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NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: TUESDAY A.M.
December 3, 1968

RELEASE NO: 68-204

PRESS KIT

PROJECT: HEOS-A

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11/27/68

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HEOS-A SATELLITE

The European Space Research Organization's first interplanetary physics research satellite, HEOS, is scheduled for launching on a National Aeronautics and Space Administration Thor-Delta vehicle from Cape Kennedy, Fla., no earlier than Dec. 5.

HEOS (Highly Eccentric Orbit Satellite) will be the first spacecraft launched under an ESRO-NASA agreement providing for launchings on a reimbursable basis.

HEOS' scientific mission is to study interplanetary physics -- particularly magnetic fields -- cosmic radiation and solar wind outside of the magnetosphere and the Earth's shock-wave. For this purpose a highly elliptical orbit was selected, with an apogee of 225,000 kilometers (138,000 statute miles) equivalent to two-thirds the distance from the Earth to the Moon and well above the regions of space influenced by the Earth.

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The HEOS mission was planned for the period of high solar activity, near the end of 1968 or the beginning of 1969. The 238-pound satellite will have a perigee of 440 kilometers (274 miles) an inclination of 28.3 degrees and a period of approximately five days.

HEOS is capable of modifying its attitude and spin rate on ground command. It also has the unique feature of being "magnetically clean," i.e.: the magnetic field induced by the satellite itself as measured by the on-board magnetometer is only 0.15 gamma.

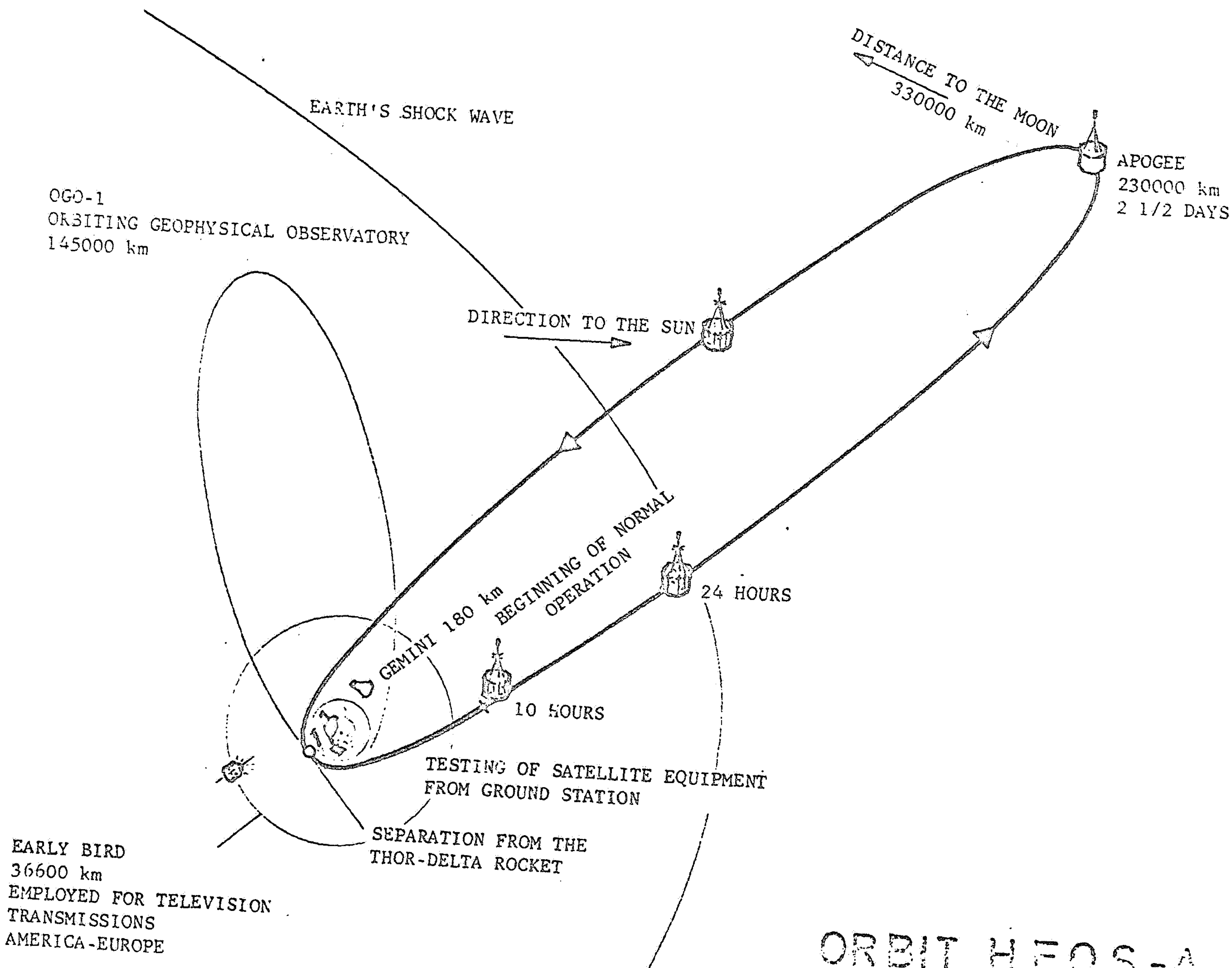
HEOS was prepared under the supervision of ESRO's European Space Technology Center (ESTEC) at Noordwijk, Holland. The satellite carries eight experiments prepared by university laboratories in Belgium, Federal Republic of Germany, France, Italy and the United Kingdom. The spacecraft was developed by a consortium of industries in Belgium, Federal Republic of Germany, France and the UK. Total cost of the project is estimated to be $16 million including the launching costs of approximately $4 million.

