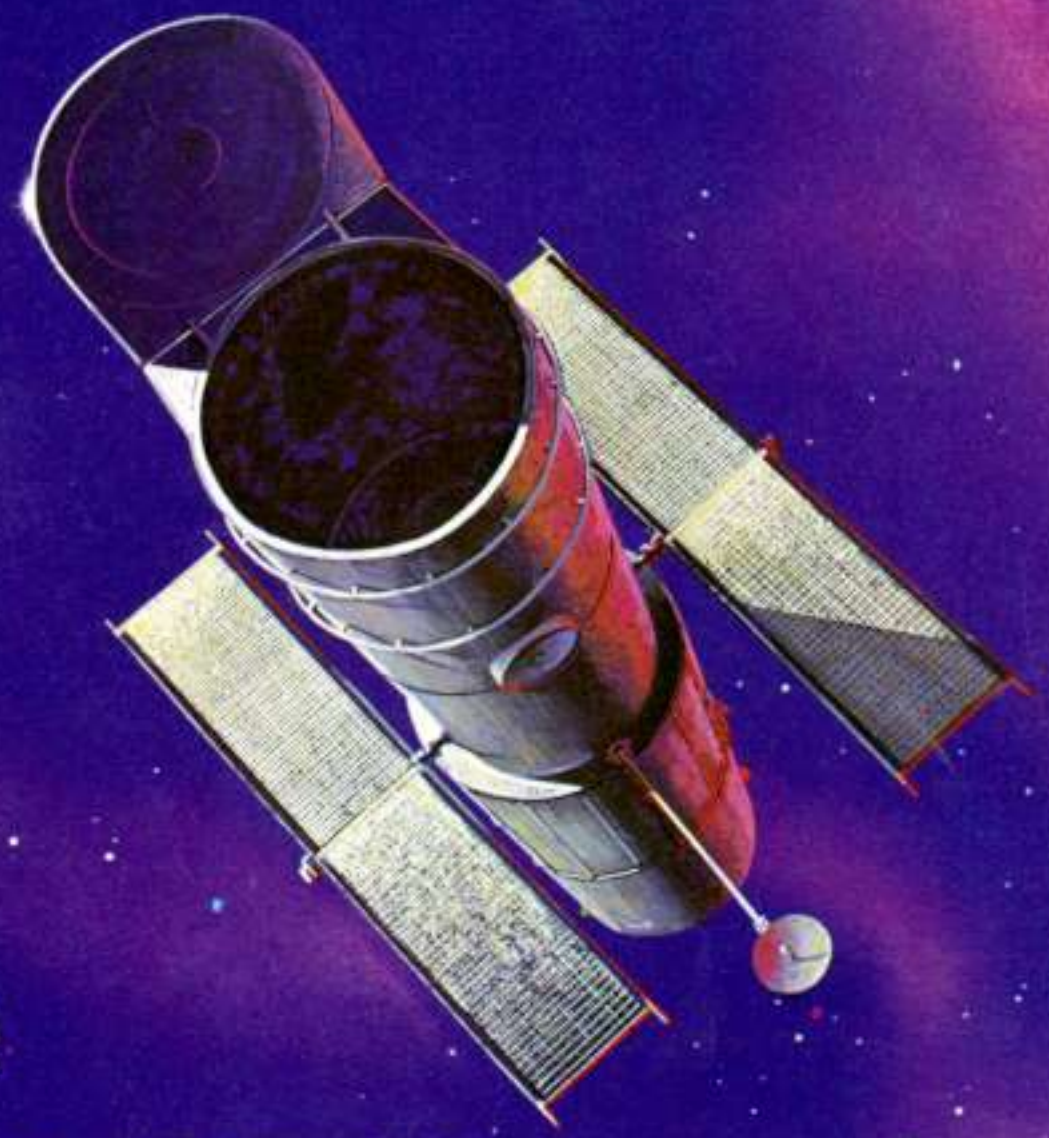


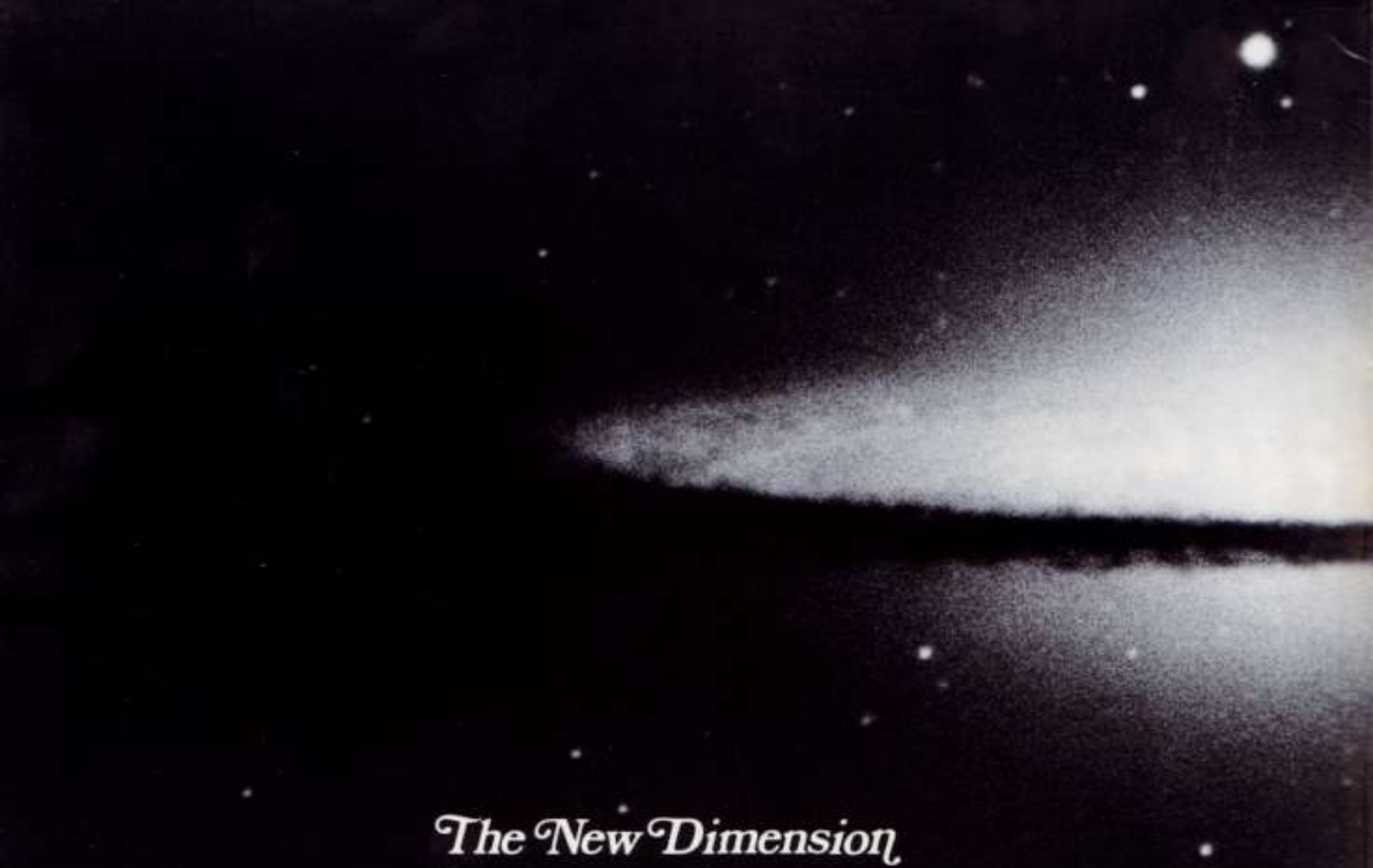
NASA

Space Telescope

A New Look in Astronomy

Lockheed Missiles & Space Company

Sunnyvale, California



The New Dimension

The Space Telescope is a look into the far reaches of the universe, a look of a magnitude until recently impossible . . . for only in the most recent past was man able to step off his mother planet and explore the oceans of space.

The magnificent accomplishments of space exploration to date proved in practice what theory predicted—that away from the protective atmosphere of our planet we can see, record, and measure phenomena which cannot reach us here in undistorted form.

Photographs courtesy of Hale Observatories.

Astronomy

Observing the skies led to concepts of time, calendars, and clocks. Observing the motion of planets led to the laws of gravitation. These discoveries in turn accelerated the development of mathematics.

