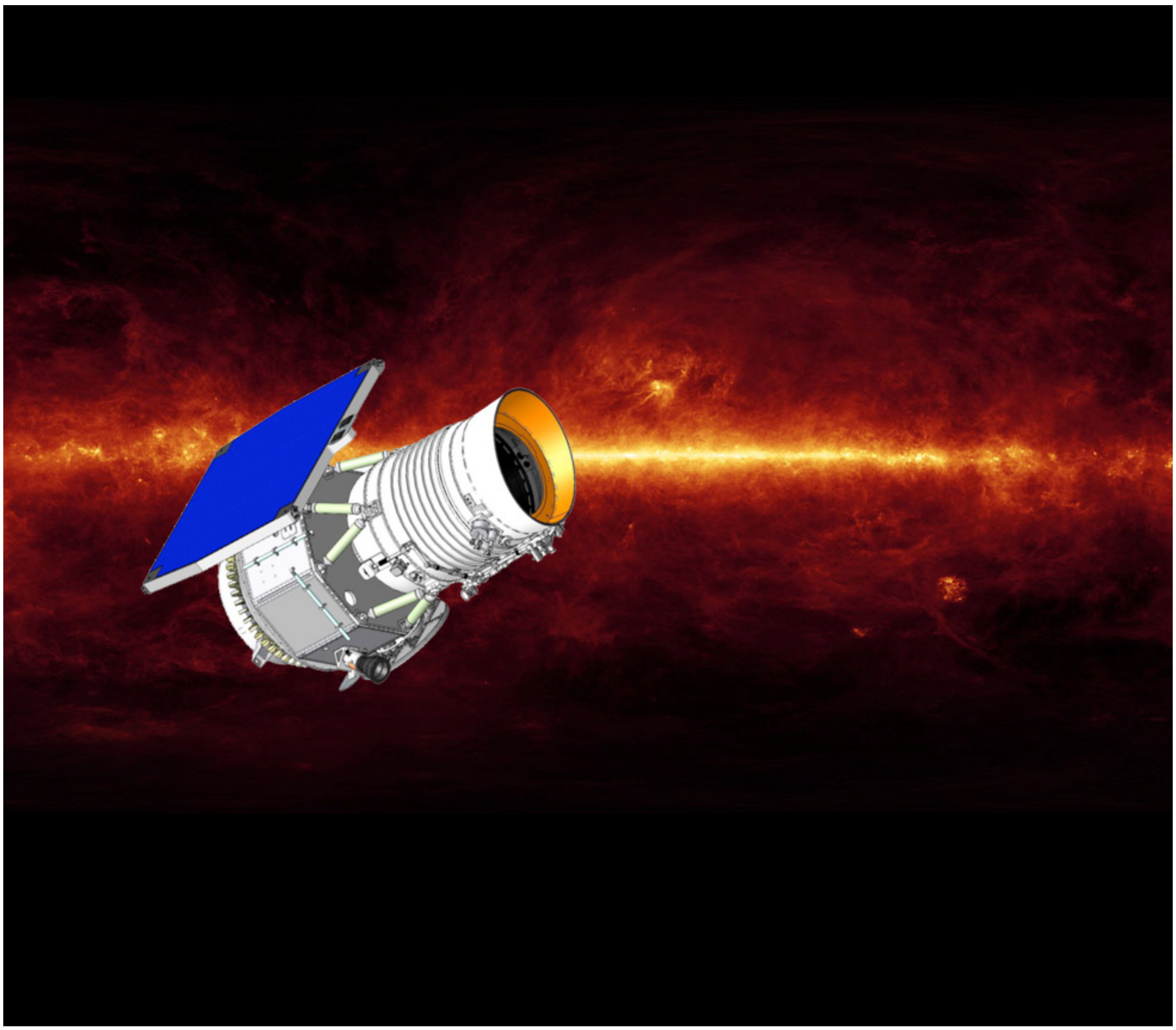
National Aeronautics and Space Administration

PRESS KIT/DECEMBER 2009

Wide-field Infrared Survey Explorer Launch



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Media Services Information

NASA Television

In the continental United States, NASA Television's Public, Education and Media channels are carried by MPEG-2 digital C-band signal on AMC-6, at 72 degrees west longitude, Transponder 17C, 4040 MHz, vertical polarization. They're available in Alaska and Hawaii on an MPEG-2 digital C-band signal accessed via satellite AMC-7, transponder 18C, 137 degrees west longitude, 4060 MHz, vertical polarization. A Digital Video Broadcast-compliant Integrated Receiver Decoder with modulation of QPSK/DBV, data rate of 36.86 and FEC 3/4 is required for reception. NASA TV Multichannel Broadcast includes: Public Services Channel (Channel 101); the Education Channel (Channel 102); and the Media Services Channel (Channel 103). Analog NASA TV is no longer available. For digital downlink information for each NASA TV channel, schedule information for mission activities and access to NASA TV's public channel on the Web, visit **http://www.nasa.gov/ntv**.

