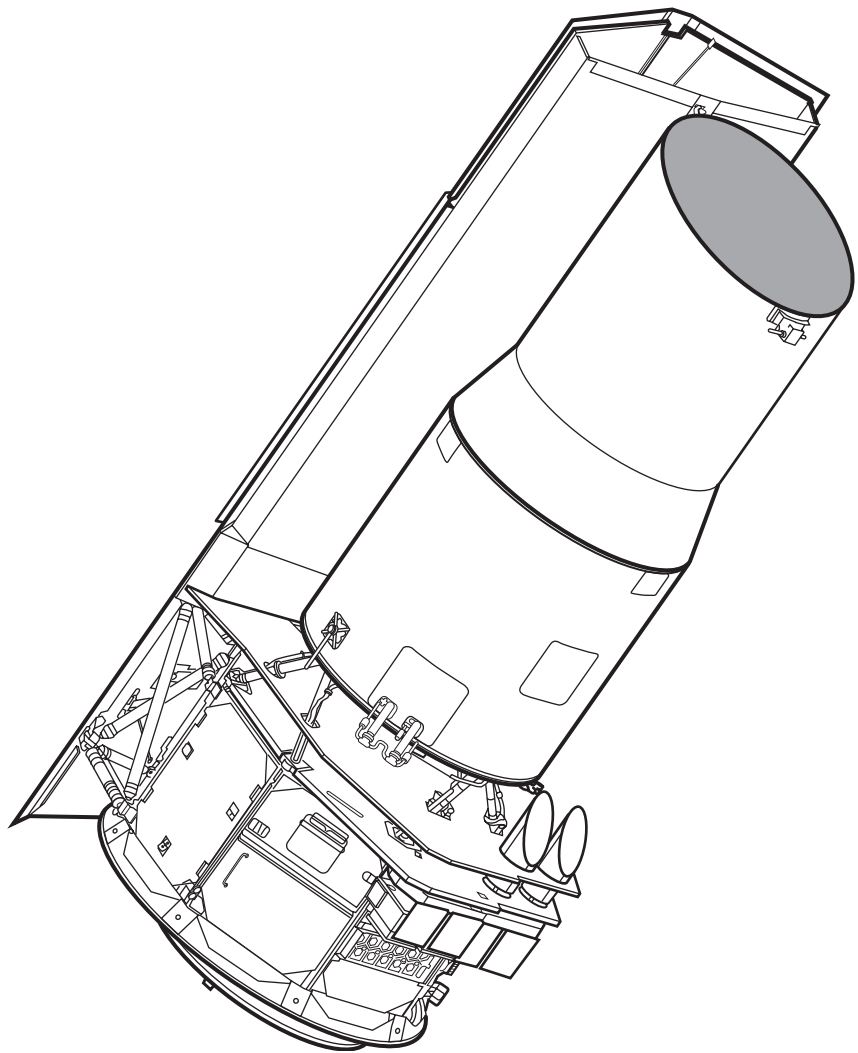


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Space Infrared Telescope Facility Launch

Press Kit
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Contents

General Release	3
Media Services Information	5
Quick Facts	6
Science Objectives.....	7
False Colors	9
Infrared Missions -- Past and Future.....	10
Science Working Group	13
Mission Overview	17
Spacecraft.....	23
The Telescope.....	29
Program/Project Management.....	33

GENERAL RELEASE:

SPACE OBSERVATORY TO STUDY THE FAR, THE COLD AND THE DUSTY

A NASA observatory set to launch on Aug. 25 will open a new window on the universe, using infrared technology to study celestial objects that are either too cool, too dust-enshrouded or too far away to be seen otherwise.

From its Earth-trailing orbit around the Sun, the Space Infrared Telescope Facility will pierce the thick dust that permeates the universe, unveiling new information about galaxies, stars and dusty discs around nearby stars, which may be "planetary construction zones."

"The Space Infrared Telescope Facility will complete NASA's suite of Great Observatories, a program that includes three previous missions that studied the universe with visible light, X-rays and gamma rays," said Dr. Ed Weiler, associate administrator for space science, NASA Headquarters, Washington. "Many cosmic objects produce radiation over a wide range of wavelengths, so it's important to get the whole picture." The three previous Great Observatories are the Hubble Space Telescope, Compton Gamma Ray Observatory and Chandra X-ray Observatory.

By studying the structure and composition of dusty planet-forming discs around stars, the Space Infrared Telescope Facility will aid the search for Earth-like planets that may harbor life. This makes it a cornerstone of NASA's Origins Program, which seeks to answer the questions, "Where did we come from? Are we alone?"

Infrared detectors can see longer wavelengths than the red light visible to our eyes. As the universe expands, starlight from distant galaxies is shifted from blue to red and ultimately into the infrared. Most radiation emitted by stars, galaxies and other objects in the early universe now lies in the infrared. The Space Infrared Telescope Facility will enable scientists to look further back in space and time than was previously possible.

"With this mission, we will see the universe as it was billions of years ago, helping us pinpoint how and when the first objects formed, as well as their composition," said Dr. Anne Kinney, director of the astronomy and physics division and the Origins program in the Office of Space Science at NASA Headquarters.

"The observatory will give us a better understanding of the universe and our place within it," said Dr. Michael Werner, the mission's project scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "For example, interstellar space has lots of carbon-rich organic molecules. Understanding these may illuminate the processes by which life formed."

During its two-and-one-half- to five-year mission, the telescope will also study brown dwarfs, or cool, "failed stars." Some scientists think that brown dwarfs may account for

some or all of the elusive "dark matter" thought to be prevalent in the universe. The mission will also study planets in our own solar system, asteroids and comets, and it certainly will yield unforeseen discoveries.

The observatory's telescope, which is cooled to extremely low temperatures, has three science instruments. The infrared array camera is a general-purpose camera for near-to mid-infrared wavelengths, while the infrared spectrograph breaks light into its various wavelengths, much like a prism, to help astronomers study the composition of cosmic objects. The multiband imaging photometer will gather pictures and limited spectroscopic data at far-infrared wavelengths to study cool, dusty objects.

The spacecraft itself features several technological breakthroughs, and the out-of-the-ordinary mission design will pay dividends as well. "The innovations have substantially reduced mission development costs," said Project Manager Dave Gallagher at JPL. "For example, the mission's Earth-trailing orbit simplifies scheduling and operations. And because the telescope detects heat from relatively cool objects, we have to keep it extremely cold. We've found a more efficient way to cool the telescope and slash the amount of liquid helium the observatory must carry."

The mission's technologies and science discoveries will help enable future Origins missions, such as the James Webb Space Telescope and Terrestrial Planet Finder.

The launch, from Cape Canaveral Air Force Station, Fla., will be broadcast live on NASA Television on the AMC-9 satellite, transponder 9C, located at 85 degrees west longitude, vertical polarization, frequency 3880.0 megahertz, audio 6.8 megahertz. The launch will be carried on a live webcast at <http://www.jpl.nasa.gov/webcast/sirtf>.

More information about the Space Infrared Telescope Facility is available on the project website at <http://sirtf.caltech.edu>. More information on NASA's Origins Program is at <http://origins.jpl.nasa.gov>.

JPL manages the mission for NASA's Office of Space Science, Washington, and also conducts flight operations. All aspects of science operations, including data processing, will be handled at the Space Infrared Telescope Facility Science Center at the California Institute of Technology in Pasadena. Lockheed Martin Space Systems Company, Sunnyvale, Calif., is responsible for spacecraft design and development, as well as observatory systems engineering, integration and testing. Ball Aerospace and Technologies Corporation, Boulder, Colo., is responsible for the design and development of the cryo-telescope assembly, as well as integration of the science instrument cold assemblies into the cryostat. Ball is also the subcontractor for two science instruments. NASA's Goddard Space Flight Center is responsible for building the Infrared Array Camera. The instruments' principal investigators are astronomers at Cornell University, Ithaca, N.Y.; University of Arizona, Tucson, and the Harvard Smithsonian Center for Astrophysics, Cambridge, Mass.

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Media Services Information

NASA Television Transmission

NASA Television is broadcast on AMC-9, transponder 9, C-Band, located at 85 degrees West longitude. The frequency is 3880.0 MHz. Polarization is vertical and audio is monaural at 6.8 MHz. The tentative schedule for television transmissions of mission activities is described below; updates will be available from the Jet Propulsion Laboratory, Pasadena, Calif.; and NASA Headquarters, Washington.

Briefings and Television Feed

NASA plans to broadcast the pre-launch media briefings and the launch live on NASA Television. Check the NASA TV schedule for updated dates and times of mission events. Events carried live on NASA TV will also be accessible via webcast at <http://www.jpl.nasa.gov/webcast/sirtf> .

Status Reports

NASA will issue periodic status reports on mission activities. They may be accessed online at <http://sirtf.caltech.edu> .

Launch Media Credentialing

News media representatives who would like to cover the launch in person must be accredited through the NASA Kennedy Space Center newsroom. Journalists may contact the newsroom at 321/867-2468 for more information.