The NASA-ESRO agreement of December 1966 concerning reimbursable launchings provides that ESRO will furnish the spacecraft and reimburse NASA for Delta launch vehicle costs and other support.

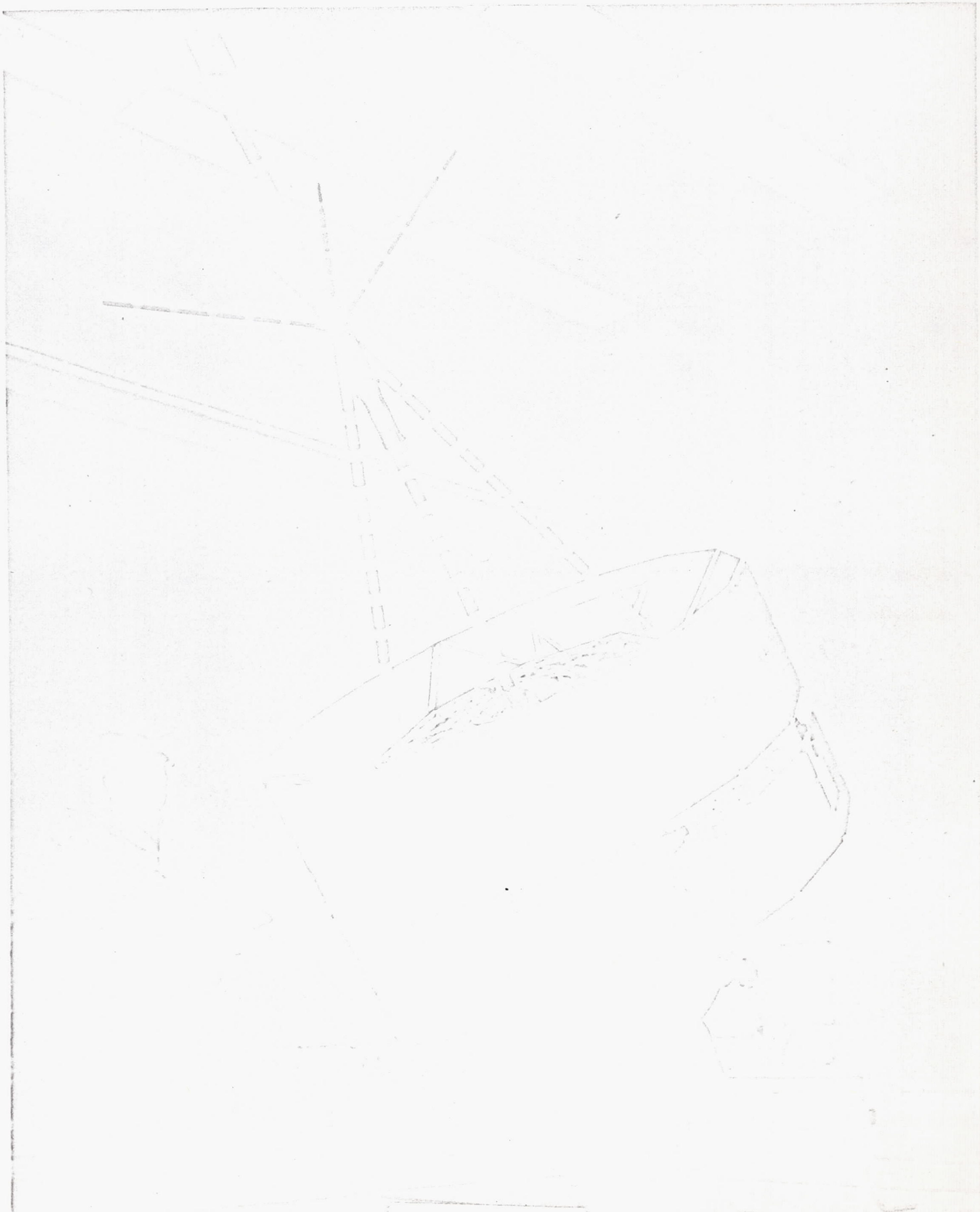
The HEOS contract was signed March 8, 1967.