Audio

Audio of the pre-launch news conference and launch coverage will be available on "V-circuits" that may be reached by dialing 321-867-1220, -1240, -1260 or -7135.

Briefings

A mission and science overview news conference will be held at NASA Headquarters approximately two to four weeks before launch. The news conference will be broadcast live on NASA Television.

Pre-launch readiness and mission science briefings will be held at 1 p.m. and 2 p.m. PST (4 p.m. and 5 p.m. EST), respectively, on launch minus two days in the NASA Resident Office, Building 840, Vandenberg Air Force Base, Calif. These briefings will also be carried live on NASA Television.

Media advisories will be issued in advance, outlining details of these broadcasts.

Launch Media Credentials

News media interested in attending the launch should contact Bryan Boyette, U.S. Air Force 30th Space Wing Public Affairs Office, Vandenberg Air Force Base, Calif., phone 805-606-3595, fax 805-606-8303,email bryan.boyette@vandenberg.af.mil . Foreign nationals must submit accreditation requests no later than one month before launch. Please include full legal name, news organization, address, nationality/citizenship, passport number and date of birth. A legal photo identification will be required upon arrival at Vandenberg to cover the launch.

News Center/Status Reports

The Wide-field Infrared Survey Explorer News Center at the NASA Vandenberg Resident Office will be staffed beginning launch minus four days and may be reached at 805-605-3051. Recorded status reports will be available beginning launch minus three days at 805-734-2693.

Internet Information

More information on the mission, including an electronic copy of this press kit, news releases, fact sheets, status reports and images, can be found at http://wise.astro.ucla.edu , http://www.nasa.gov/wise and http://www.jpl.nasa.gov/wise .

Quick Facts

Spacecraft

Spacecraft Dimensions: 2.85 meters (9.35 feet) tall, 2 meters (6.56 feet) wide and 1.73 meters (5.68 feet) deep

Weight (spacecraft bus and science instrument): 661 kilograms (1,457 pounds)

Power: 301 Watts on average consumption, 551 Watts available capacity

Science Instrument: cryogenic telescope with megapixel infrared cameras, one for each of four wavelengths WISE observes

Instrument Dimensions: 40-centimeter-diameter (16-inch) telescope, housed in a cryostat 1.85 meters (73 inches) tall and 1.17 meters (46 inches) in diameter

Instrument Weight: 347 kilograms (765 pounds), plus 15.7 kilograms (35 pounds) of frozen hydrogen at launch

Mission

Launch: no earlier than December 9, 2009, at 6:09:33 a.m. PST (9:09:33 a.m. EST), from Space Launch Complex 2, Vandenberg Air Force Base, Calif.

Launch Vehicle: United Launch Alliance Delta II 7320

Launch Period: any day of the year is possible

Launch Window: 14 minutes and 18 seconds (6:09:33 a.m. to 6:23:51 a.m. PST, or 9:09:33 a.m. to 9:23:51 a.m. EST)

Expected Mission Duration: 10 months – enough for a one-month checkout plus nine months for one-and-a-half sky surveys

Orbit: sun-synchronous, 525 kilometers (326 miles) from Earth, orbiting Earth once every 95 minutes,15 times per day

Orbital Inclination: 97.5 degrees

NASA Investment: approximately $320 million (design, development, launch and operations)

Mission Overview

The Wide-field Infrared Survey Explorer, or WISE, will scan the entire sky in infrared light, picking up the glow of hundreds of millions of objects and producing millions of images. The mission will uncover objects never seen before, including the coolest stars, the universe's most luminous galaxies and some of the darkest near-Earth asteroids and comets. Its vast catalogs will help answer fundamental questions about the origins of planets, stars and galaxies, and provide a mountain of data for astronomers to mine for decades to come.

Thanks to next-generation technology, WISE's sensitivity is hundreds of times greater than its predecessor, the Infrared Astronomical Satellite, which operated in 1983.