Internet Information

Information on the mission, including an electronic copy of this press kit, press releases, fact sheets, status reports and images, is available from a variety of sources. Caltech operates the mission web site at <http://sirtf.caltech.edu> .

Quick Facts

Spacecraft

Size: 4.45 meters (14.6 feet) long, 2.1 meters (6.9 feet) in diameter

Weight: 865 kilograms (1,907 pounds) (loaded with propellant and coolant at launch)

Power: 400 watts

Batteries: 16 amp-hours

Science instruments: infrared array camera, infrared spectrograph, multiband imaging photometer

Launch Vehicle

Type: Delta II, Model 7920H

Length: 39.6 meters (129.9 feet)

Diameter: 2.9 meters (9.5 feet)

Weight: 282,900 kilograms (623,794 pounds)

Stages: 2

Fuel: 9 strap-on solid rocket motors; kerosene and liquid oxygen first stage, hydrazine and nitrogen tetroxide second stage

Mission

Launch: Aug. 23, 2003 from Pad 17-B, Cape Canaveral Air Force Station, Fla.

Primary mission: 2.5 years after 2-month in-orbit checkout, with a goal of 5-year lifetime

Orbit: Heliocentric (circling Sun), trailing behind Earth

Orbital period: 372 days

Program

Cost: \$1.19 billion (including launch vehicle, observatory, mission operations and data analysis)

Science Objectives

Imagine listening to the sweeping movements of a symphony, but the only notes your ears pick up are just a few pitches around middle C. With such limited perception you would miss much or most of the music, its structure and beauty. Historically, astronomers have found themselves in a similar situation. Though their trade is not in music appreciation, they have attempted to capture what they thought was the full grandeur of the cosmos in only visible light.

Seeing the Invisible

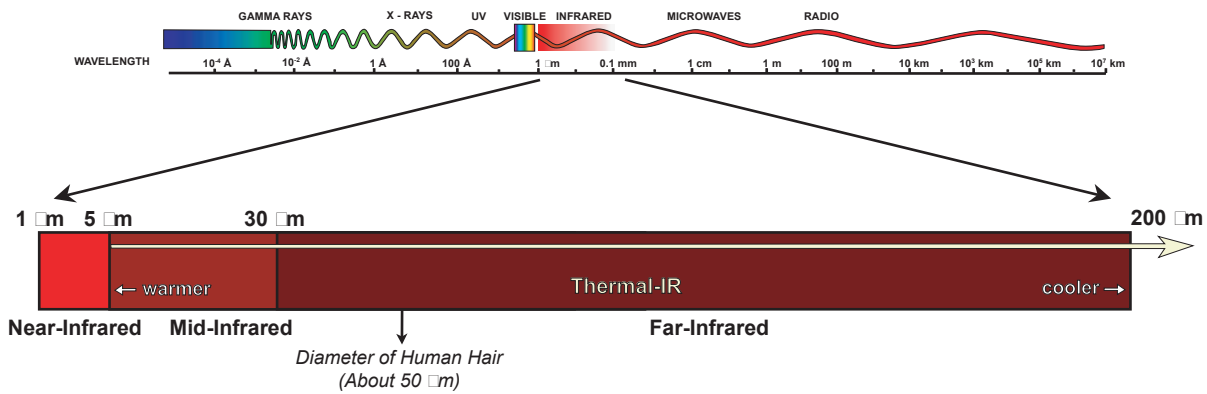
Our eyes detect only a sliver of the enormous bombardment of energy the universe washes over us at any instant. The remainder of this energy comes in the form of radio waves, microwaves, heat, X-rays, gamma rays and other types of what scientists call electromagnetic radiation. The various types of radiation differ in frequency, wavelength and the amount of energy. The shorter the wavelength, the higher the energy and frequency, and vice-versa. At one end of the scale are radio waves, which have low frequencies, low energy and long wavelengths. At the other end of the scale are gamma rays, with high frequencies, high energy and extremely short wavelengths.

Midway between radio waves and gamma rays is the spectrum of visible light. Here, what the eye perceives as color reflects the light's wavelength, energy and frequency. At one end of the scale is red light, which has a low frequency, low energy and long wavelength. At the other end of the scale is violet light, which has a relatively higher frequency, higher energy and shorter wavelength. Wavelengths of light in the visible spectrum ranges from about 0.7 micron for red light to 0.4 micron for violet (a micron is one-millionth of one meter, or about 1/50th the width of a human hair).

Infrared light lies just beyond the red portion of the visible spectrum. It has lower energy and a lower frequency than red light, and is therefore called "beyond the red," or "infrared." The infrared region stretches from a wavelength of about 1 micron (the "near infrared") to 200 microns and beyond (the "far infrared").

The Importance of Temperature

Any object in the universe with a temperature above absolute zero (minus 273.15 C or minus 459.4 F) will emit electromagnetic radiation. The type of radiation depends on the object's temperature. For an object to radiate gamma rays, for example, its temperature must exceed 1 billion C (1.8 billion F). Since gamma rays are thought to be the most energetic form of light, gamma-ray telescopes capture some of the most extreme, cataclysmic events in the universe such as supernova explosions and colliding neutron stars.



Electromagnetic spectrum

More familiar celestial objects like stars have temperatures near 10,000 C (18,000 F), and radiate energy mostly as visible light. Following this pattern, objects with cooler temperatures - perhaps a few hundred degrees or cooler, around the temperature of the human body, for example - emit most of their light in the infrared range. Infrared telescopes therefore provide an excellent tool to probe the cool, otherwise invisible universe, including such objects as vast clouds of dust floating between stars, to planets orbiting nearby stars that are too distant and dim to detect in visible light.

Lifting the Cosmic Veil

Some of the most dramatic objects in the universe are completely obscured from us in visible light. For example, vast clouds of interstellar dust conceal what is thought to be a super-massive black hole lurking in the center of our Milky Way galaxy. However, this dust becomes transparent in near- and mid-infrared light, thereby allowing astronomers to peer at such fascinating phenomena.

Looking Back in Time

Nearly all galaxies in space appear to move away from each other, the result of cataclysmic event dubbed the Big Bang. As a result, just as the pitch of a siren seems to lower as a fire truck passes by, light from distant, receding objects in the universe also appears to shift to longer wavelengths. This is called red shift. The farther away an object is, the faster it appears to be moving away from us and the greater its light shifts toward the red. Light takes a finite time to reach us, so when we look out at very distant objects we actually see them as they appeared when the universe was much younger. As a result of the expansion of the universe, most of the optical and ultraviolet radiation emitted from very distant stars, galaxies and quasars since the beginning of time now lies in the infrared. As a result, infrared observations will help answer how and when the first objects in the universe formed.

False Colors

If an infrared telescope sent us back pictures printed out in actual infrared inks, the results would be invisible to us. Infrared light, by definition, is outside the range of our vision. In order to create pictures that astronomers can effectively analyze, technicians often arbitrarily pick certain colors to represent data that would normally be invisible. In the parlance of image-processing scientists, these are called "false colors" because they are not the colors the eye would really see. Despite their name, false colors are a very helpful tool in making scientific discoveries.

A "true color" picture recreates what our eyes would see under natural conditions. Human eyes are generally able to distinguish three distinct bands of light: red, green and blue. All colors we perceive are simply combinations of these three colors. One way that spacecraft create a "true color" image is by taking three identical black-and-white images through red, green and blue filters in rapid succession. Each of these grayscale images can be matched up with its respective color and combined to form a color image. An infrared telescope also produces data represented as grayscale images. Three of these images may likewise be mapped to red, green and blue, and then merged to form a color image. The colors in the image accurately represent variations in the brightness of the object at whatever wavelength the telescope's detector is sensitive to. But they are dubbed "false color" since they do not show us the true colors we would see with the naked eye.

Image processors sometimes add color to a single black-and-white image to improve visibility or to better highlight certain important features. This is done by mapping a set of colors to various brightness levels in the grayscale image. In this kind of image the colors simply indicate overall intensity. Any number of different color palettes can be used to convey the same information.

Colors and Chemicals

Astronomers often determine the chemical makeup of an object in space by using an instrument based on the simple prism that separates a beam of light scrutinizing the spectrum of colors in light given off by that object. For example, the atoms in a particular object, say a star, absorb light at certain frequencies and emit light at other frequencies. This results in very finely etched lines in the color spectrum from the star, what scientists refer to as "absorption lines" and "emission lines." Each pattern of these lines serves as a distinctive fingerprint of the particular chemicals that make up the star. This technique of analyzing the light from stars is called spectroscopy. If the star or other object lies in the far reaches of the universe where it speeds away from us quickly, the red shift causes its spectral lines to move into the infrared. In fact, scientific detective work to determine exactly how far a given line has shifted into the infrared is one way to gauge how quickly an object races away from us. From this information astronomers can estimate the object's age and distance.

