishes spin-up of the third stage spacecraft assembly. The ISEE spacecraft are attached to the third stage motor.

LAUNCH OPERATIONS

Delta 144 with the ISEE 3 spacecraft will be launched under the direction of the Kennedy Space Center's Expendable Vehicles Directorate from Pad B, southernmost of the two launch pads at Complex 17, Cape Canaveral Air Force Station.

The Delta first stage and interstage were erected on Pad B June 23. Mounting of the nine strap-on solid rocket motors around the base of the first stage was accomplished June 26-27 and the second stage was erected June 28.

The ISEE 3 spacecraft arrived at KSC June 29 and underwent initial processing at Hangar AE at Cape Canaveral Air Force Station. It was moved into the Spin Test Facility July 21 and mated with the third stage Aug. 1. The spacecraft/third stage assembly was moved to the pad and erected atop the second stage Aug. 3. The spacecraft was scheduled to be encapsulated Aug. 9 within the payload shroud which will protect it during its flight through the atmosphere.

All launch vehicle and pad operations during the launch countdown are conducted from the blockhouse at Complex ly by a joint government-industry team.

LAUNCH SEQUENCE FOR ISEE 3

Event	Time	Altitude Kilometers/miles	
Liftoff	0 sec.	0	0
Six Solid Motor Burnout	38 sec.	6	4
Three Solid Motor Ignition	39 sec.	6	4
Three Solid Motor Burnout	1 min. 18 sec.	21	13
Nine Solid Motor Jettison	1 min. 27 sec.	26	16
Main Engine Cutoff (MECO)	3 min. 45 sec.	91	56
First/Second Stage Separation	3 min. 54 sec.	96	60
Second Stage Ignition	3 min. 56 sec.	99	61
Fairing Jettison	4 min. 56 sec.	126	78
Second Stage Cutoff #1 (SEC #1)	8 min. 44 sec.	157	97
Begin Coast Phase Roll (1 rpm)	9 min. 23 sec.	157	97
End Coast Phase Roll	44 min. 23 sec.	275	171
Second Stage Ignition #2	53 min. 31 sec.	285	177
Second Stage Second Cut-Off 2 (SECO 2)	53 min. 52 sec.		
Third Stage/Payload Spin-up	54 min. 50 sec.		
Jettison Stage II	54 min. 52 sec.		
Third Stage Ignition	55 min. 33 sec.		
Third Stage Burnout	56 min. 17 sec.	287	178
Payload Separation, Activate Retro System.	57 min. 30 sec.	327	203

ISEE 3 TEAM

NASA Headquarters

Dr. Noel S. Hinners	Associate Administrator for Space Science
Andrew J. Stofan	Deputy Associate Administrator
Dr. Adrienne Timothy	Deputy Associate Administrator (Science)
T. Bland Norris	Director, Astrophysics Programs
Dr. Harold Glaser	Director, Solar Terrestrial Programs
Frank Gaetano	ISEE Program Manager
Dr. Erwin R. Schmerling	ISEE Program Scientist
John F. Yardley	Associate Administrator for Space Flight
Joseph B. Mahon	Director of Expendable Launch Vehicle Programs
Peter T. Eaton	Manager, Delta Program
William C. Schneider	Associate Administrator for Tracking and Data Acquisition

Goddard Space Flight Center

Dr. Robert S. Cooper	Director
Robert E. Smylie	Deputy Director
Robert Lindley	Director of Projects
Don Fordyce	Associate Director for Projects
Jeremiah J. Madden	Project Manager
T. von Rosenvinge	Project Scientist
Dr. Stephen Paddack	Deputy Project Manager,

Goddard Center (cont'd.)

James O. Redding	Financial Manager
John A. Hrastar	Mission Operations Manager
Martin A. Davis	Scientific Instrument Manager
David W. Grimes	Delta Project Manager
William R. Russell	Deputy Delta Project Manager, Technical
Robert Goss	Chief, Mission Analysis and Integration Branch, Delta Project Office
E. Michael Chewning	Delta Mission Integration Manager
Thomas C. Moore	Mission Operations Manager
Kenneth McDonald	Network Support Manager

Kennedy Space Center

Lee Scherer	Director
Gerald D. Griffin	Deputy Director
Dr. Walter J. Kapryan	Director, Space Vehicle Operations
George F. Page	Director, Expendable Vehicles
W. C. Thacker	Chief, Delta Operations Division
Wayne McCall	Chief Engineer, Delta Operations
David Bragdon	Spacecraft Coordinator