HEOS will be the third ESRO satellite to be placed in orbit by NASA. ESRO's Earth orbiting scientific satellites ESRO II and ESRO I were launched from the Western Test Range, Calif., on May 16 and Oct. 3, 1968, respectively. Both satellites were cooperative projects in which ESRO provided the spacecraft and experiments and NASA furnished the Scout vehicles and launchings.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS)


EARTH'S SHOCK WAVE
DISTANCE TO THE MOON
330000 km
APOGEE
230000 km
2 1/2 DAYS
OGO-1
ORBITING GEOPHYSICAL OBSERVATORY
145000 km
DIRECTION TO THE SUN
GEMINI 180 km
BEGINNING OF NORMAL
OPERATION
24 HOURS
10 HOURS
TESTING OF SATELLITE EQUIPMENT
FROM GROUND STATION
SEPARATION FROM THE
THOR-DELTA ROCKET
EARLY BIRD
36600 km
EMPLOYED FOR TELEVISION
TRANSMISSIONS
AMERICA-EUROPE

ORBIT HEOS-A



THE HEOS-A MISSION

The scientific mission of HEOS-A is the investigation of interplanetary space during the period of maximum solar activity.

Two factors influence the space environment near the Earth, the first being the Earth's magnetic field, the presence of which has been known for hundreds of years. The second is the solar-wind. Its presence was established by early space probes, most of them within the last ten years.

"Solar-wind" is the term used to describe the continuous out-flow of plasma (protons and electrons) from the Sun, characterized by a velocity of several hundred kilometers per second under quiet conditions. But this velocity is not constant. At times of high solar activity the wind blows more strongly. The number of Sun spots and solar flares has been observed to vary within a solar cycle extending over an 11-year period. The Sun is presently near its peak of activity for the current solar cycle.

Strength of the Earth's magnetic field decreases rapidly with distance from the Earth. The limit of the magnetic field is a boundary or perimeter where the pressure of the solar wind is balanced by the pressure of the magnetic field. The region inside this boundary (the magnetopause) is called the magnetosphere and is closely controlled by the Earth's magnetic field. The region beyond the magnetosphere is referred to as the transition region where the Earth's field does not exist and the interplanetary field is highly disordered. This transition region is bounded on its outside by a shock front caused by the solar wind which is "supersonic", i.e.: is bodily travelling faster than magnetohydrodynamic waves can propogate in it. The situation of an aircraft travelling supersonically in the atmosphere, producing a shock wave and hence the sonic boom, is somewhat analogous.

The region beyond the shock wave is termed interplanetary space and is uninfluenced by the presence of the Earth. The closest approach to interplanetary space is along the Earth-Sun line where the shock front is some eleven Earth radii distant (70,000 km). The positions of the shock front and the magnetosphere are greatly influenced by the solar wind and solar activity. Thus in order to study interplanetary space, a spacecraft must be orbited with an apogee well in excess of eleven Earth radii. The orbit chosen for HEOS-A means that the experiments can study interplanetary space for some eighty hours of every five-day orbit for the first four months of operation.