Infrared Missions -- Past and Future

Space-based Missions

Infrared Astronomical Satellite (NASA/Netherlands/United Kingdom): Launched Jan. 25, 1983, this mission conducted the first all-sky survey from space at infrared wavelengths. The satellite circled Earth in a 900-kilometer (559-mile) polar orbit and operated for 10 months before exhausting all of its liquid helium coolant. It mapped 96 percent of the sky in four broad wavelength bands, centered at 12, 25, 60 and 100 microns. The mission detected about 350,000 infrared sources, and its data essentially built the framework for all subsequent infrared observatories. The satellite's most significant discoveries included ultraluminous infrared galaxies, whorls of dust around the star Vega and other stars, six new comets and wisps of warm dusty material called infrared cirrus that pervades our galaxy.

Cosmic Background Explorer (NASA): Launched Nov. 18, 1989, this mission studied both infrared and microwave radiation emitted by remnants of the Big Bang, the cataclysmic event believed to mark the beginning of the physical universe. The mission discovered a diffuse background infrared radiation that is thought to be a remnant of the Big Bang. In addition, it mapped the brightness of the sky at several infrared wavelengths. Using Cosmic Background Explorer data, scientists discovered that cosmic microwave background radiation is not entirely smooth, but instead shows tiny variations in temperature - the seeds that may have led to the formation of galaxies.

Infrared Space Observatory (European Space Agency, with participation of Japan and NASA): The mission, launched Nov. 17, 1995, observed at wavelengths between 2.5 and 240 microns, covering a much wider wavelength range with greater sensitivity and higher resolution than any previous mission. It operated for 2-1/2 years until its liquid helium coolant ran out in May 1998. Its cameras and spectrographs made many detailed observations of objects ranging from nearby comets to distant galaxies. One of the mission's most important observations was the diffuse infrared glow, first discovered by the Cosmic Background Explorer, thought to be the result of a population of distant, ancient galaxies.

Hubble Space Telescope Near Infrared Camera and Multi-Object Spectrometer (NASA): The Near Infrared Camera and Multi-Object Spectrometer is an instrument installed on NASA's Hubble Space Telescope, allowing it to observe using near-infrared light in wavelengths between 0.8 and 2.5 microns (visible light lies between 0.3 and 0.7 microns). The instrument is capable of both imaging and spectroscopy, or analyzing light for signs of chemical elements in the near infrared. It has had success in imaging and studying the close environments and some circumstellar debris discs around nearby stars. The University of Arizona, Tucson operates and manages the instrument for NASA.

James Webb Space Telescope (NASA): With a planned launch in 2011, this telescope will study objects in both infrared and visible light with extremely high sensitivity and resolution. It will use mid- and near-infrared detectors to provide the best views yet of the sky within this range of wavelengths. The mission is planned to study the early universe and the formation of galaxies, stars and planets. It will also follow up on some of the many anticipated discoveries by the Space Infrared Telescope Facility.

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NASA Airborne Missions

Kuiper Airborne Observatory: From 1971 to 1995, NASA's Kuiper Airborne Observatory was the world's only airborne telescope devoted exclusively to astronomical research. It observed in the infrared range at wavelengths between 1 and 500 microns. A converted C-141 military cargo plane carried the 91-centimeter-diameter (36-inch) telescope to an altitude of 13.7 kilometers (45,000 feet), thereby greatly reducing the infrared interference from moisture in Earth's atmosphere. Among the observatory's most notable discoveries were the first sighting of rings around Uranus and an atmosphere around Pluto.

Stratospheric Observatory for Infrared Astronomy: The Stratospheric Observatory for Infrared Astronomy incorporates an infrared-sensitive telescope onboard a modified Boeing 747-SP aircraft. The observatory is scheduled to fly in 2004. Astronomers hope to use the airborne telescope to study star birth and death, nebulae and black holes. The project is managed by NASA's Ames Research Center, Moffett Field, CA.

NASA Ground-based Projects

Two-Micron Sky Survey (California Institute of Technology): The first infrared survey of the sky from the ground was made at Mount Wilson Observatory in Southern California in the 1960s. It was led by Drs. Robert Leighton and Gerry Neugebauer of the California Institute of Technology in Pasadena. The survey, conducted at a wavelength of 2.2 microns, covered about 75 percent of the sky and produced a catalogue of 5,000 celestial objects.

Two Micron All-Sky Survey (NASA/University of Massachusetts/California Institute of Technology): Using two infrared telescopes, one at Mount Hopkins, Ariz., and the other at Cerro Tololo, Chile, this mission conducted the most thorough high-resolution digital survey of the entire sky, observing nearly 500 million objects. The Arizona telescope began observations in June 1997, while the Chilean telescope began in March 1998. The survey concluded in February 2001, and the data analysis of the full survey is just beginning. The project's major contributions were the detection of hundreds of brown dwarfs, mapping of the Milky Way's structure and dust distribution, charting of the large-scale structure of the nearby universe, observations of galaxies hidden behind the disc of the Milky Way, and discoveries of numerous dust-obscured galaxies and quasars in the distant universe.

Infrared Telescope Facility: NASA's Infrared Telescope Facility is a ground-based, 9.8-foot-wide (3-meter) telescope, designed to be sensitive to infrared wavelengths. The telescope is located at the summit of Mauna Kea in Hawaii, and is managed for NASA by the University of Hawaii Institute for Astronomy, located in Honolulu. The telescope was established in 1979 to provide infrared support of NASA missions such as the Voyager spacecraft to the outer planets, and 50 percent of its observing time remains reserved for study of solar system objects, mainly planets and their moons.

Near Versus Far Infrared

Infrared radiation spans a vastly wider range of wavelengths than visible light. This large stretch means that quite different astronomical objects dominate distinct regions within the infrared spectrum. In the near infrared region, cooler stars such as red dwarfs and red giants glow brightly. Astronomers are exploiting this fact in attempts to map the true distribution of stars in galaxies, a task that is nearly impossible in visible light because the brighter blue stars in a galaxy's spiral arms often drown out the older, dimmer stars in the main plane of the galaxy.

Interstellar dust becomes transparent in the near- and mid-infrared, allowing for a glimpse inside star-forming regions and a probe into the hearts of galaxies.

Moving farther out into the infrared range reveals cooler objects such as comets, asteroids and objects in the far outer solar system, all of which usually escape detection in visible light. In the far infrared, stars all but vanish, and the cold dust - often only a few tens of degrees above absolute zero - that usually goes unseen between these bright beacons takes on an eerie glow.

The Chemistry of Life

Virtually all molecules - from simple chemicals to complex biomolecules - have emission and absorption lines in the infrared spectrum. Around nearby stars, infrared studies will allow us to compare the inner and outer regions of young planetary discs, and to scan for sites where planets may be forming. Infrared spectral lines will help us identify and map the distribution of organic chemicals such as methane in young planetary systems, as well as life-sustaining water. Comparing these fledgling planetary systems with our solar system will help us understand how the chemical composition of these planet-forming discs may set the stage for life.

Key Science Goals

In the planning stages of the Space Infrared Telescope Facility, researchers identified several key science goals to help shape the design of the telescope and its instruments. For each of these astronomical objectives, the mission has capabilities beyond those of visible-light telescopes to answer fundamental questions and provide deeper understanding of the cosmos.

-- **Brown Dwarfs:** Mysterious objects often characterized as "failed stars," brown dwarfs form in the same birth process as stars but never achieve the mass needed to ignite sustained nuclear fusion reactions in their core, and thus never "turn on" and shine like a true star. The exact mass range for brown dwarfs is still somewhat ill-defined, but most are thought to range between twice the mass of Jupiter to 1/10th the mass of our Sun. (The Sun is about 1,000 times more massive than Jupiter.) Brown dwarfs were only a theoretical concept until they were discovered in 1995, and

Science Working Group

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Giovanni Fazio	Principal Investigator, Infrared Array Camera; Harvard Smithsonian Center for Astrophysics
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Bob Gehrz	Community Coordinator and Facility Scientist for Optics; University of Minnesota
Jim Houck	Principal Investigator, Infrared Spectrograph; Cornell University
Michael Jura	Interdisciplinary Scientist; University of California, Los Angeles
Charles Lawrence	Deputy Project Scientist; NASA Jet Propulsion Laboratory
Frank Low	Facility Scientist; University of Arizona
George Rieke	Principal Investigator, Multiband Imaging Photometer; University of Arizona
Marcia Rieke	Outreach Coordinator; University of Arizona
Tom Roellig	Facility Scientist; NASA Ames Research Center
Tom Soifer	Space Infrared Telescope Facility Science Center Director [ex-officio]; California Institute of Technology
Michael Werner	Project Scientist; NASA Jet Propulsion Laboratory
Ned Wright	Interdisciplinary Scientist; University of California, Los Angeles

astronomers now think there may be as many brown dwarfs as there are stars. The Space Infrared Telescope Facility will add significantly to our understanding of these curious objects, from their number and distribution to their temperatures, sizes and chemical composition.

