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For Release IMMEDIATE

Press Kit

Project HEAO-3

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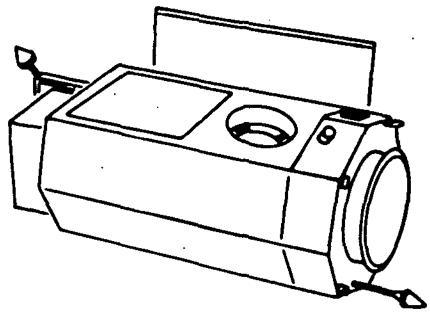

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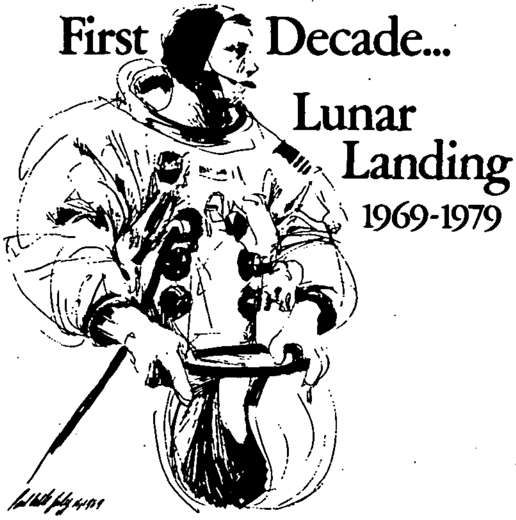

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For Release:

IMMEDIATE

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RELEASE NO: 79-113

THIRD HIGH ENERGY OBSERVATORY TO BE LAUNCHED

The National Aeronautics and Space Administration is preparing to place in Earth orbit its third and last High Energy Astronomy Observatory, HEAO-3.

The satellite is scheduled to be carried aloft by an Atlas Centaur rocket on or about Sept. 20 from Cape Canaveral, Fla.

-more-

September 4, 1979

This mission differs from previous ones in the series in that the spacecraft will be looking at the universe through different eyes. The two previous spacecraft conducted X-ray surveys and looked at particular X-ray sources. This one will be scanning the heavens primarily for cosmic ray particles and gamma ray photons.

Data returned by the three observatories are expected to provide new knowledge about some of the most intriguing mysteries of the universe -- pulsars, quasars, exploding galaxies and black holes in space.

The first high energy observatory, launched in 1977, did an all-sky survey, mapping X-ray sources throughout the celestial sphere. It also measured and mapped low-energy gamma rays and their sources. The survey was completed in six months, the satellite's design lifetime, and it continued to scan the skies for a total of 17 months until its control gas was exhausted in January 1979. The first observatory reentered the Earth's atmosphere and was destroyed on March 14, 1979.

During that period the observatory increased the number of known celestial X-ray sources from 350 to 1500. It discovered a new black hole candidate (there are now four) as well as a universal hot plasma thought to constitute a major fraction of the mass in the universe.

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Another discovery was a dust and gas cloud with a mass equal to a million billion Suns enveloping a super cluster of galaxies.

The second high energy observatory, launched in November 1978, and nicknamed the Einstein Observatory, carries the largest X-ray telescope ever built. It is performing a more detailed and intensive examination of those X-ray sources mapped by the first observatory as well as other targets selected on the basis of scientific interest. It has a design lifetime of one year.

One area of intense scientific study by scientists using the satellite's data is that involving the brightest, most distant and powerful sources of radiation in the universe -- quasars. One image received was a previously known quasar more than 10 billion light years away at the very edge of the observable universe.

The third observatory, weighing about 2,948 kilograms (6,500 pounds) at liftoff, will carry three scientific experiments -- a gamma ray spectrometer, a cosmic ray isotope experiment and a heavy cosmic ray nuclei experiment. The spacecraft has a design lifetime of six months.

The spectrometer will measure gamma ray flux and energy spectra and identify gamma ray source locations to a higher precision than previously possible. Line spectra also will be obtained and analyzed from some of the sources discovered.

The high-energy particle experiments will examine the composition and synthesis of cosmic ray nuclei. The isotopic composition of the cosmic rays will provide information on the age of the universe and related cosmological questions. The existence of very heavy nuclei will provide an opportunity to probe into their origin, age and propagation through the interstellar medium.

A search will be made for theoretically-predicted chemical elements well beyond the range of today's periodic table that have never been conclusively detected in cosmic ray flux.

All three observatories were designed to be placed in low circular orbits, from 455 to 540 kilometers (280 to 335 miles) above Earth. The altitudes are far enough above the atmosphere to detect radiation which cannot reach the ground.

X-rays and gamma rays are composed of photons, which are packets of light rays. Cosmic rays are composed of atomic nuclei. X-rays have thousands of times and gamma rays millions of times the energy of visible light.

All the high-energy X-rays and gamma rays which the observatories study travel through space at the speed of light. They are forms of electromagnetic radiation. Forms studied by other spacecraft include ultraviolet and infrared radiation.

For many years, researchers in Earth-based laboratories have studied various forms of radiation and their energy mechanisms. This basic scientific knowledge has been transferred into many practical uses, including electrical applications, holography, radio, television, radar and infrared photography.

In high energy astronomy, interest lies in the extreme short-length waves known as X-rays and gamma rays. These rays are produced on Earth by natural radioactive minerals and man-made processes. X-rays and gamma rays on Earth are produced from well-understood physical processes and are used routinely in physics, chemistry, engineering, medicine and other scientific fields.