Each advance in knowledge produces its own effects, and all of them interconnect in new ways.

Many branches of modern-day physics have developed hand-in-hand with astronomy, the most spectacular perhaps being Einstein's theory of relativity. As astronomers strive to see better and deeper into space, we learn more about the science of light. With the need to record what the astronomer observes have come advances in photography—for the visible spectrum as well as for the ultraviolet and infrared.

The expansion of knowledge never stops. As we look farther into the universe and learn more about what is distant, we come to understand better what is close at hand.

Ground-Based Telescopes

As energy passes through it, our atmosphere effectively filters out most of the electromagnetic spectrum. Thus, until the advent of space probes and orbiting observatories, a large percentage of the information coming from celestial objects was not available to earth-based scientists.

Distortion by warm air rising from the earth's surface causes a shimmering or "twinkling" of images, contributed to by the heat-producing and retaining capacity of cities, with their expanses of pavement.

Even in the most agreeable of climates, overcast skies prevent viewing on many nights.

Perhaps the most difficult man-made problem to overcome is the increase in ambient light, accelerated in recent years by the proliferation of cities and compounded by blankets of smog which increase the light pollution.

New Expectations

The Space Telescope is a better research tool whose time has come.

Placed in orbit by the Space Shuttle, the Telescope will perform its many functions in an environment impossible to duplicate on Earth. Atmospheric filtering, haze, twinkling, and light pollution will be eliminated. Most of the Space Telescope's time in orbit can be used for observation because there will be no weather limitations.

The Space Telescope will have 10 times better resolution than ground-based telescopes; it will be able to see objects that are 50 times fainter and 7 times farther away than those we now observe. These improvements open up an immense new volume of space to observation.

Ultimately, the Space Telescope's greatest contribution to humankind will probably be the unexpected breakthrough that brings completely new knowledge. Looking into incredibly deep space, the Space Telescope does more than conquer the distance. The events we witness occurred millions and billions of years ago as we perceive time. Energy in its visible and invisible forms brings with it knowledge of the space-time continuum itself.

Inside the Telescope

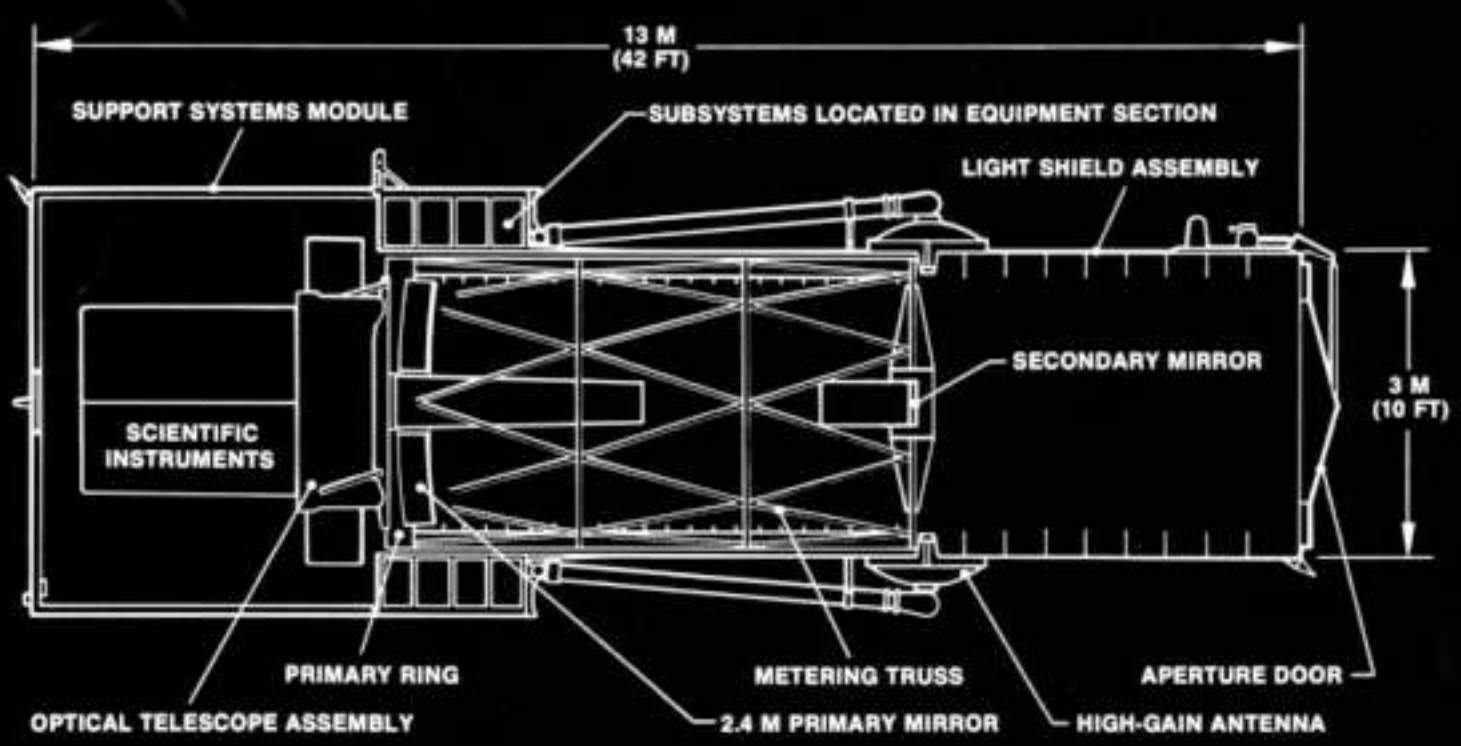
The Space Telescope overall is a cylinder 14.3 meters (43 feet) long and 4.7 meters (14 feet) in diameter—very similar in size to the 3-meter (120-inch) telescope at Lick Observatory.