-- Circumstellar Discs: A substantial amount of the mission's observing time will be spent examining circumstellar discs of material surrounding young stars. Astronomers now think these discs are common when stars and then planets form, and have divided them into two main types: protoplanetary discs and planetary debris discs.

Protoplanetary discs are composed of gas and dust, thought to provide the raw materi-

als for future planets. By contrast, planetary debris discs would form at a later stage of evolution, when most of the gas has dissipated. These later-stage discs are composed mostly of small dust grains presumably formed from collisions between small meteor-sized rocks and/or larger asteroids. By observing circumstellar discs of various ages, the mission will trace how they evolve into a mature system of planets.

Attempting to see faint circumstellar discs at visible wavelengths is extremely difficult because of the glare from parent stars. However, this relative difference in brightness is reduced in the infrared. The mission will study hundreds of nearby stars to determine the prevalence of such discs. It will also use images and spectral studies to understand the structure and composition of these discs. This information will be invaluable in deciphering the number and nature of planetary systems beyond our solar system. This will help advance the ultimate search for Earthlike planets, some of which may harbor life.

-- Star Birth and Death: Giant clouds of molecules, composed mostly of hydrogen gas, provide the basic building blocks for stars. These clouds, scattered throughout the spaces between stars in our Milky Way Galaxy, contain enough dense gas and dust to form hundreds of thousands of Sun-like stars. The Space Infrared Telescope Facility will study the temperature and density of these molecular clouds in order to understand the physical conditions and chemical compositions from which emerging stars form.

Stars are born within cocoons of dust and dense molecular gas, a process mostly hidden from view at visible wavelengths. Near-infrared light, at wavelengths of a few microns, pierce this dusty veil to provide astronomers with a peek at newborn stars. The observatory's short-wavelength camera will probe the formation and early evolution of young stars in the first million years of life. The mission's observations will also reveal the extent to which new stars are formed in clusters rather than in isolation.

In addition, this mission will study old stars. Once it has exhausted most of its thermonuclear fuel over billions of years, a star like our Sun enters a rapidly changing stage of life, when its behavior and ultimate fate depend on its birth mass. During the late stages of its life, a star typically ejects gaseous material from its outer layers, either through a gentle, gradual process known as a "nova," or through a violent cataclysmic explosion known as a "supernova."

The observatory will study this material ejected by stars that have depleted virtually all their hydrogen and can no longer support themselves with nuclear fusion. It will also provide information about the temperature and chemical composition of the ejected material, and how quickly its parent star loses mass. The gas and dust thrown off by dying stars is an important constituent of the interstellar medium, and a thorough analysis of this material is essential for understanding not only how stars die, but also how they nurture the next generation of stars.

-- Active Galaxies: Many galaxies emit more radiation at infrared wavelengths than in

all other regions of the electromagnetic spectrum combined. The most dramatic of these ultra-luminous infrared galaxies are a hundred to a thousand times brighter in the infrared than our own Milky Way Galaxy. Studies at both infrared and optical wavelengths reveal that most of these objects are in fact pairs of galaxies colliding or merging. Understanding the nature of these interacting galaxies and how stars form within them is one of the most compelling problems in astrophysics.

Astronomers believe that many of these bright galaxies are powered by central black holes, while others produce "starbursts" spawned by colliding galaxies. The Space Infrared Telescope Facility will study the properties and evolution of ultra-luminous infrared galaxies out to great distances. By studying the spectra of the infrared light emitted from them, astronomers will better understand physical conditions in the optically obscured interiors of these galaxies, providing insight into the ultimate power source for these bright beacons.

-- The Early Universe: Because light from the most distant objects in space is shifted toward the red end of the spectrum, and because faraway objects are so distant in time, infrared telescopes provide an excellent window into the early universe. Astronomers will exploit this capability to observe dusty galaxies being born in the infant universe. By examining properties of galaxies at different red shifts, or cosmological ages, scientists will trace the history of star formation as a function of galactic environment, and try to explain why the rate of star formation across the entire known universe was much higher about 7 billion years ago than it is now. These observations will also help astronomers understand the distribution of galaxies in space and why they often appear in clusters.

Some of the most important discoveries about the early universe may come from observations of the cosmic infrared background. This faint infrared glow in the distant, early universe is thought to result from a collection of countless unseen galaxies, too faint or close together to be detected individually by previous missions. By studying the intensity of the background at different wavelengths, astronomers can interpret the history of star formation, the history of galaxy formation and the presence or absence of dust in the earliest primeval galaxies. The Space Infrared Telescope Facility should be able to characterize the sources of this radiation.

-- Enduring Mysteries of the Solar System: Earth's own neighborhood, the solar system, still holds many secrets. Asteroids, comets, interplanetary dust and some of the member planets and their moons have defied full understanding when studied in visible light. But snooping in the infrared will allow scientists to examine some of the elusive properties of such features and help explain how our solar system developed and continues to evolve over time. These observations may then help astronomers more effectively scout out other solar systems in the nearby universe.

The Importance of Serendipity

The technical capabilities of the Space Infrared Telescope Facility will almost certainly lead to discoveries that no one can predict before the start of the mission. In some respects the mission will be hundreds, if not thousands of times more sensitive than past infrared missions. Compound that with the fact that the universe has not been studied extensively at many of these target wavelengths, and we have a recipe for serendipity. Much of the observing schedule has been left flexible, open to the astronomical community to delve into unanticipated territories. There will also be room for follow-up observations on unexpected findings as they are made. As history has taught, astronomers can always expect the unexpected.

Mission Overview

The Space Infrared Telescope Facility, part of NASA's Origins Program, will help astronomers study the early universe, distant galaxies, and newly forming stars and planets. It is also the fourth and final mission of NASA's Great Observatories, a series that has included the Hubble Space Telescope, the Chandra X-Ray Observatory and the Compton Gamma Ray Observatory.

The observatory consists of an 85-centimeter-diameter (33.5-inch) telescope and three cryogenically cooled science instruments. The science instruments will perform imaging and spectroscopy - breaking light into different colors, like a prism, so the chemical composition of an object can be determined. Observations will be conducted in the infrared to detect objects and processes in the universe that are either too cool or too dust-enshrouded to be seen otherwise. The observatory will launch into an orbit that trails Earth as it goes around the Sun. This unique orbit places the observatory in deep space, far from the heat generated by Earth itself.

The spacecraft will communicate with tracking stations of NASA's Deep Space Network once every 12 hours. At those times, it can receive commands from ground controllers and also send science data to Earth. Once a week, a new sequence of commands will be uplinked, telling the observatory what scientific targets to observe and when. The spacecraft will store these commands and then point the telescope and its instruments toward a given target at the appropriate time. Once it makes these observations, the spacecraft will transmit the data to the ground for processing and analysis by scientists, after which this information will be shared with the general public.

Launch Site and Vehicle

The spacecraft will be launched from Cape Canaveral, Fla., on a Delta II rocket.

Overall, the rocket is 39.6 meters (130 feet) long, 2.9 meters (9.5 feet) in diameter and weighs 282,003 kilograms (621,700 pounds). It has nine strap-on solid rocket motors. The Delta's first stage burns kerosene and liquid oxygen propellant, and produces 890,000 newtons (200,000 lbs.) of thrust. The second stage burns hydrazine and nitrogen tetroxide propellant, producing a thrust of 43,400 newtons (9,750 pounds).

Launch Period

The primary launch period opens August 23 and closes September 17, 2003. If launch

does not take place then, there is a contingency period September 18-30, 2003.

Launches in the beginning of the period (August 23-26) lift off with an azimuth of 105 degrees (which is to say, in approximately an east-south-easterly direction). After that date, all launches during both the primary and contingency periods lift off with an azimuth of 107 degrees (slightly more southerly).

Daily Launch Time

There is one instantaneous launch opportunity each day during the launch period. On August 25, the launch time is at 1:35:39 a.m. EDT (10:35:39 p.m. PDT August 24). From August 24-26, the launch time slips earlier by approximately a minute a day. On August 27, the launch time is at 2:03:09 a.m. EDT (11:03:09 p.m. PDT August 26). For the remainder of the launch period, the launch time slips earlier by 20 seconds per day.