Much is yet to be learned, however, about the ways in which X-rays and gamma rays are produced in deep space -- in some cases, with incredible intensity and with energy much greater than can be produced here on Earth.

It is expected that the radiation data collected by the three satellites, after reduction and analysis are completed, will lead to a better understanding of such things as how these high energies are generated in space, how basic elements are formed and how the universe evolved.

Several hypotheses are being pursued in astrophysics and cosmology that need additional experimental evidence which may be obtained by the observatories. These hypotheses are related to radio galaxies, neutron stars, pulsars, quasars and supernovae.

The High Energy Astronomical Observatory Project is managed for NASA's Office of Space Science by the Marshall Space Flight Center, Huntsville, Ala. Program manager is Richard E. Halpern and the program scientist is Dr. Albert G. Opp, both at NASA Headquarters in Washington, D.C. At the Marshall Center, Dr. Fred A. Speer is the project manager, and Dr. Thomas A. Parnell is the project scientist. Spacecraft prime contractor is TRW of Redondo Beach, Calif.

Kennedy Space Center, Fla., manages the launch operations, including pre-launch checkout, launch and flight through observatory separation in orbit.

NASA's Lewis Research Center, Cleveland, Ohio, manages launch vehicle procurement and related activities.

Control of the in-orbit observatories is under the direction of the Marshall Center in conjunction with TRW flight control engineers operating from facilities at NASA's Goddard Space Flight Center, Greenbelt, Md.

Cost of the three-mission program is about $246 million. The cost of the third mission will be approximately $44 million.

(END OF GENERAL RELEASE. BACKGROUND INFORMATION FOLLOWS.)

MISSION DESCRIPTION

The third high energy astronomy observatory will examine gamma ray sources and cosmic ray flux from a 499-km (301-mi.) orbit inclined 43.6 degrees to the equator. It will perform an all-sky survey of cosmic rays and gamma rays in a manner similar to the mission of the first observatory in the series.

The spacecraft will be launched from the U.S. Air Force Eastern Test Range's Complex 36B on Atlas-Centaur AC-53. Spacecraft separation will occur over the Ascension Island station. After separation, observatory control will be assumed by the project's operations control center at the Goddard Space Flight Center, Greenbelt, Md. The flight control team there will transmit commands to the observatory, receive, transmit and analyze data to evaluate performance and control the observatory.

After insertion into orbit, the spacecraft will go through three phases of operation.

- Activation. This mode includes solar array deployment, removal of separation transients, Sun acquisition, and, if necessary, activation of thermal control heaters and standby heaters. Observatory subsystems are then activated, calibrated and checked out. During this procedure, the solar arrays are held within 7 degrees of the Sun line.

- Experiment checkout. Experiments will be activated and checked out after observatory subsystems are operating properly. The initial data from each experiment will be obtained by an on-off cycle so that experiment operation can be evaluated before full turn-on for routine operation.

- Celestial scan. The scan mode, initiated by ground command, will be continuous throughout the mission. The alignment of the solar arrays toward the Sun will be maintained within 15 degrees of a chosen reference.

Observatory data stored in the on-board tape recorder will be transmitted to tracking sites at a rate of 6.4 kilobits per second.

MISSION OPERATIONS

Control of the in-orbit observatories is directed by the Marshall Space Flight Center, Huntsville, Ala., through flight control engineers assigned to Goddard Space Flight Center. Flight control operations are executed by TRW personnel under the direction of the Marshall flight director supported by experimenters associated with each mission.

The Marshall Center directs mission planning and establishes support requirements to be met by the worldwide Spaceflight Tracking and Data Network, the Operations Control Center and Data Processing Center. Goddard provides and operates these existing network and mission operations support facilities required by Marshall to control and operate the observatories.

The large amounts of data taken by each of the observatories are reduced and analyzed by the principal investigators, co-investigators and other scientists representing various universities, government agencies and industrial groups. They make known their findings in scientific reports, papers, publications and presentations.

SCIENTIFIC EXPERIMENTS

The satellite will carry three experiments, conceived by scientists from four organizations in the United States, one in France and one in Denmark.