The eight HEOS experiments will make measurements of magnetic fields, the solar wind, and solar and galactic comsic rays.

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LIST OF HEOS-A EXPERIMENTS

-- S-16-Optical observation of an Ion Cloud to investigate magnetic field and electric field within magnetosphere, Max Planck Institute for Extraterrestrial Physics (Munich, Germany), Prof. R. Lust and Dr. H. Gollnitz.

-- S-24-A-Measurement of the interplanetary field and its irregularities, Imperial College, University of London (England), Prof. H. Elliot and Dr. P. Hedgecock.

-- S-24-B-Measurement of the flux of cosmic ray protons of energy greater than 350 MeV, Imperial College, University of London (England), Prof. H. Elliot and Dr. A. Engel.

-- S-24-C-Directional measurement of protons in the energy range from .9 to 20 MeV, Imperial College, University of London (England), Prof. H. Elliot and Dr. R. Hynds.

-- S-58-Investigation of the angular distribution positive component of the solar wind, University of Brussels (Belgium), Prof. Coutrez and Mr. W. Scholiers.

-- S-72-Measurement of the flux and energy distribution of various cosmic ray particles (protons in the energy range from 5 to 850 MeV, alpha particles in the range 150 to 1500 MeV and electrons in the range 1.5 to 15 MeV, Centre D'Estudes Nucleaires De Saclay (France), Prof. J. Labeyrie, Dr. J. Engelman and Mrs. L. Koch.

-- S-73-Measurement of the energy distribution of the solar wind in the range from 100 to 15000 MeV, University of Florence and Rome (Italy), Prof. A. Bonetti and Prof. G. Pizzella.

-- S-79-Detection of electrons in the cosmic radiation in the energy range from 50 to 600 MeV, University of Milan (Italy) and Centre D'Etudes Nucleairs De Saclay (France), Prof. C. Occhialini-Dilworth, Dr. C. Bland, Prof. J. Labeyrie and Dr. Koechlin.

Abstract of Experiments

S-24A is designed to measure magnetic fields in the range $\pm$ 64 gamma with an accuracy of 0.5 gamma (a gamma is one one hundred thousandth part of a gauss). The field at the Earth's surface is typically 0.5 gauss. Because of its very high sensitivity, the three-axis magnetometer sensor is placed at the end of a boom support some 1.6 meters from the main spacecraft structure, so that the net effect of magnetic components within the satellite is reduced to a tolerable level.

One of the main features of the project has been the attempt to reduce the residual field due to the spacecraft to 0.5 gamma at the sensor. Less than 0.15 gamma has been achieved on the flight model spacecraft.

S-24A will relay information on fields within the magnetosphere, transition and interplanetary regions on a continuous basis. When operated in a selected mode, it will record data at a high rate to obtain high resolution when the satellite is passing through the shock front and magnetopause or other "irregularity". These data are stored in the experiment to be transmitted later, on a continuous, basis, at a much lower rate than they were recorded.

S-24B is designed to observe high energy cosmic ray protons with energy greater than 350 MeV and to detect directional anisotropies which may be correlated with the interplanetary field configuration observed by S-24A. The sensors consist of telescope arrangements of Cerenkov scintillation counters.

S-24C will observe solar protons of low energy in the region 0.9 to 20 MeV and will detect directional anisotropies which together with data from S-24A should yield fundamental information on the propagation mechanisms of solar protons.

The sensors consist of four-element solid-state-detector telescopes. Both S-24B and S-24C radial sensors view space through the Equators of the satellite, perpendicular to the spin axis, so that as the satellite spins the sensors scan through 360 degrees. Use is made of the satellite's attitude reference system to divide the 360 degrees into eight 45-degree counting sectors. S-24B and S-24C axial sensors view along the spin axis.

S-58/S 73 will measure both the energy distribution and angular distribution of the positive (proton) component of the solar wind. The sensor consists of a hemispherical electrostatic analyzer to select protons of a given energy and a Faraday cup to collect and count the selected protons. The sensor views through the equator of the satellite and so can make angular measurements as the satellite spins about its axis.

By making use of the spacecraft's attitude control system, the direction of the spin axis can be varied so that these experiments can scan, for example, first in the plane of the ecliptic and then perpendicular to the ecliptic. This reorientation feature also enables intercalibration of sensors to be made.