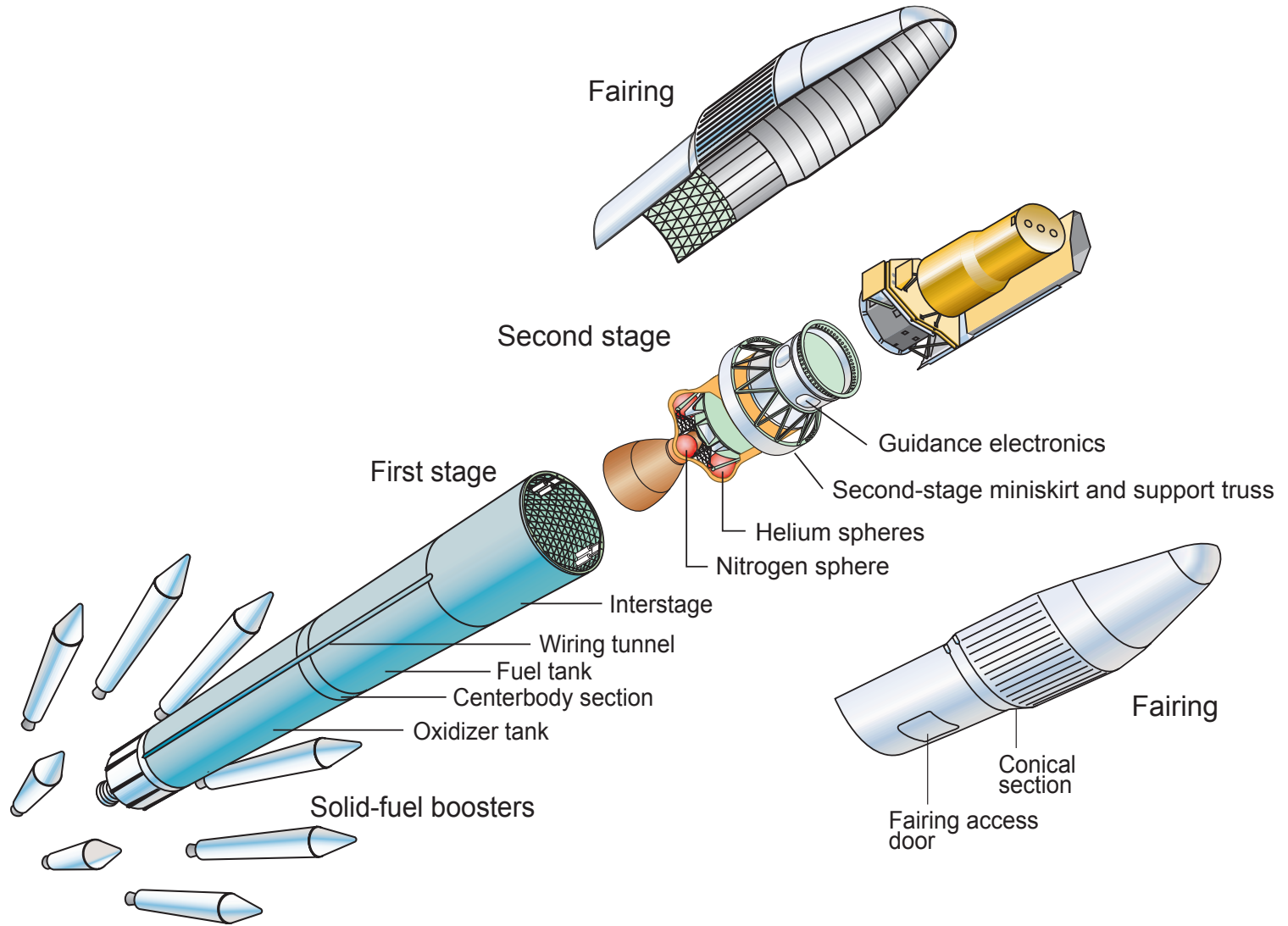
Launch and Acquisition Phase

The Space Infrared Telescope Facility will lift off from Space Launch Complex 17B at Cape Canaveral Air Force Station, Florida.

At the moment of launch, six solid rocket boosters and the liquid-fueled main engine will ignite. At 76.5 seconds after liftoff, those six solid rocket boosters will burn out, and will be jettisoned about four seconds later. At 79 seconds after launch, three additional solid rocket boosters will ignite and burn until 2 minutes, 36 seconds after launch, and then will be jettisoned four seconds later.

The Delta's main engine will conclude firing at 4 minutes, 23.5 seconds after liftoff. Eight seconds later, the first and second stages will separate. Four minutes and 37 seconds after launch, the second stage will begin burning. Four minutes and 41.5 seconds after liftoff, the nose cone, or "fairing," will be jettisoned, triggering a signal to the observatory to open vent valves on the cryostat helium tank. This action will release helium vapor that has built up in the tank and allow the helium coolant to remain at a low temperature of minus 271 C (minus 457 F).

The Delta's second stage engine will cut off for the first time at first second-stage engine cutoff will occur at 7 minutes, 16.5 seconds after launch. After coasting, the second stage will restart at launch plus 38 minutes, 35 seconds, and will burn for 275 seconds. At this point, the observatory and the second stage will have escaped Earth's gravity and will be in the proper Earth-trailing orbit. Five minutes later, the observatory will separate from the second stage. The second stage will perform a maneuver to move away from the observatory to avoid future contact and possible contamination. After separation from the second stage, the observatory will orient itself so the Sun shines on the solar panel assembly for generating power.



Delta II rocket

The spacecraft will launch eastward over the Atlantic Ocean, pass over South Africa, and then continue onto the coast of western Australia, where Canberra, Australia will be the first NASA Deep Space Network station to communicate with the observatory. Then, because of Earth's rotation beneath it, the observatory will appear to "move up and backwards" toward the coast of Japan and China, and eventually fly over the other two Deep Space Network stations in Madrid, Spain, and Goldstone, California.

By the end of the second day after launch, the observatory will pass the orbit of the Moon. Once in orbit, the observatory will travel more slowly than Earth, and will start to lag behind. Each year of the mission, the observatory will move farther and farther behind Earth at a rate of one-tenth of an astronomical unit, or one-tenth of the average distance of Earth from the Sun (150 million kilometers, or 93 million miles).

Low-gain antennas will be used for communications during at least the first 24 days of operations because the angle between the observatory, Earth and the Sun will not allow use of a dish-shaped high-gain antenna. The telescope must be shielded from the Sun, and because the high-gain antenna is fixed to the telescope, it cannot be initially pointed toward Earth without drastically reducing the amount of power-generating sunlight hitting the solar panels.

Initially, the low-gain antennas will send information to the ground at the rate of 88 kilobits per second. That rate will decrease to 44 kilobits per second by about 28 days after launch. Commands will be uplinked to the antenna at 2,000 bits per second.

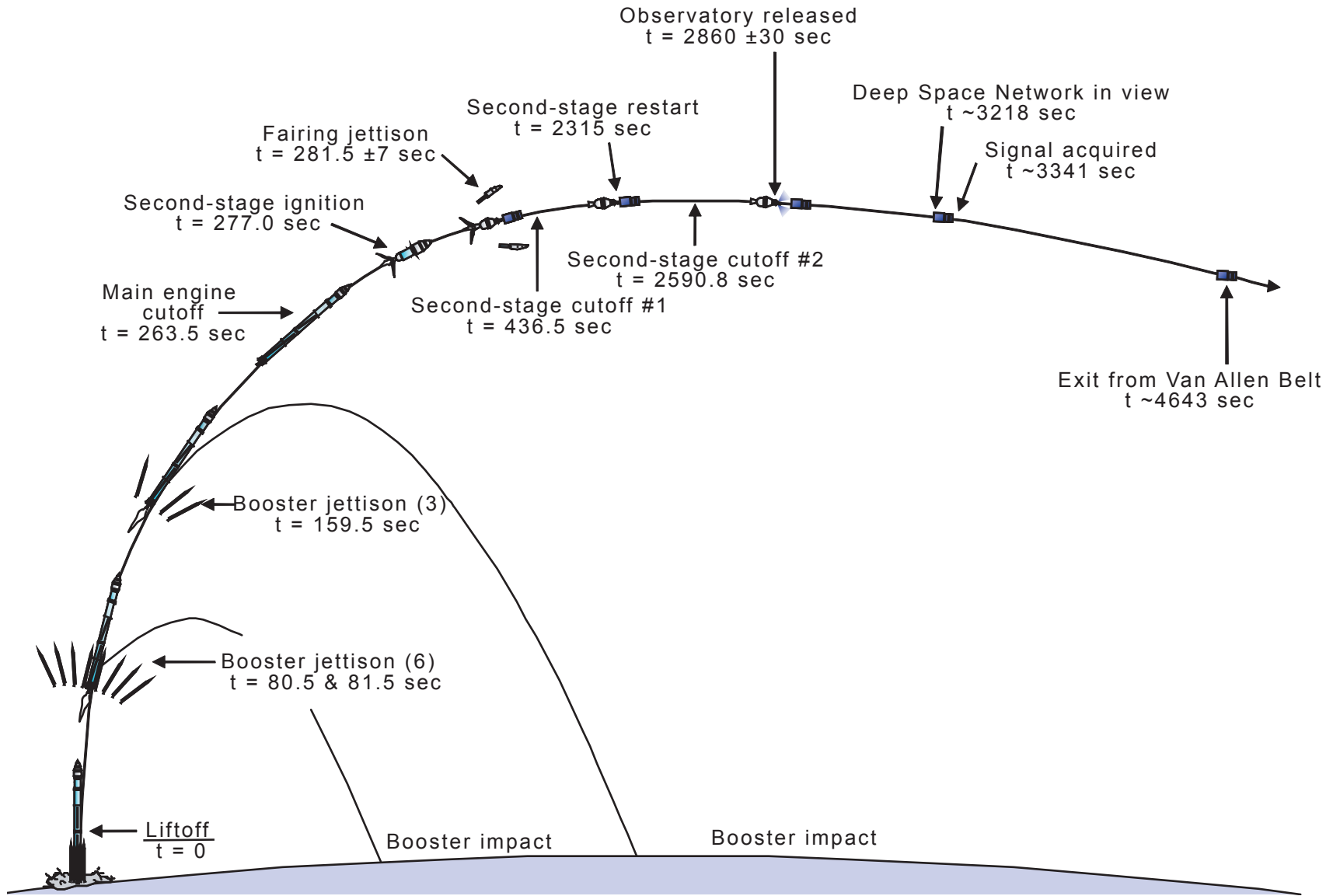
A high-gain antenna will then take over the uplink and downlink duties about 24 days after launch, transmitting data at 2.2 megabits per second.