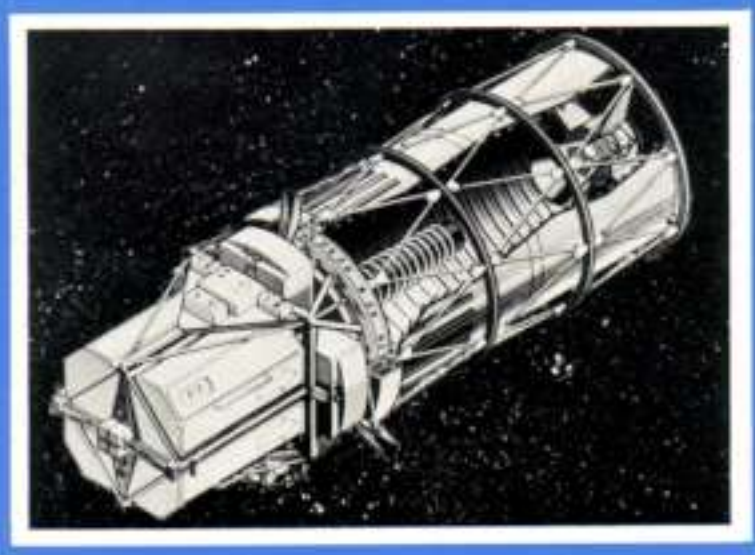
In orbit the telescope will consist of three parts: an Optical Telescope Assembly, Scientific Instruments, and a Support Systems Module.

The Optical Telescope Assembly will comprise a 2 meter class reflecting telescope. A meteoroid shield and sunshade will protect the optics.

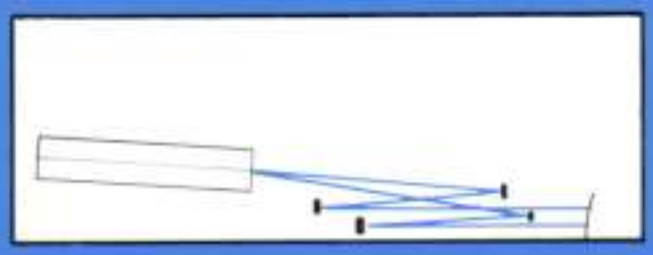
The Scientific Instruments package will provide the means of converting the telescope images to useful scientific data.