S-72 consists of a four-element, solid-state-detector telescope and is designed to measure electrons, protons and alpha particles of solar and galactic origin over wide energy ranges.

S-79 will measure the spectrum of high energy cosmic ray electrons in the range 50 to 600 MeV. The sensor, a four-element telescope, embodies a gas Cerenkov detector to filter out effectively a large proportion of the greater proton flux at comparable energies.

S-16 At a predetermined point in the orbit of the spacecraft a capsule will be ejected containing a barium/copper oxide mixture. When the capsule is some 40 km from the spacecraft, the mixture will be ignited, releasing a cloud of barium ions and atoms which will be furhter ionized by solar radiation. This cloud will be observed from ground stations in North and South America and its motion will yield information on the magnetic field at the ignition point. The choice of location of the ground stations and time of release must take into account the weather conditions at the stations, the position of the Sun and the position and phase of the Moon, to optimize the observation conditions.

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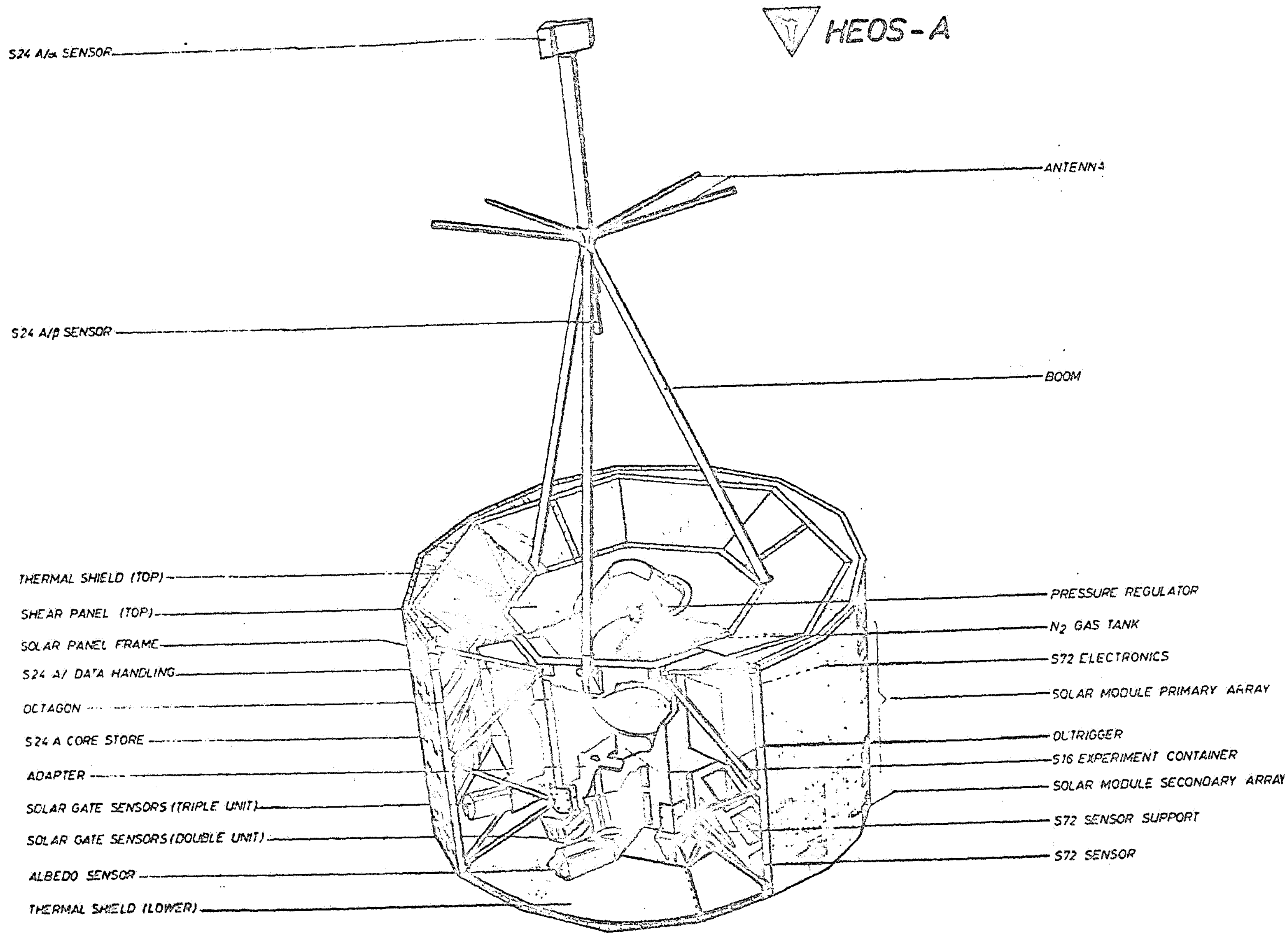
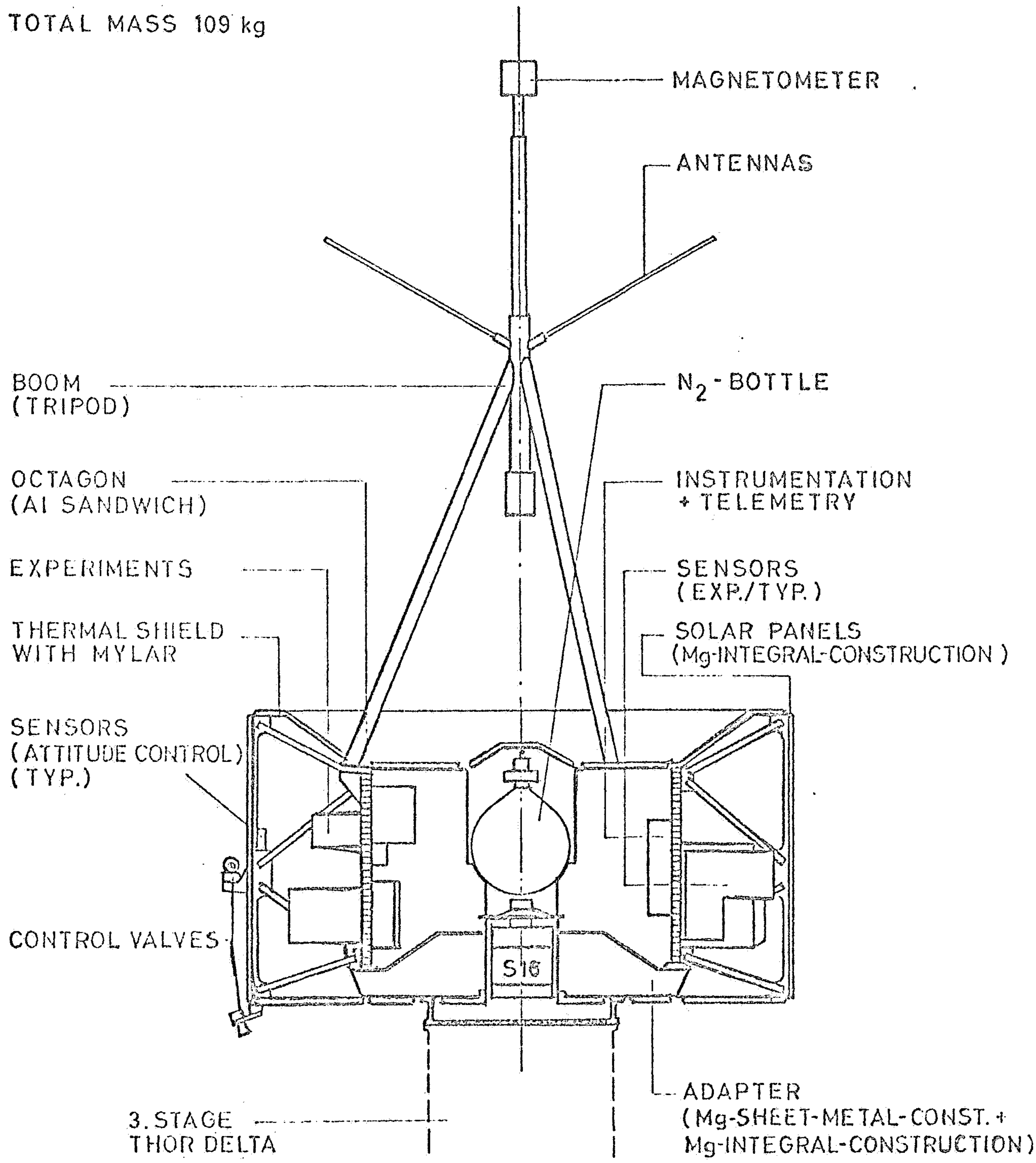