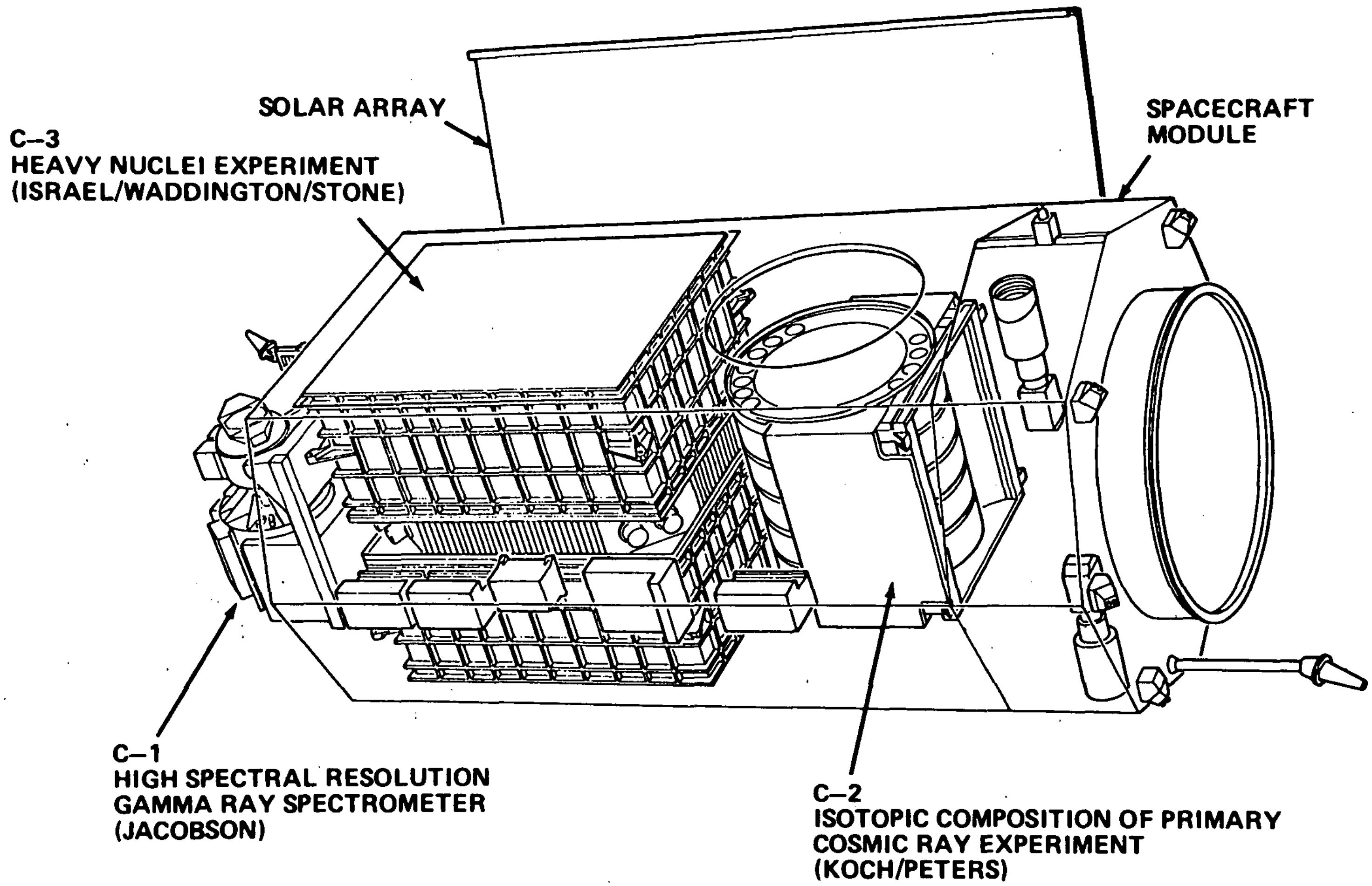
The experiments are described briefly below:

High Spectral Resolution Gamma Ray Spectrometer (C-1) -- Dr. A. S. Jacobson, NASA Jet Propulsion Laboratory, Pasadena, Calif.

The scientific goal is to explore for sources of X-ray and gamma ray line emissions from approximately 0.06 to 10 million electron volts. The instrument will measure the spectrum and intensity of both diffuse and discrete sources of X and gamma radiation. It will also measure the isotropy of the diffuse background and temporal fluctuations of discrete sources.