Television Coverage

The Delta rocket will carry two video cameras. From the time of launch to the first cutoff of the second-stage engine at about launch plus 7 minutes, 16.5 seconds, a rear-facing camera will provide dramatic scenes of the receding Earth, the solid-fuel boosters being jettisoned and the reignition of the second-stage engine. From the time of the first cutoff of the second-stage engine until it is restarted at about cutoff to second stage restart at about 39 minutes, 35 seconds, there will be no video coverage. After the second-stage engine restarts, a forward-facing camera will provide coverage through the final cutoff of the second-stage engine and the deployment of the infrared observatory.

In-Orbit Checkout and Calibration

In-orbit checkout will begin 5 hours, 42 minutes after launch and will end 60 days after launch, when the observatory is expected to be fully operational. During this period, ground controllers will verify that the spacecraft machinery, the telescope and the science instruments all function correctly and that the observatory as a whole is operational.



Launch phases

About halfway through this phase, the telescope will reach its final operating temperature.

Science Verification

After in-orbit checkout, a 30-day science verification phase will confirm that the science instruments can be commanded and operated efficiently, and that returned data can be analyzed promptly and accurately. The instruments will be tested in all observing modes and will collect data to be processed on the ground. In a sense, it will be a dry run for the science mission and provides an opportunity to work out any kinks in the gathering and processing of data. Also during this phase, the Space Infrared Telescope Facility will complete its early release observations - its first "pretty pictures" from space.

Science Mission

The science mission will begin approximately three months after launch, after the in-orbit checkout and science verification phase are completed. The mission is expected to last a minimum of 2-1/2 years, and may go as long as five years.

Mission Operations

Mission operations will be conducted from NASA's Jet Propulsion Laboratory in Pasadena, California. Spacecraft communications will be conducted through NASA's Deep Space Network.

Science Data Processing and Archiving

The Space Infrared Telescope Facility Science Center at the California Institute of Technology (Caltech), Pasadena, Calif., will process and archive all science data pertaining to the mission. In addition, the science center is responsible for evaluating proposals submitted by researchers, and selecting most of the investigations to be carried out using the observatory. The center evaluates observatory performance - such as photometry (getting a measurement of the brightness or the flux of a source rather than an image) and pointing - during in-orbit checkout and throughout the mission. It also provides scientific support in response to unexpected issues that may arise while the observatory is in orbit. The science center processes and calibrates completed observations within hours of downlink at a rate of 1 gigabyte per day. . Soon after collection, the mission's data will be archived at the center, where it will then be studied and verified by a team of observers and made available to the public.

Spacecraft

Like all spacecraft, the design of the Space Infrared Telescope Facility is a delicate balance of form and function. The form is the spacecraft's dimensions and weight, dictated by the size and power of the launch vehicle, or rocket, lifting it into space. The function is the infrared-observing capabilities of the scientific cargo onboard the spacecraft.

The spacecraft is unique in that it is smaller and lighter than past missions involving cryogenically cooled telescopes. In past missions, a vacuum shell surrounded the telescope like a thermos bottle, actively chilling the observatory and science instruments. On the Space Infrared Telescope Facility, the vacuum shell surrounds only the instrument chamber and the liquid helium tank. Engineers refer to this configuration as a "warm launch architecture." It means that much less coolant is needed, allowing for the use of a relatively smaller launch vehicle. In addition, it will permit the spacecraft to collect science data for up to five years, twice the length of the longest previous infrared mission.

A new name for the Space Infrared Telescope Facility is expected to be announced about four months after launch, when the first images and science results will be released. The new name was selected after a worldwide contest with more than 7,000 entries.

Overview

The Space Infrared Telescope Facility is only one-third as long and one-eleventh the weight of its bigger sibling, the Hubble Space Telescope. But by incorporating the latest technological innovations into the new spacecraft's design, the mission architects have packed a remarkable amount of science capability into a relatively small package. Within the four-meter-tall (14.6-foot), 865-kilogram (1,907-pound) observatory is enclosed a cryogenically cooled telescope and three science instruments - a multiband imaging photometer, an infrared spectrometer and an infrared-detector array camera - as well as all the power, computer, communications and navigation equipment required to make the mission a success.

The observatory is composed of three main sections. The tube-shaped cryogenic telescope assembly includes the telescope and scientific instruments, enclosed within a protective outer shell. At the rear of the telescope is an eight-sided spacecraft structure that houses all the computers, electronics, antennas and thrusters needed to keep the observatory operating and oriented correctly in space. The spacecraft's third main section is the solar panel array, which serves as the observatory's power plant and

does double duty as a heat shield to shade the rest of the spacecraft.

Thermal Protection

The ultra-sensitive instruments onboard require special shielding to protect them from the environmental hazards of deep space. Because thermal protection is very important for the mission, the telescope is cooled using extremely cold liquid helium. Over the course of the mission, this ultra-cold helium will slowly leak out into space. After five years, all of the helium will be lost. The cooler that engineers can keep the telescope with strategies other than the liquid helium, the slower the coolant will be consumed and the longer the mission can last.

The outer shell that encloses the telescope serves as both a dust cover and a heat shield. Shaped like a cylinder, the entire outer shell is composed of aluminum - a quarter inch layer in a honeycomb pattern is sandwiched between two sheets. The side of the outer shell that faces the Sun has a shiny silver coating to reflect away heat from the solar panels. The side facing away from the Sun has a black coating designed to radiate any residual heat from the solar panel and spacecraft. In engineering parlance, the outer shell provides "passive" thermal protection for the spacecraft.

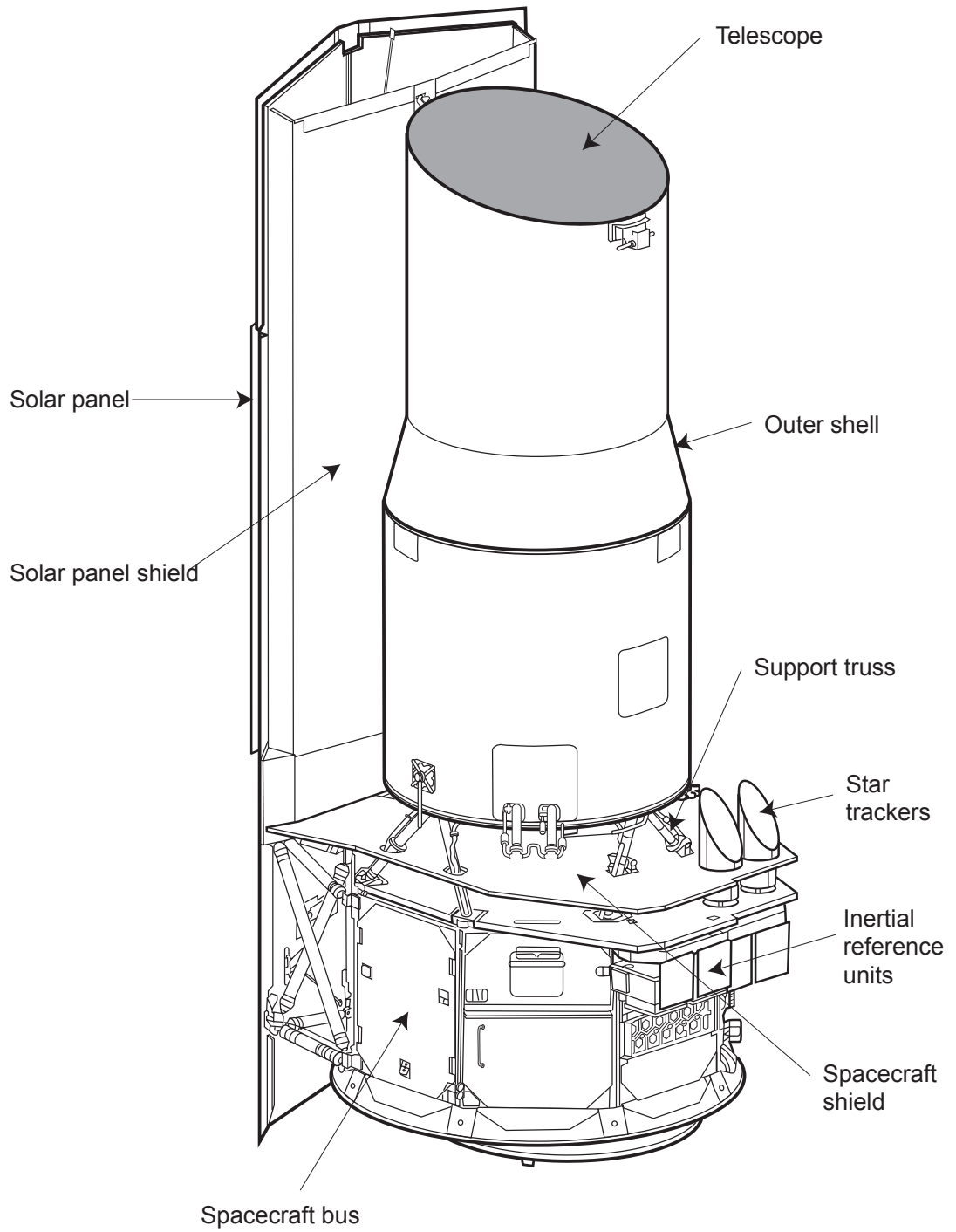
The observatory is also protected by an "active" thermal control system that consists of heat pipes, thermally conductive adhesives, heaters and temperature sensors. Propane and ammonia flowing through pipes embedded in the spacecraft's exterior panels conduct heat away from the observatory. Various parts of the spacecraft that need to be heated in order to operate are equipped with controlled heaters but insulated to avoid heating the telescope. The spacecraft's solar panels are made out of special material to minimize heat flow to the telescope. The finishes on the solar panels themselves also help regulate panel temperature.