HEOS - A
S24 A/α SENSOR
ANTENNA
S24 A/β SENSOR
BOOM
THERMAL SHIELD (TOP)
SHEAR PANEL (TOP)
SOLAR PANEL FRAME
S24 A/ DATA HANDLING
OCTAGON
S24 A CORE STORE
ADAPTER
SOLAR GATE SENSORS (TRIPLE UNIT)
SOLAR GATE SENSORS (DOUBLE UNIT)
ALBEDO SENSOR
THERMAL SHIELD (LOWER)
PRESSURE REGULATOR
N2 GAS TANK
S72 ELECTRONICS
SOLAR MODULE PRIMARY ARRAY
OUTRIGGER
S16 EXPERIMENT CONTAINER
SOLAR MODULE SECONDARY ARRAY
S72 SENSOR SUPPORT
S72 SENSOR

PRINCIPAL LAY-OUT HEOS-A



SPACECRAFT

HEOS is an octagonal structure 255 centimeters high and 130 centimeters in diameter. It will have an expected lifetime of one year. The satellite will be spin stabilized at 10 rpm, a rate that will be regulated by a gas jet system. The spin axis is capable of reorientation. The inertial attitude of the spacecraft will be determined with an accuracy of $\pm$ 2 degrees by the attitude measurement system. Exterior of the spacecraft carries 8,576 solar cells for electrical power generation.

Eclipses of less than one hour are predicted for the first six months in orbit and thereafter eclipses near apogee of only three hours are expected. During long eclipses the spacecraft systems, except the command receiver, will be shut down; consequently only a 5 ampere-hour battery is carried.

All data will be transmitted in real time, the telemetry rate being 12 bits per second. The transmitter operates on 136.65 megahertz and has a power of 5.5 watts. Seventy commands can be transmitted to the spacecraft via the command receiver operating on 148.25 megahertz. Almost 100 per cent telemetry coverage will be possible at one or other of the ESTRACK stations at Redu, Belgium and Fairbanks, Alaska.

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TRACKING

An extended parking orbit will bring the injection point into the final trajectory above the Indian Ocean, and thus the apogee will be well above the Equator in the Northern hemisphere. This will permit the use of the ESTRACK stations at Redu (Belgium), Fairbanks (Alaska) and Spitzbergen (Norway) to follow the high altitude part of the orbit, instead of having to rely only on the remote ESTRACK station in the Falkland Islands supplemented by the ELDO station of Gove in Australia as would have been required with a direct ascent trajectory from Cape Kennedy which would have brought the apogee in the Southern hemisphere.

In the injection phase the spacecraft will be followed by the NASA down range stations and by three telemetry stations of the Centre National D'Etudes Spatiales (CNES, France), located in Africa.

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LAUNCH VEHICLE

The HEOS-A will be launched by NASA's Improved Delta rocket. The Delta will be launched from Complex 17B at Cape Kennedy on an initial launch azimuth of 89.8 degrees. The 15-minute launch window opens at 2 P.M. EST and is acceptable Dec. 5 through Dec. 13.

Spacecraft separation is scheduled some 50 minutes after liftoff midway between Africa and Australia, 28 degrees South latitude and 90 degrees East longitude (northeast of Amsterdam St. Paul Island in the Indian Ocean).

The Delta rocket is the first launching service to be purchased from NASA by a fireign country. The European Space Research Organization will be charged an amount of $8 3/4 million.

The launch vehicle, including a thrust-augmented Thor first stage, the enlarged Delta second stage, and the FW-4 third stage, is known as the Thrust Augmented Improved Delta (TAID).

Delta project management is directed by NASA's Goddard Space Flight Center. Launch operations are conducted by the Kennedy Space Center Unmanned Launch Operations. The Douglas Aircraft Co., Santa Monica, Calif., is the prime contractor.

Delta Statistics

The three-stage Delta for the HEOS-A mission has the following characteristics:

Height: 92 feet (includes shroud)

Maximum Diameter: 8 feet (without attached solids)

Liftoff Weight: about 75 tons

Liftoff Thrust: 270,000 pounds (including strap-on solids)

First Stage (liquid only): Modified Air Force Thor, produced by Douglas Aircraft Co., engines produced by Rocketdyne Division of North American Aviation.