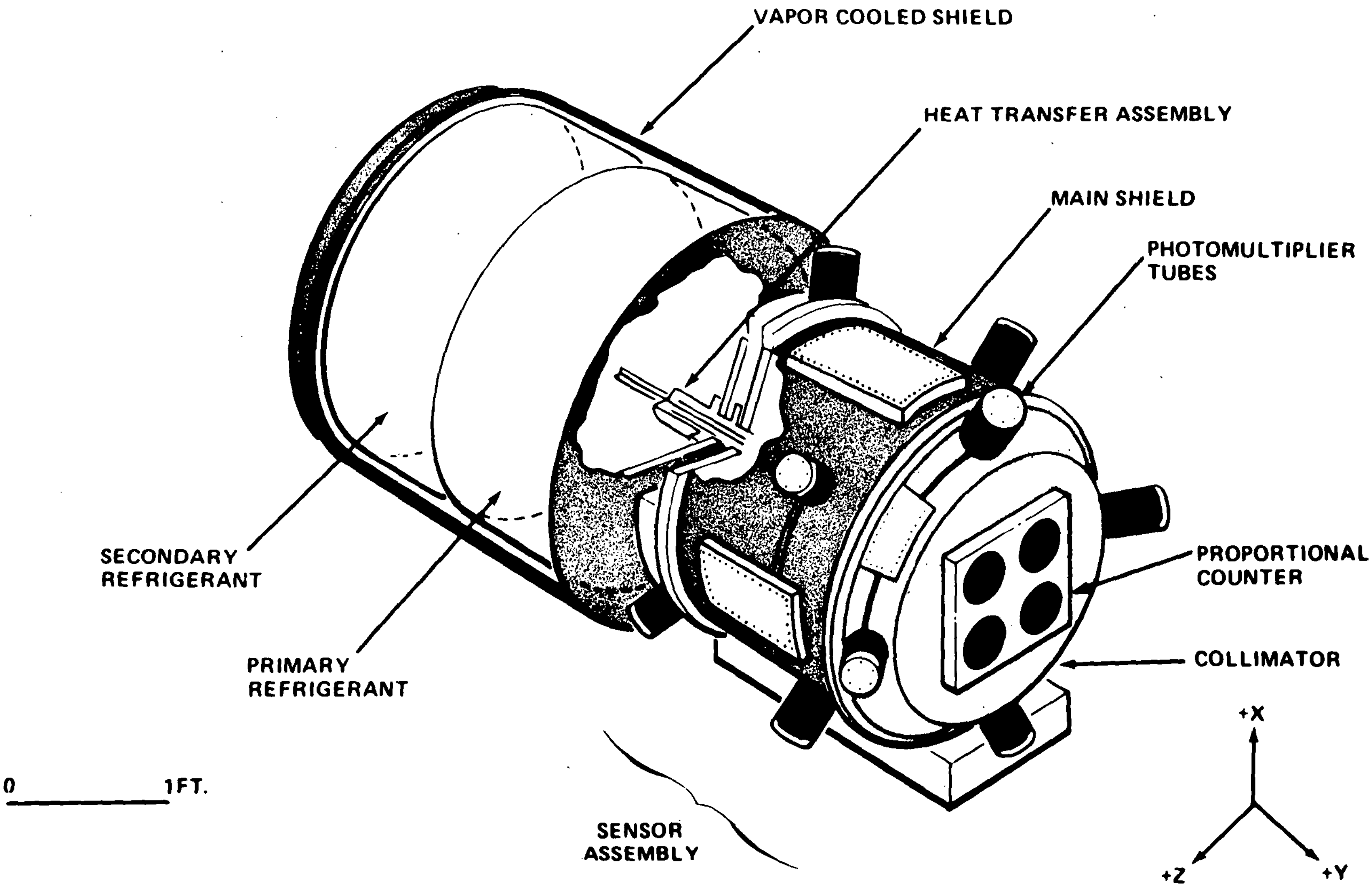
Additional goals are to search for new discrete sources of X and gamma rays, observe gamma ray bursts and to measure the spectrum and intensity of the Earth's X and gamma ray albedo.

HEAO-3 EXPERIMENTS



HEAO C-1 EXPERIMENT

HIGH SPECTRAL RESOLUTION GAMMA-RAY SPECTROMETER   JACOBSON



A cluster of four high-purity germanium detectors surrounded by a cesium-iodide, sodium-activated shield provides active collimation and background rejection. The germanium crystals are cooled by a solid cryogen refrigerator.

Isotopic Composition of Primary Cosmic Rays Experiment (C-2) -- Dr. L. Koch, Center for Nuclear Studies, Saclay, France, and Dr. B. Peters, Danish Space Research Institute, Copenhagen.

This cosmic ray experiment will measure the isotopic composition of primary cosmic rays with atomic charge z in the range of 4 (beryllium) to 56 (iron) and in the momentum range from 2 to 20 giga electron volts per nucleon. In addition, the charge resolution of the instrument will allow identification of all incident nuclei up to charge z=50 (tin).

Flash-tube trays define the trajectory of incident particles through the detectors which are powder Cerenkov counters. The indices of refraction of the counters are chosen to maximize the useful observation time for the geomagnetic cutoff associated with the orbital inclination of the observatory.

Heavy Nuclei Experiment (C-3) -- Professor M. H. Israel, Washington University, St. Louis; Professor E. C. Stone, California Institute of Technology, Pasadena; and Professor C.J. Waddington, University of Minnesota, Minneapolis.