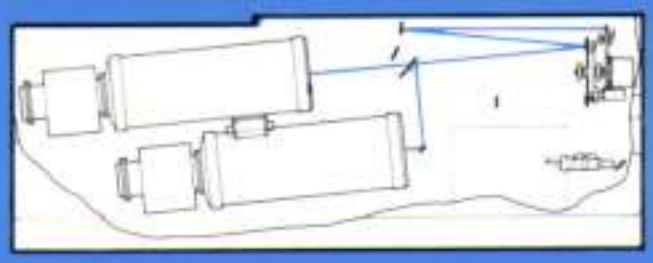
The Support Systems Module will contain a very precise stabilization system, the communications system, and the power system. Electrical power will be supplied by solar panels.

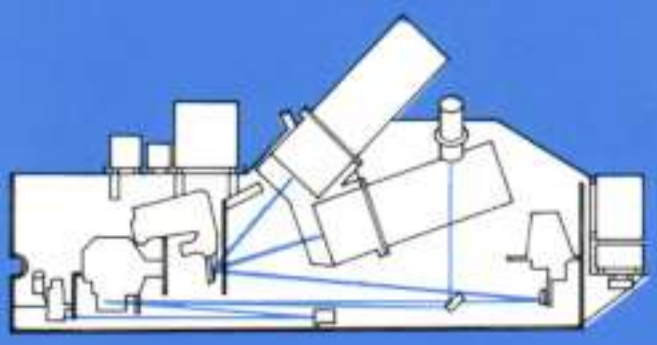


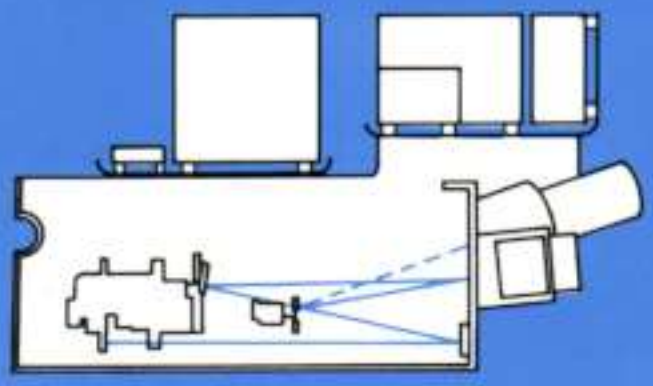


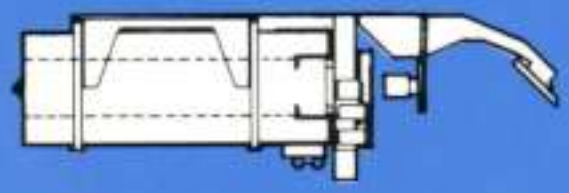
SCIENTIFIC INSTRUMENTS











TELESCOPE OPTICS

Light enters the open end of the telescope, is projected by the primary mirror onto the smaller secondary mirror, and, from there, is deflected to the scientific instruments for analysis.

A faint-object camera will make images of very faint light sources.

A faint-object spectrograph will measure the wavelengths of energy coming from faint sources.

A high resolution spectrograph will perform spectroscopy of point or extended sources in both ultraviolet and visible light.

A high speed area photometer will obtain precise measures of constant or time variable intensities over a broad wavelength interval from either point sources or celestial fields of small angular size.

One of the three fine-guidance sensors, which are part of the Optical Telescope Assembly, will provide for astrometry—measurement of the positions and motions of stars.

A wide-field camera will make images of celestial objects.

Astronomical Studies for a New Era

The Space Telescope's potential is so great that not only the astronomers but most members of the global scientific community see it as a herald of a new era, an era of super-discoveries, of conscious expectation of the unexpected.

ASTRONOMICAL SUBJECTS TO BE STUDIED

Celestial objects which exist under conditions of gravity, temperature, radiation, and time that cannot be duplicated on Earth will be studied—such objects as:

Gaseous nebulae	*Pulsars*
Dust clouds	*Neutron stars*
Variable stars	*Black holes*
Binary stars	*Forming galaxies*
Novae	*Quasars*
Supernovae	*Exploding galaxies*

The nearby stars, the weather on nearby planets, and the planetary systems on stars 30 or more light years away will also be subjected to Space Telescope scrutiny.