CONTRACTORS

Fairchild Space & Electronics Co. Germantown, Md.	Spacecraft
McDonnell Douglas Astronautics Co. Huntington Beach, Calif.	Delta Launch Vehicle

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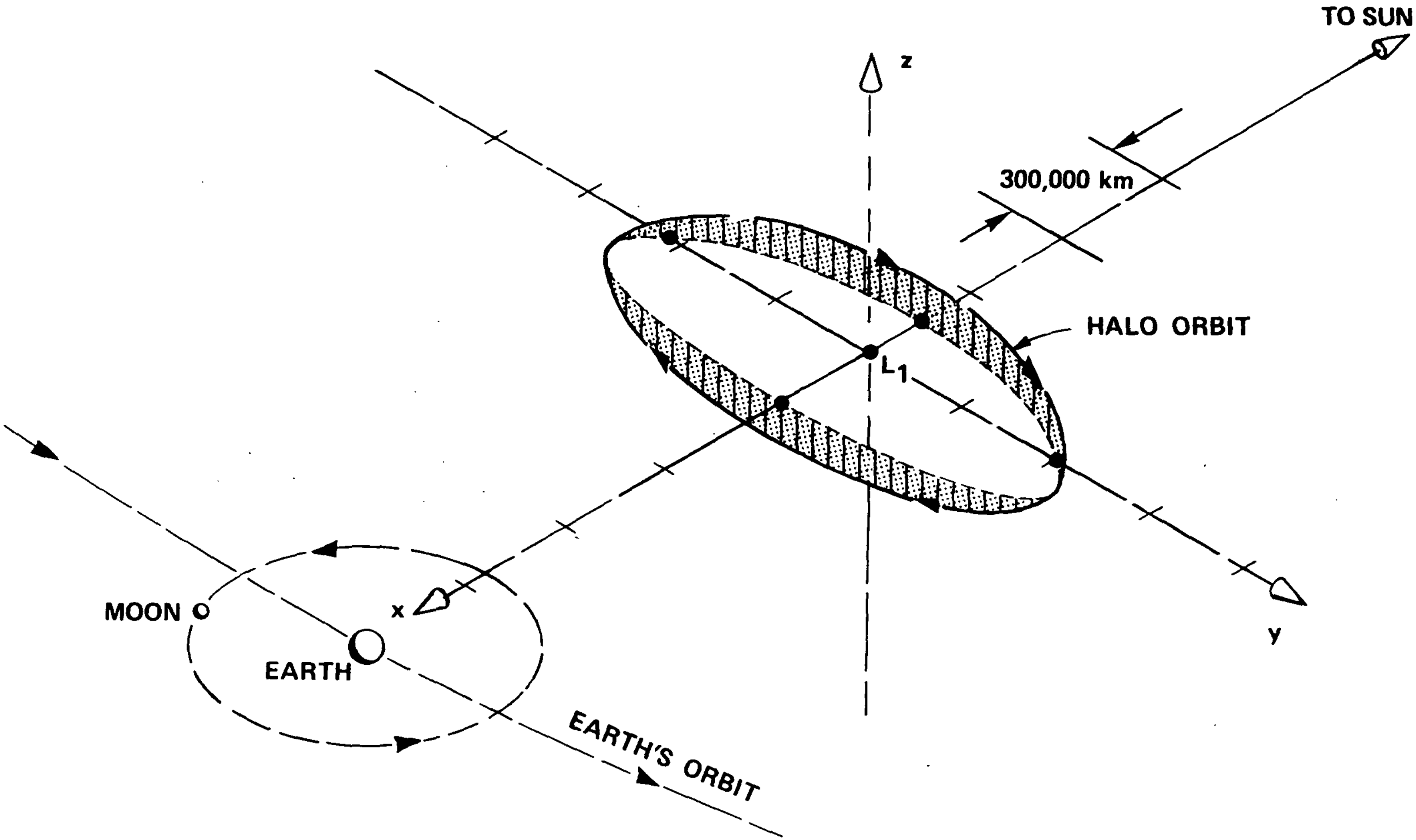
HALO ORBIT AROUND SUN-EARTH LIBRATION POINT



NOMINAL TRANSFER TRAJECTORY