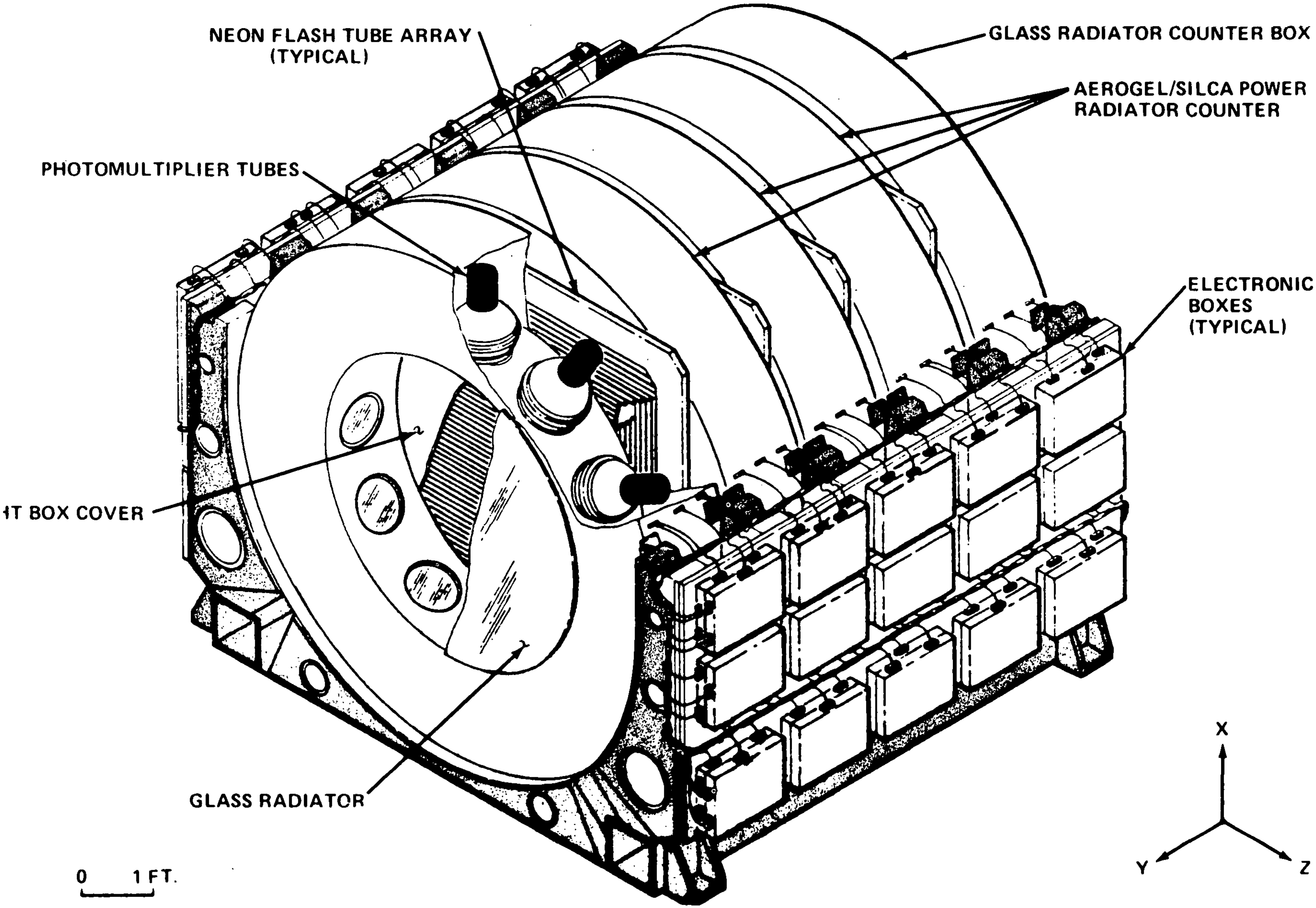
This cosmic ray experiment consists of two large ionization chambers mounted back to back with a large Cerenkov counter between. It will observe rare, high atomic-number (z less than 30), relativistic nuclei in the cosmic rays. The instrument will measure the elemental composition and energy spectra of these nuclei with sufficient resolution to determine the abundance of individual elements from chlorine (z=17) through at least uranium (z=92).

It can also detect the theoretically predicted superheavy nuclei, substantially heavier than uranium, if they are present in the cosmic rays. These data will provide information on nucleo-synthesis models and on the relative importance of different types of stellar objects as cosmic ray sources.