Space Shuttle

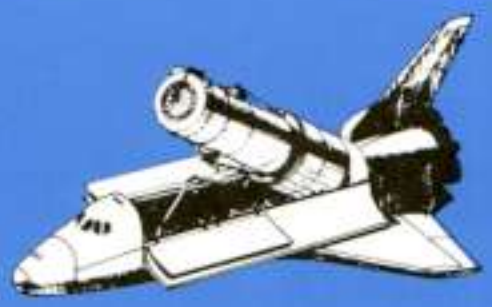
The Space Telescope will be placed in orbit by the Space Shuttle, which is now close to completion. The Space Shuttle is a manned space vehicle that can take off vertically like a rocket, orbit Earth for several days, and then land like a conventional airplane.

The Space Shuttle contains a large cargo bay and carries equipment to manipulate orbiting satellites. The Space Telescope can be serviced and repaired while it is in orbit, and new instruments can be installed. It can also be returned to Earth for major repairs and improvements and then be replaced in orbit.

Space Shuttle Operations

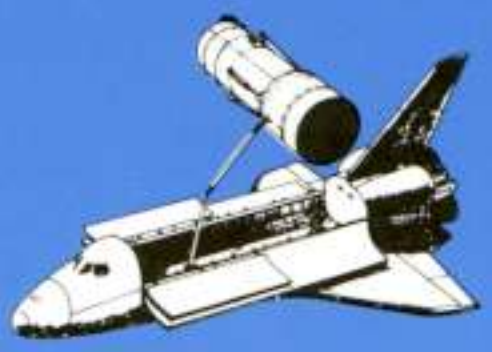
LAUNCH

Two reusable solid-propellant boosters and an external fuel tank are required to launch the Orbiter into space. The boosters later separate and parachute to the ocean for recovery and reuse. The Orbiter is then driven by liquid-propellant engines.



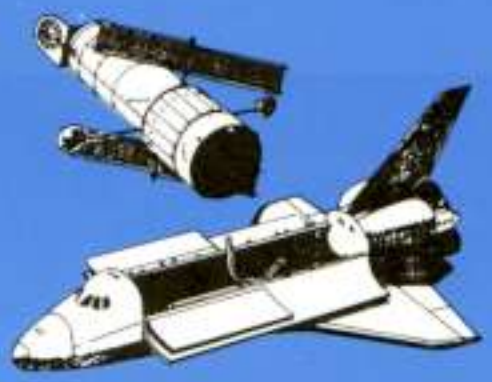
ORBITAL OPERATION

After orbital insertion and circularization, the Orbiter is maneuvered into the proper position and the Space Telescope is raised in preparation for deployment.



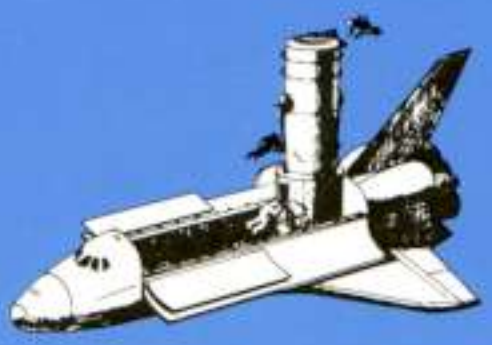
DEPLOYMENT

After a preliminary checkout, the Space Telescope is positioned by the remote manipulator arm into the proper orbit orientation.



CHECKOUT

As the Orbiter remains nearby for help if needed, the Space Telescope receives a thorough checkout to make sure that all systems are operating properly. For the Orbiter to retrieve the Telescope, the steps are reversed.



ON-ORBIT SERVICE

During the first revisit, about two to three years later, the Space Telescope is captured and placed in the cargo bay. A crew in space suits provides necessary service, making repairs and replacing equipment. This capability makes the Space Telescope a practical reality.

REENTRY

The Orbiter is well insulated from the intense heat generated during reentry. After it enters Earth's atmosphere, it lands like a conventional airplane. Servicing and repairs prepare the Space Shuttle for its next mission.

In The Future

On the path of knowledge man confronts himself. He knows that the more he learns, the more conscious he will become of how little he knows—how much more there is to be discovered.

The light from distant galaxies, billions of years en route to the here and now, makes man ponder about the current existence of the past. It may make him wonder about the current existence of the future. In the confrontation with the mysteries of the space-time continuum and his own being, man stands at the threshold of a new era, an era not of conquest but of unity with the environment of the universe.