Height: 51 feet

Diameter: 8 feet

Weight: approximately 53 tons

Thrust: 172,000 pounds

Burning Time: 2 minutes, 30 seconds

Propellants: RP-1 kerosene is used as the fuel and liquid oxygen (LOX) is utilized as the oxidizer.

Strap-on Solids: Three solid propellant Castor II rockets produced by the Thiokol Chemical Corp.

Height: 25 feet

Diameter: 3 feet

Weight: 30,000 pounds (all three solids)

Thrust: 100,000 pounds (all three solids)

Burning time: 38 seconds

Propellants: solid

Second Stage: Produced by the Douglas Aircraft Co., utilizing the Aerojet-General Corp., AJ-10-118E propulsion system; major contractors for the auto-pilot system include Minneapolis-Honeywell, Inc., Texas Instruments, Inc., and Electrosolids Corp.

Height: 16 feet

Weight: 6½ tons

Diameter: 4.7 feet

Thrust: 7,700 pounds

Burning Time: 6 minutes, 26 seconds

Propellants: Liquid-Unsymmetrical Dimethyl Hydrazine (UDMH) for the fuel and Inhibited Red Fuming Nitric Acid (IRFNA) for the oxidizer.

<u>Third Stage</u>: FW-4 developed by the United Technology Corp.

Height: 5 feet, 2 inches

Diameter: 19.6 inches

Weight: about 660 pounds

Thrust: 5,450 pounds

Burning Time: 31 seconds

Propellant: solid

SEQUENCE OF LAUNCH EVENTS

Event	Time	Surface Range*	Altitude*	Velocity (miles per hour)
Solid Motor Burnout	38 sec.	3.0 miles	5.0 miles	1,347
Solid Motor Separation	60 sec.	9.0 miles	12.0 miles	1,828
Main Engine Cutoff (MECO)	2 min., 30 sec.	108 miles	66 miles	9,000
Second Stage Ignition	2 min., 36 sec.	124 miles	71 miles	8,983
Shroud Separation	2 min., 46 sec.	143 miles	81 miles	9,018
Second Engine Cutoff	9 min., 2 sec.	1,264 miles	267 miles	16,244
Third Stage Ignition	48 min., 35 sec.	11,765 miles	277 miles	16,200
Third Stage Burnout	49 min., 6 sec.	11,916 miles	284 miles	22,840

* All distances are statute miles.

HEOS PROGRAM PARTICIPANTS

European Space Research Organization

Professor Hermann Bondi	Director General
Jean-Albert Dinkespiler	Director, Plans and Programs
Marcel Depasse	Director of Administration
Werner Kleen	Director, European Space Technology Center, Noordwijk, The Netherlands
Pierre Blassel	Director, Satellite and Sounding Rocket Department
Jean V. Vandenkerckhove	Project Manager
Graham Booth	Deputy Project Manager
Andre Moritz	Deputy Project Manager
Die Ter Lennertz	Test Director
Ernst Trendelenberg	Director, Space Science Department
Brian Taylor	Project Scientist
Ugo Montalenti	Director, European Operations Center, Darmstadt, Federal Republic of Germany

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Isaac T. Gillam	Delta Program Manager Headquarters
William R. Schindler	Delta Project Manager Goddard
Robert J. Goss	HEOS-A Project Manager Goddard
Dr. Kurt H. Debus	Director Kennedy Space Center
Robert H. Gray	Director, Unmanned Launch Operations, Kennedy Space Center

Hugh Weston — Manager, Delta Operations
Kennedy Space Center

INDUSTRIAL PARTICIPANTS

Prime Contractor

Junkers Flugzeug und Motorenwerke GmbH, Munich, FRG

Co-Contractors

British Aircraft Corp., Stevenage, UK
Etudes Techniques et Constructions Aerospatiales, Charleroi, Belgium
Messerschmitt AT, Augsbourg, FRG
Societe Nationales d'Etudes et de Constructions de Moteurs d'Aviation, Paris, France

Consultant

Lockheed Missiles and Space Corp., California, USA

Communications Equipment

Compagnie Francaise Thomson-Houston-Brand-Hotchkiss, Paris, France
Societe Anonyme de Telecommunication, Paris, France
Laboratori Elettronici e Nucleari, Milan, Italy

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