Command and Data Handling

The command and data handling system is the spacecraft's brain. It can operate the observatory either with commands stored in computer memory or via "real-time" commands radioed from Earth for immediate execution. In addition, it handles engineering and science data destined to be sent to Earth. The system's design is based on technology from NASA's Mars Surveyor and Stardust projects. At its heart is a RAD6000 processor, a radiation-hardened version of the PowerPC chip used on some models of Macintosh computers. A duplicate backup system is available to take over spacecraft control if needed.

Electrical Power

The solar panel array provides the electrical power needed to operate the observatory for five years. The array consists of two solar panels, each with 392 solar cells. Each



Observatory exterior

solar cell is 5.5 by 6.5 centimeters (2.2 by 2.6 inches). Together the cells can convert radiation from the Sun into a total of 427 watts of electrical power at the beginning of the mission and 386 watts towards the end. Unlike most spacecraft solar arrays that are deployed shortly after launch, this mission's solar array is fixed. To ensure that sunlight will hit the solar panels properly, the telescope cannot be pointed at targets more than 120 degrees away from the Sun.

The solar array also shades the telescope from direct exposure to the Sun. Half of the solar array's surface area is covered with solar cells. The other half is covered with flexible optical solar reflectors that reduce the overall solar panel temperature to about 57 C (134 F).

Attitude Determination and Control

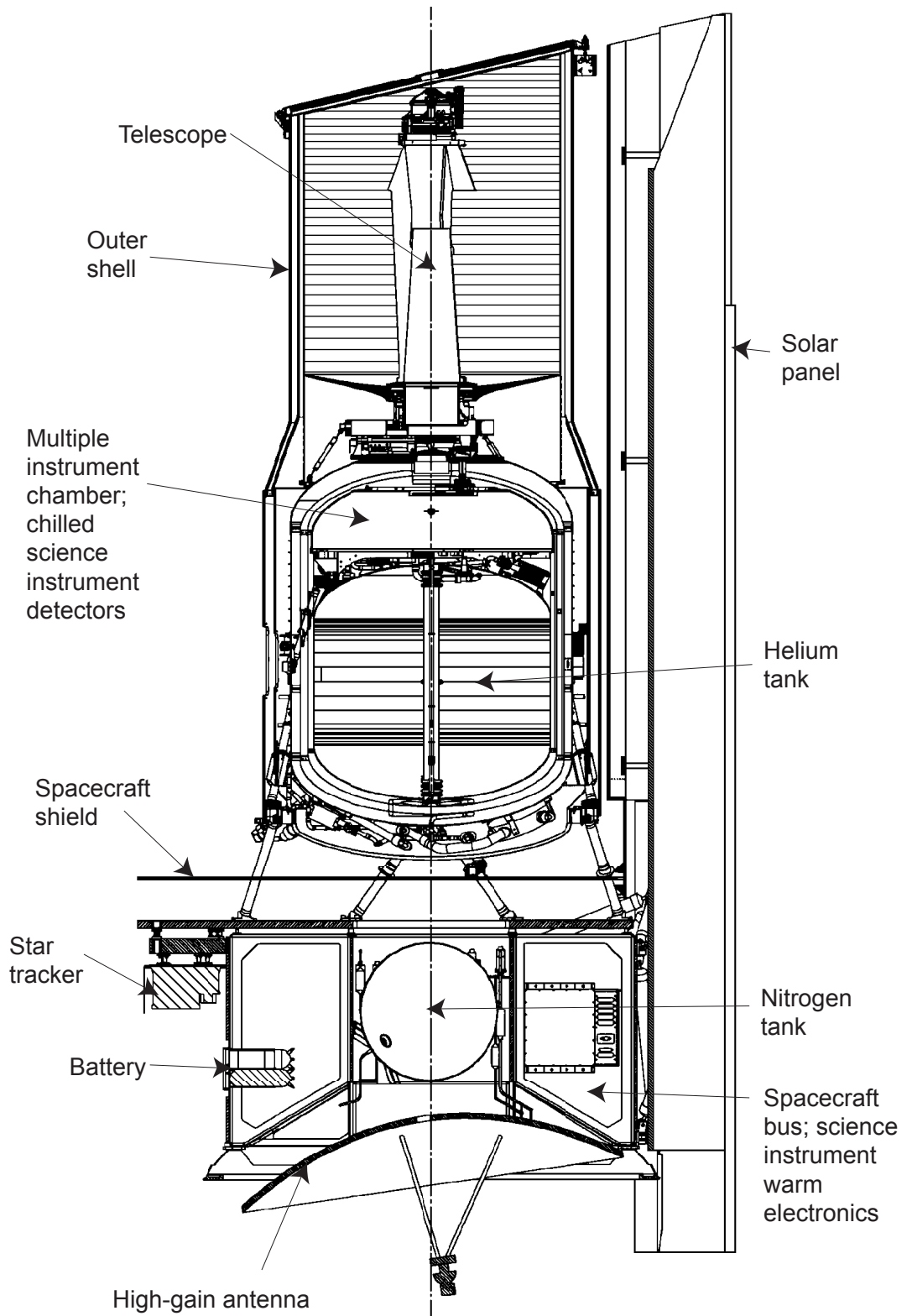
The Space Infrared Telescope Facility uses a pointing control system to orient and maneuver in deep space (or, in engineering language, to determine and control the spacecraft's "attitude"). It can also execute small maneuvers such as turning, or by speeding itself up or slowing itself down, to point the telescope at science targets. The system also keeps the spacecraft pointed in the correct angle from the Sun, with the high-gain antenna pointed toward Earth.

The spacecraft has four modes used to point the telescope at observing targets. In the first mode, called "inertial pointing," the observatory essentially sits and stares at the same point in space without moving. This is useful for observing faint, distant objects.

In a second mode, called "incremental pointing," the spacecraft again sits and stares at the same point in space without moving. After capturing one image, however, the spacecraft moves slightly and fixes on a new point. This process may be repeated several times, so that a given target object appears in different parts of the image frame. This helps to guarantee that at least some of the pictures will be high-quality. It is useful for images of extremely high resolution.

A third pointing scheme called the "scan map mode" is used only by one of the three science instruments, the multi-band imaging photometer. This instrument has a single moving part, a scan mirror. In this pointing mode, the observatory moves in one direction, while the photometer's scan mirror moves at the same speed, but in the opposite direction. This technique freezes a big portion of the sky for a period of time, which is useful for mapping large areas.

The fourth and final pointing mode is called the "tracking mode." It is useful for taking pictures of comets and other moving objects within our solar system. For this mode, information about the movement of solar system objects (called "ephemerides") is loaded into the observatory's onboard computer. Tracking is done autonomously without intervention by ground controllers.



Observatory cutaway

The observatory can accurately move 180 degrees in 1,000 seconds (16 minutes, 40 seconds), 1 degree in 100 seconds or 1 arc-minute in 20 seconds (an arc-minute is 1/60th of one degree). A star tracker calculates the spacecraft's position by comparing observed stars to an onboard catalog of 87,000 stars. Other onboard sensors keep the telescope aligned correctly relative to the stars, stabilize the pointing system and keep the observatory positioned safely relative to the Sun.