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NASA
National Aeronautics and Space Administration

- **NASA's Office of Space Science is responsible for overall direction of the Space Telescope program**
- **Marshall Space Flight Center is responsible for overall project management**
- **Goddard Space Flight Center is responsible for the scientific instruments, mission operations and data reduction**
- **Johnson Space Center is responsible for the Space Shuttle and flight crew operations**
- **Kennedy Space Center is responsible for the Space Shuttle launch operations**
- **European Space Agency Members will provide scientific instruments, solar arrays and participate in flight operations**

SPACE TELESCOPE PRIME CONTRACTORS

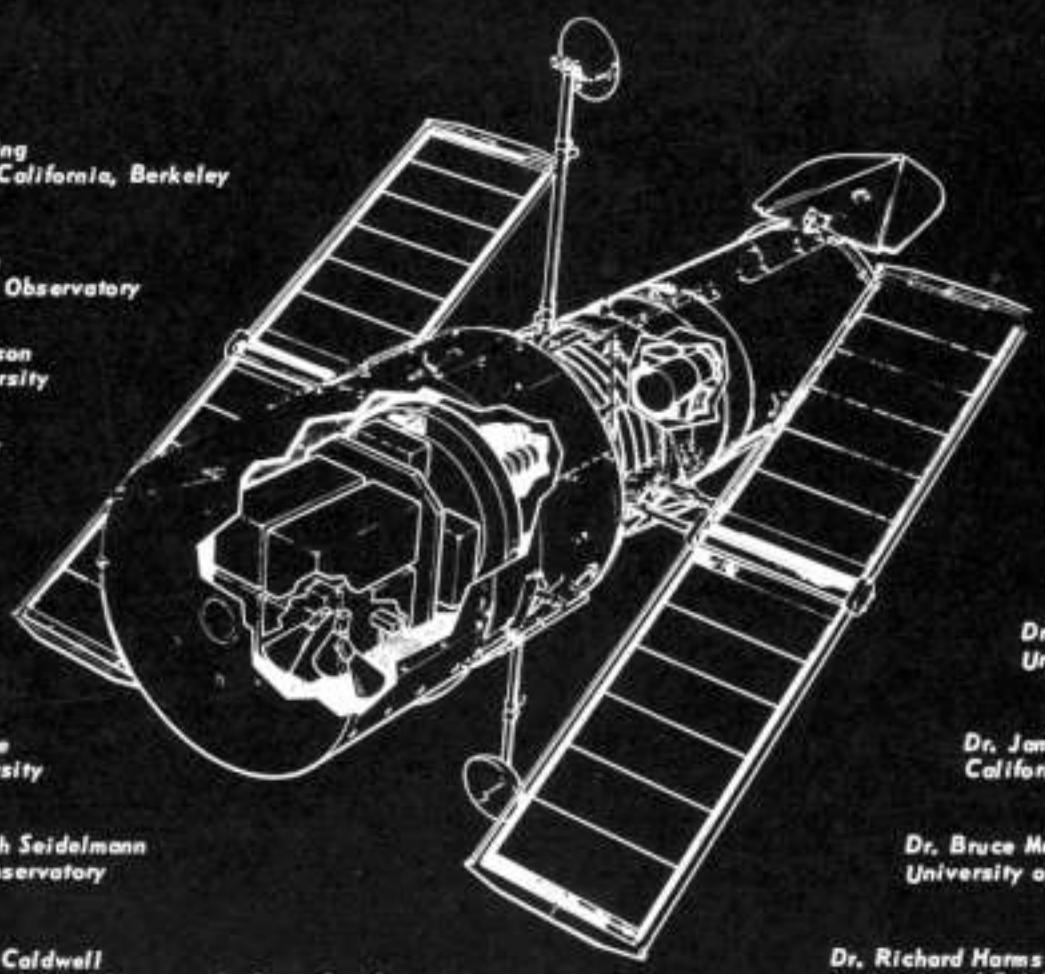
LOCKHEED MISSILES & SPACE COMPANY
Prime contractor responsible for the Support Systems Module and Systems Engineering

•

PERKIN-ELMER
Prime contractor responsible for the Optical Telescope Assembly

•

PARTICIPATING SCIENTISTS



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