HEAO C-2 EXPERIMENT

ISOTOPIC COMPOSITION OF PRIMARY COSMIC RAYS

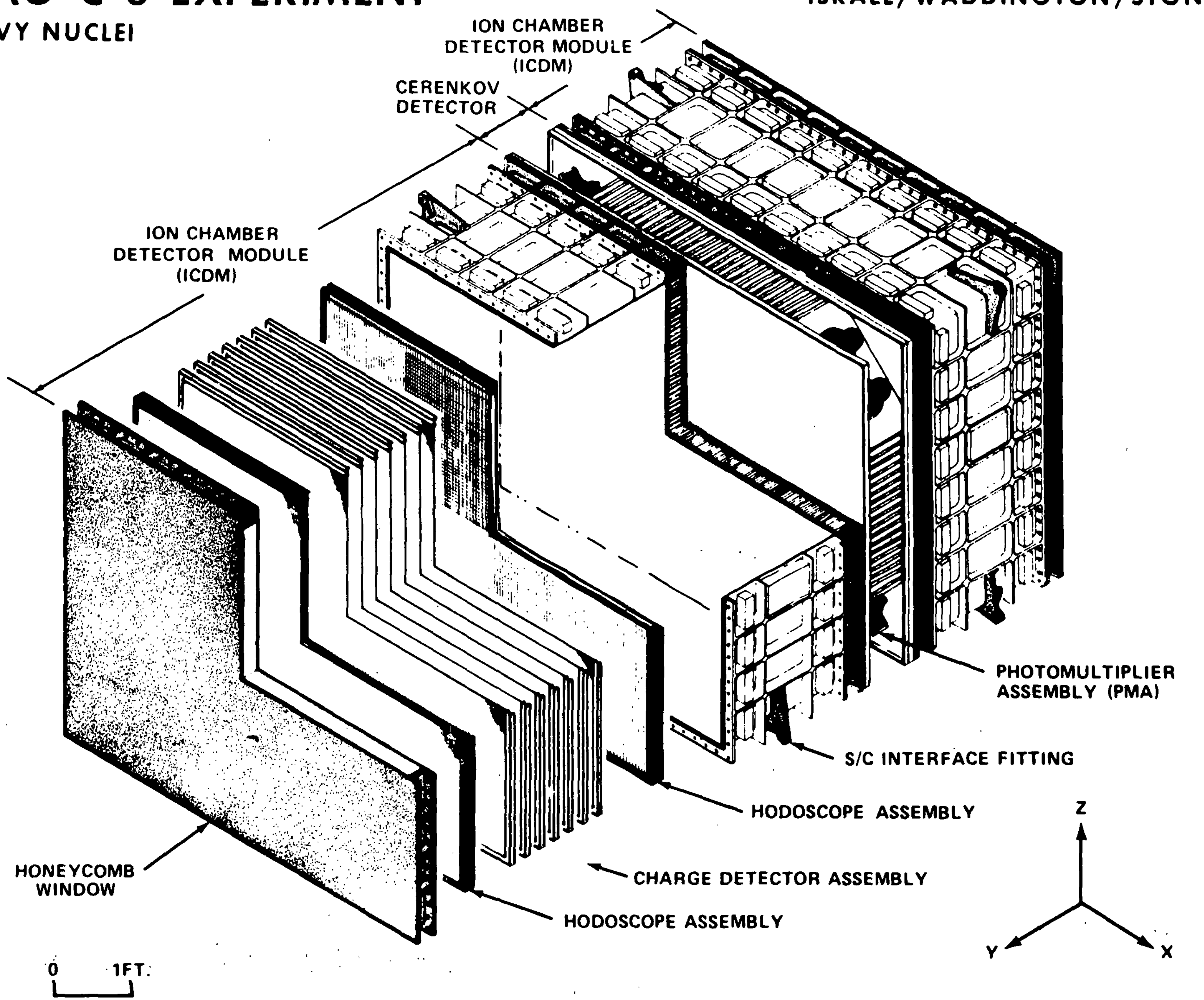
KOCH/PETERS



HEAO C-3 EXPERIMENT

HEAVY NUCLEI

ISRAEL/WADDINGTON/STONE



SPACECRAFT DESIGN

The basic subsystems design of the spacecraft is common for all three missions. The shape, arrangement and objectives of the experiments on the three spacecraft are different for each mission.

The observatories (the basic spacecraft plus experiments) each weigh about 3,150 kg (7,000 lb.), including 1,350 kg (3,000 lb.) of experiments. Overall observatory length is about 5.8 meters (19 feet).

Spacecraft subsystems take advantage of existing hardware designs developed in other spacecraft programs. About 80 per cent of the hardware designs are "off-the-shelf."

The satellite consists of two main parts, an experiment module and a spacecraft equipment module. The latter is an octagon-shaped prism 83.8 centimeters (33 inches) high and 231 cm (91 in.) in diameter. This module has remained essentially the same on all three observatories, supplying the support systems needed to operate a spacecraft and its scientific instruments. It is attached at the bottom of each experiment module.

The experiment module for the third observatory is six-sided, 4.35 m (14.3 ft.) long, and 2.43 m (8 ft.) in diameter. The large and small solar panels produce up to 405 watts of power. The experiments unit can return data to Earth at the rate of 5.4 kilobits per second. The three experiments on the module are the gamma ray spectrometer, the cosmic ray isotope experiment and the heavy nuclei experiment.

PROJECT RESULTS TO DATE

From X-ray and gamma-ray information received via the first two high energy observatories, scientists have been able to describe many new features of the universe.

Researchers have reported that data collected during the 17 months of successful operation of the first observatory have enabled them to catalog some 1,500 new sources of X-rays and to determine their distribution over the celestial sphere.

Many of the sources have been located with such precision that optical astronomers were able to quickly identify the X-ray object with a faint visible object -- frequently a binary system -- leading to a much better understanding of the type of source than if only the X-ray object were observed. Included in the list of such correlations is the discovery of a new black hole candidate.

Other results included evidence for a universal hot plasma that may constitute a large fraction of the mass of the universe, detection of high energy X-rays thought to be streaming from the polar region of a 10-km-diameter neutron star, and detailed measurements made on the mysterious gamma ray bursts whose precise source locations are still being sought.

Voluminous new data based on the second orbiting observatory, also called the Einstein Observatory, featured many high-resolution images produced by the X-ray telescope with its two types of imaging detectors. Many previously unknown X-ray sources stand out clearly in these images, and extended objects such as supernovae remnant clouds are revealed in the X-ray spectrum to have marked variations in intensity in different regions.

The Einstein Observatory examined the Andromeda galaxy, finding more than 70 X-ray objects. In the gaseous nebula, Eta Carinae, it discovered a number of X-ray objects associated with young, exceedingly hot stars. Such young stars were not expected to be a strong source of X-rays.

Another important result has been the high-resolution image of a previously unknown quasar more than 10 billion light years away. This ability to detect quasars in X-rays at such distances may indicate that quasars even farther away, near the outermost limits of the observable universe, may be detected first by an X-ray telescope.

The discovery of X-ray objects in deep sky surveys,(long observations of apparently blank regions) have revealed that what has generally been considered to be a diffuse X-ray background may partially consist of a large number of discrete sources. This tentative conclusion bears on one of the most important hypothetical issues in cosmology today: namely, whether the universe will continue to expand indefinitely or will eventually cease its expansion and begin to collapse toward a repeat of the "big bang" which is thought to have occurred 15-20 billion years ago.

In addition to imaging experiments, the observatory is examining the details of the spectra and the fluctuations in the X-ray flux on time scales down to a few microseconds. X-ray emission lines have been identified for the first time from highly ionized states of magnesium, sulfur, argon and calcium, in addition to the lines of silicon and iron which had already been detected by others. These measurements confirm the theory that our Sun and planets were most likely formed from material from ancient supernovae explosions. The time variability studies will hopefully lead to a better understanding of the nature of supernovas.