The spacecraft moves itself by changing the momentum of four spinning devices similar to gyroscopes called reaction wheels. In addition, the spacecraft is equipped with six primary thrusters and six backups that use gaseous nitrogen as a cold propellant. These thrusters keep the amount of momentum stored in the reaction wheels within a specified range, and are used to "unload" excess momentum as it builds up. An onboard tank stores 15.6 kilograms (about 34.4 pounds) of nitrogen propellant.

Telecommunications

The radio system onboard the observatory is designed to operate out to a distance of 96 million kilometers (about 60 million miles). The system uses a parabolic dish high-gain antenna, two receiving low-gain antennas and two transmitting low-gain antennas. The system can receive commands from Earth at speeds ranging from 7.8125 to 2,000 bits per second, and can send data to Earth at speeds from 40 to 2.2 million bits per second.

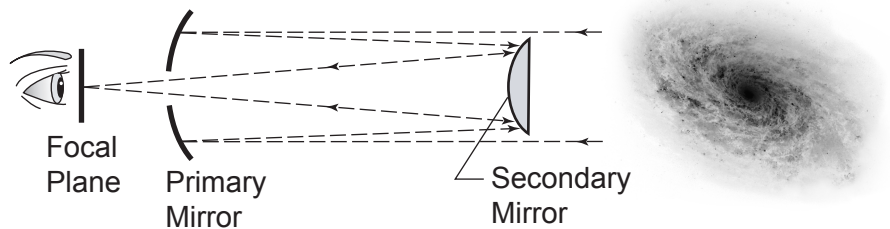
The Telescope

The heart of the Space Infrared Telescope Facility is an 85-centimeter-diameter (about 33.5-inch) telescope and three cryogenically cooled science instruments that will perform imaging and spectroscopy at wavelengths from about 3 to 180 microns. The instruments are the infrared array camera, infrared spectrograph and multiband imaging photometer.

Like the Hubble Space Telescope, this mission's telescope is of a Cassegrain design, named for the French sculptor Guillaume Cassegrain, who invented it in 1672. In this design, light from distant objects in space enters the telescope and is reflected by a primary mirror at the telescope's rear. The light is then gathered onto a smaller secondary mirror suspended in the middle of the telescope near the front end. The light in turn reflects back toward the rear of the telescope, where it passes through a hole in the middle of the primary mirror.

At the rear, behind the primary mirror, is the sensor that records the image. Three centuries ago, this "sensor" would have been the eye of the astronomer peering

into the telescope. Later, the living eye was replaced by photographic film. However, infrared radiation does not pack enough energy to leave a suitable image on a photographic plate. Instead, contemporary astronomers rely on electronic devices to detect infrared light.



Cassegrain telescope design

The mission's telescope is based on a refinement of Cassegrain layout called a Ritchey-Chrétien design. This design, developed in the 1920s, uses primary and secondary mirrors in the shape of hyperbolas in order to prevent an optical problem called a coma.

All its parts, except the mirror supports, are made of lightweight beryllium, with an aluminum coating on the primary mirrors. Beryllium is a very strong material that works well in infrared space telescopes because it has a low heat capacity at very low temperatures. As a result, the telescope weighs less than 50 kilograms (about 110 pounds) and is designed to operate at an extremely low temperature.

Although many different wavelengths of light enter the telescope, the various science

instruments are sensitive only to certain infrared wavelengths.

The telescope is attached to the top of the vapor-cooled cryostat shell. The telescope and cryostat shell are warm at launch, and are then actively chilled to an appropriate operating temperature once in orbit. Only the portions of the three science instruments that need to be chilled are contained in the multiple instrument chamber, which is mounted directly to the helium tank in the cryostat shell.

The sensors for each of the three science instruments are mounted within a structure called the cryostat, the cold-storage portion of the spacecraft that is maintained just a degree or so above absolute zero. The science instruments' electronics that don't need to be chilled are mounted elsewhere on the spacecraft structure.

The chamber that contains the science instruments is designed so that no light can get through it except for the beam reflected by the telescope's mirrors. The chamber is 84 centimeters (33 inches) in diameter by 20 centimeters (7.87 inches) high. It has an aluminum base plate and cover, and is mounted directly to the tank that contains the telescope's helium coolant.

Detectors

The detectors that the observatory uses to record its observation take advantage of infrared-sensitive materials made from alloys of exotic metallic substances, such as silicon, indium, antimony, gallium, and germanium. When infrared radiation strikes the Space Infrared Telescope Facility infrared detectors, an electrical charge is generated. This charge is directly proportional to the amount of infrared light. Since infrared detectors are extremely sensitive to heat, they must be kept chilled by a coolant system, such as liquid helium in the case of this mission.

Riding an awesome wave of research advances in light-detection technology made by industry and academia over the last decade, mission scientists now refer to the detectors as the "heart and soul" of the Space Infrared Telescope Facility.

Each of the observatory's three main science instruments is equipped with one or more "detector arrays," lattice-like arrangements of individual detectors. The arrays convert energy from infrared radiation into electrical signals, which are then converted into "bits" of digital data. To give an idea of the leaps and bounds of such technology, the Infrared Astronomical Satellite of the mid-1980s boasted an array of 62 detectors. The Space Infrared Telescope Facility will carry arrays of up to 65,536 detectors. Such light-gathering prowess coupled with state-of-the-art cryogen chilling capabilities gives this new observatory unprecedented infrared sensitivity.

Infrared Array Camera

The infrared array camera is a general-purpose camera that can take images at near- and mid-infrared wavelengths. Observers will use the camera for a wide variety of

astronomical research programs.

The camera has four channels that provide simultaneous images at wavelengths of 3.6, 4.5, 5.8 and 8 microns. Each of these images is a square 5.12 by 5.12 arc-minutes. (An arc-minute, 1/60th of a degree, is the width of a quarter held at a distance of 100 yards. For comparison purposes, the Moon as seen from Earth has a diameter of 30 arc-minutes, or one-half degree.)

The camera uses two sets of detector arrays -- two for short wavelengths, and two for longer wavelengths. The two short-wavelength channels have composite detectors made from indium and antimony. The long-wavelength channels use silicon detectors specially treated with arsenic. Each detector array captures an image 256 by 256 pixels in size.

The principal investigator is Dr. Giovanni Fazio, Harvard Smithsonian Center for Astrophysics, Cambridge, Mass.

Infrared Spectrograph

The infrared spectrograph provides both high- and low-resolution spectroscopy at mid-infrared wavelengths. Spectrometers, or spectrographs, are instruments that break light into its constituent wavelengths, creating spectra that can be studied to identify the chemicals that make up the object giving off the light.

The instrument has no moving parts. It has four different modules that make observations in different wavelength ranges: a low-resolution, short-wavelength mode covering wavelengths from 5.3 to 14 microns; a high-resolution, short-wavelength mode covering 10 to 19.5 microns; a low-resolution, long-wavelength mode covering 14 to 40 microns; and a high-resolution, long-wavelength mode covering 19 to 37 microns. Each module has its own entrance slit to let in infrared light. Each detector captures an image 128 by 128 pixels. The shorter-wavelength silicon detectors are treated with arsenic; the longer-wavelength silicon detectors are treated with antimony.

The principal investigator is Dr. Jim Houck, Cornell University, Ithaca, N.Y.

Multiband Imaging Photometer

The multiband imaging photometer will provide imaging and limited spectroscopic data at far-infrared wavelengths.

The photometer has three detector arrays. One array creates 128- by 128-pixel images at a wavelength of 24 microns and is composed of silicon, specially treated with arsenic. Another array creates images 32 by 32 pixels at wavelengths from 50 to 100 microns, while another is 2 by 20 pixels and operates at 160 microns. Both of these latter arrays use germanium treated with gallium.

The instrument's field of view varies from about 5.3 by 5.3 arc-minutes at the shortest wavelength to about 0.8 by 5.3 arc-minutes at the longest wavelength. The only moving part in the photometer is a scan mirror, used to efficiently map large areas of the sky.

The principal investigator is Dr. George Rieke, University of Arizona, Tuscon.

Cryostat

The observatory's cryostat will keep the science instruments at temperatures as low as 1.4 C (about 2.5 F) above absolute zero. The cryostat functions by venting helium vapor from a liquid helium tank. This tank holds about 360 liters (about 95 gallons) of liquid helium at launch.

In order to protect the science instruments, the cryostat shell that encloses them must be sealed during ground operations and launch. After the spacecraft cools down following launch, a door on the top of the shell is opened to allow light from the telescope's optics that pass into the chamber that contains the science instruments.

Program/Project Management

NASA's Jet Propulsion Laboratory, Pasadena, Calif., is the implementing center for the Space Infrared Telescope Facility, and provides project management, flight operations, mission assurance and other support services.

At NASA Headquarters, Dr. Edward Weiler is associate administrator for space science, Dr. Anne Kinney is the director of the Astronomy and Physics Division, which includes the "Origins" program, Lia LaPiana is the Space Infrared Telescope Facility program executive, and Dr. Jay Frogel is the program scientist.

At JPL, the project manager is David Gallagher and the project scientist is Dr. Michael Werner.

8-21-03