ATLAS-CENTAUR LAUNCH VEHICLE

Contractor for the Atlas booster stage (SLV-3D) is the Convair Division of General Dynamics Corp. The stage-and-one-half Atlas is powered by three engines -- two Rocketdyne YLR-89-NA-7 engines providing 1,645,842 newtons (370,000 lb.) of thrust and one Rocketdyne YLR-105-NA-7 engine with 266,893 N (60,000 lb.) thrust. All three engines operate on liquid oxygen and RP-1 propellant.

General Dynamics is also contractor for the Centaur upper stage (D-1A), which is powered by two Pratt and Whitney RL10A-3-3 engines with a total thrust of 133,447 N (30,000 lb.). These engines operate on liquid oxygen and liquid hydrogen.

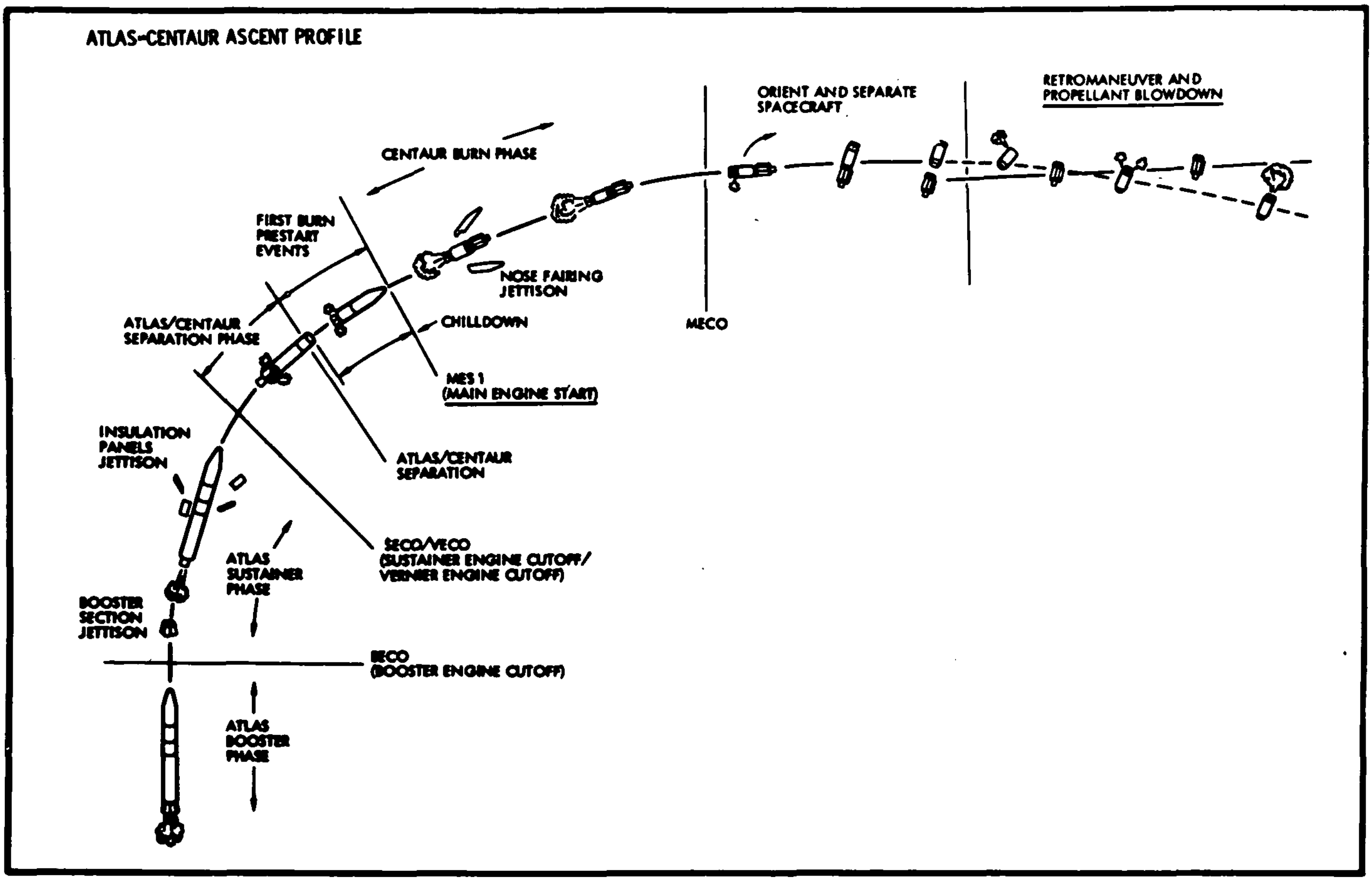
Physical characteristics of the Atlas SLV-3D stage are:

- Length: 21.3 m (70 ft.)
- Diameter: 3 m (10 ft.)
- Dry weight: 5,672 kg (12,512 lb.)
- Launch weight: 130,332 kg (287,333 lb.)

Physical characteristics of the Centaur D-1A upper stage are:

- Length: 9 m (30 ft.)
- Diameter: 3 m (10 ft.)
- Dry weight: 1,768 kg (3,897 lb.) excluding nose fairing
- Launch weight: 17,716 kg (39,057 lb.)

Total height of the Atlas-Centaur space launch vehicle, ready for launch, is 39.9 m (131 ft.) with a launch weight of about 149,240 kg (329,017 lb.) for the third high energy observatory.



LAUNCH PREPARATIONS

A NASA-contractor team under the direction of the Kennedy Space Center's Cargo Operations Directorate has responsibility for managing the preparation and launch of the Atlas-Centaur vehicle that will carry the third high energy observatory.

The Atlas and Centaur stages of the launch vehicle arrived at the Kennedy Space Center June 14. Atlas-Centaur 53, carrying the satellite, will lift off from Pad B, southernmost of two launch pads at Complex 36 of the Cape Canaveral Air Force Station of the U.S. Air Force Eastern Test Range. The Atlas-Centaur was erected on Pad B June 19.

The spacecraft was delivered July 27 and moved to the spacecraft Assembly and Encapsulation Facility-2 in the Kennedy Space Center Industrial Area for systems checkout.

THE PROGRAM TEAM

NASA Headquarters

Dr. Thomas A. Mutch	Associate Administrator for Space Science
T. Bland Norris	Director, Astrophysics Programs
Richard E. Halpern	Manager, High Energy Payloads
Dr. Albert G. Opp	Program Scientist
John F. Yardley	Associate Administrator for Space Transportation Systems
F. R. Schmidt	Program Manager, Expendable Launch Vehicles
Dr. William Schneider	Associate Administrator for Space Tracking and Data Systems
Frederick B. Bryant	Manager, Space Tracking and Data Systems Network

Marshall Space Flight Center

Dr. William R. Lucas	Director
Dr. Fred A. Speer	Manager, HEAO Project
Fred S. Wojtalik	Chief Engineer, HEAO Project
Charles H. Meyers	Manager, Spacecraft Office
Joseph B. Jones	Manager, Experiment Office
Tom Irby	HEAO-3 Observatory Manager
Dr. Tom Parnell	HEAO-3 Project Scientist

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Robert E. Smylie	Acting Director
Tecwyn Roberts	Director of Networks, Tracking and Data Acquisition
Albert G. Ferris	Director, Mission and Data Operations
Richard S. Costa	Mission Operations Systems Manager

Kennedy Space Center

Richard G. Smith	Director
Gerald D. Griffin	Deputy Director
George F. Page	Director, Shuttle Operations
I. A. Rigell	Acting Director, Cargo Operations
Charles D. Gay	Director, Deployable Payloads Operations
John D. Gossett	Chief, Centaur Operations
Larry Kruse	Spacecraft Coordinator

Lewis Research Center

Dr. John McCarthy	Director
Larry Ross	Director, Launch Vehicles
Edwin T. Muckley	HEAO Project Engineer

Jet Propulsion Laboratory

Dr. A. S. Jacobson	Principal Investigator, High Spectral Resolution Gamma Ray Spectrometer (C-1)

Center for Nuclear Studies, Saclay, France

Dr. L. Koch	Co-Principal Investigator, Isotopic Composition of Primary Cosmic Rays Experiment (C-2)

Danish Space Research Institute, Copenhagen, Denmark

Dr. B. Peters	Co-Principal Investigator, C-2 Experiment

Washington University

Professor M. Israel	Co-Principal Investigator, Heavy Nuclei Experiment (C-3)

California Institute of Technology

Professor E. Stone	Co-Principal Investigator, C-3 Experiment

University of Minnesota

Professor C. J. Waddington	Co-Principal Investigator, C-3 Experiment

CONTRACTORS

TRW Inc. Defense and Space Systems Group Redondo Beach, Calif.	Spacecraft design and manufacture, observatory integration
General Dynamics Corp. Convair Division San Diego, Calif.	Launch vehicle manufacture
Ball Corp. Technical Products Group, Aerospace Systems Division Boulder, Colo.	C-1 and C-3 Experiment design and manufacture

GLOSSARY

Pulsars and Neutron Stars

Discovered in 1967, pulsars are stars which emit radio signals in extremely precise pulses. The bulk of available evidence suggests that pulsars may be fast-spinning neutron stars. These are compact bodies of densely packed neutrons (atomic particles having no electric charge), believed to form when a large star burns up much of its fuel and collapses. Containing the mass of a star in a sphere 16 km (10 mi.) in diameter, they are so closely packed that a spoonful of material from the center would weigh a billion tons.

Black Holes

These are believed to be the final stages in the collapse of a dying star. The star's material is so densely packed -- even more so than a neutron star -- and its gravitational force so great that even light waves are unable to escape. Black holes have been hypothesized but conclusive observations have not yet been possible.

Quasars

Astronomers are still baffled by the nature of quasars, but many believe that among observable objects they are the most remote in the universe. They look like stars when viewed through an optical telescope but emit more energy than the most powerful galaxies known. According to calculations, if they are as distant as many astronomers think they are, the total energy emitted by a quasar in one second would supply all of Earth's electrical energy needs for a billion years.

Radio Galaxies

Located on the fringes of visibility, radio galaxies emit radio waves millions of times more powerful than the emissions of a normal spiral galaxy. No one knows what these peculiar galaxies are. Several of them broadcast with such power that a sizable fraction of the nuclear energy locked up in their matter must be going completely into the production of radio waves.

Supernovae

Supernovae are cataclysmic events that generate violent explosions, blowing the surface layers of large stars out into space at their lives' end. The materials of the exploded stars mix with other material of the universe (primarily hydrogen). Later in the history of the galaxy, other stars are formed out of this mixture. Our Sun is one of these stars; it contains debris of countless others that exploded before the Sun was born.

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