WISE will join two other infrared missions in space -- NASA's Spitzer Space Telescope and the Herschel Space Observatory, a European Space Agency mission with important NASA participation. WISE is different from these missions in that it will survey the entire sky. It is designed to cast a wide net to catch all sorts of unseen cosmic treasures, including rare oddities.

The closest of WISE's finds will be near-Earth objects, both asteroids and comets, with orbits that come close to crossing Earth's path. The mission is expected to find hundreds of these bodies, and hundreds of thousands of additional asteroids in our solar system's main asteroid belt. By measuring the objects' infrared light, astronomers will get the first good estimate of the size distribution of the asteroid population. This information will tell us approximately how often Earth can expect an encounter with a potentially hazardous asteroid. WISE data will also reveal new information about the composition of near-Earth objects and asteroids -- are they fluffy like snow or hard like rocks, or both?

The next closest targets for WISE are cool "failed" stars called brown dwarfs.These Jupiter-like balls of gas form like stars but fail to gather up enough mass to ignite like stars.The objects are cool and faint, and nearly impossible to see in visible light. WISE should uncover about 1,000 in total, and will double or triple the number of star-like objects known within 25 light-years of Earth. What's more, if a brown dwarf is lurking closer to us than the closest known star, Proxima Centauri, WISE will find it and the little orb will become famous for being the "closest known star."

The most distant objects that will stand out like ripe cherries in WISE's view are tremendously energetic galaxies. Called ultraluminous infrared galaxies, or ULIRGs, these objects shine with the light of more than a trillion suns.They crowd the distant universe, but appear virtually absent in visible-light surveys. WISE should find millions of ultra-luminous infrared galaxies, and the most luminous of these could be the most luminous galaxy in the universe.

Other WISE finds will include: newborn stars; disks of planetary debris around young stars; a detailed look at the structure of our Milky Way galaxy; clusters of galaxies in the far universe and more. The most interesting discoveries will lay the groundwork for follow-up studies with other missions, such as NASA's Spitzer Space Telescope, the Herschel Space Observatory, NASA's Hubble Space Telescope, NASA's upcoming SOFIA airborne telescope and NASA's upcoming James Webb Space Telescope. Powerful ground-based telescopes will also follow up on WISE discoveries.

As with past all-sky surveys, surprises are sure to come. For example, one of the most surprising finds to come out of the Infrared Astronomical Satellite mission was the discovery of excess infrared light around familiar stars like Vega and Fomalhaut. Astronomers soon determined that the excess light comes from pulverized rock in disks of planetary debris. The findings implied that rocky planets like Earth could be common. Today hundreds of astronomers study these debris disks, and Hubble recently captured an actual photograph of a planet orbiting Fomalhaut within its disk.

WISE will orbit Earth at an altitude of 525 kilometers (326 miles), circling Earth via the poles about 15 times a day. A scan mirror within the WISE instrument will stabilize the line of sight so that snapshots can be taken every 11 seconds over the entire sky. Each position on the sky will be imaged a minimum of eight times, and some areas near the poles will be imaged more than 1,000 times. About 7,500 images will be taken every day at four different infrared wavelengths.

The mission's sensitive infrared telescope and detectors are kept chilled inside a Thermos-like tank of solid hydrogen, called a cryostat. This prevents WISE from picking up the heat, or infrared, signature of its own instrument. The solid hydrogen, called a cryogen, is expected to last about 10 months and will keep the WISE telescope a chilly 12 Kelvin (minus 438 degrees Fahrenheit).

After a one-month checkout period, the infrared surveyor will spend six months mapping the whole sky. It will then begin a second scan to uncover even more objects and to look for any changes in the sky that might have occurred since the first survey. This second partial sky survey will end about three months later when the spacecraft's frozen-hydrogen cryogen runs out. Data from the mission will be released to the astronomical community in two stages: a preliminary release will take place six months after the end of the survey, or about 16 months after launch, and a final release is scheduled for 17 months after the end of the survey, or about 27 months after launch.

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Wide-field Infrared Survey Explorer for NASA's Science Mission Directorate. The mission's principal investigator, Edward L. (Ned) Wright, is at UCLA. The mission was competitively selected in 2002 under NASA's Explorers Program managed by the Goddard Space Flight Center, Greenbelt, Md. The science instrument was built by the Space Dynamics Laboratory, Logan, Utah, and the spacecraft was built by Ball Aerospace & Technologies Corp, Boulder, Colo. Science operations and data processing will take place at the Infrared Processing and Analysis Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA.

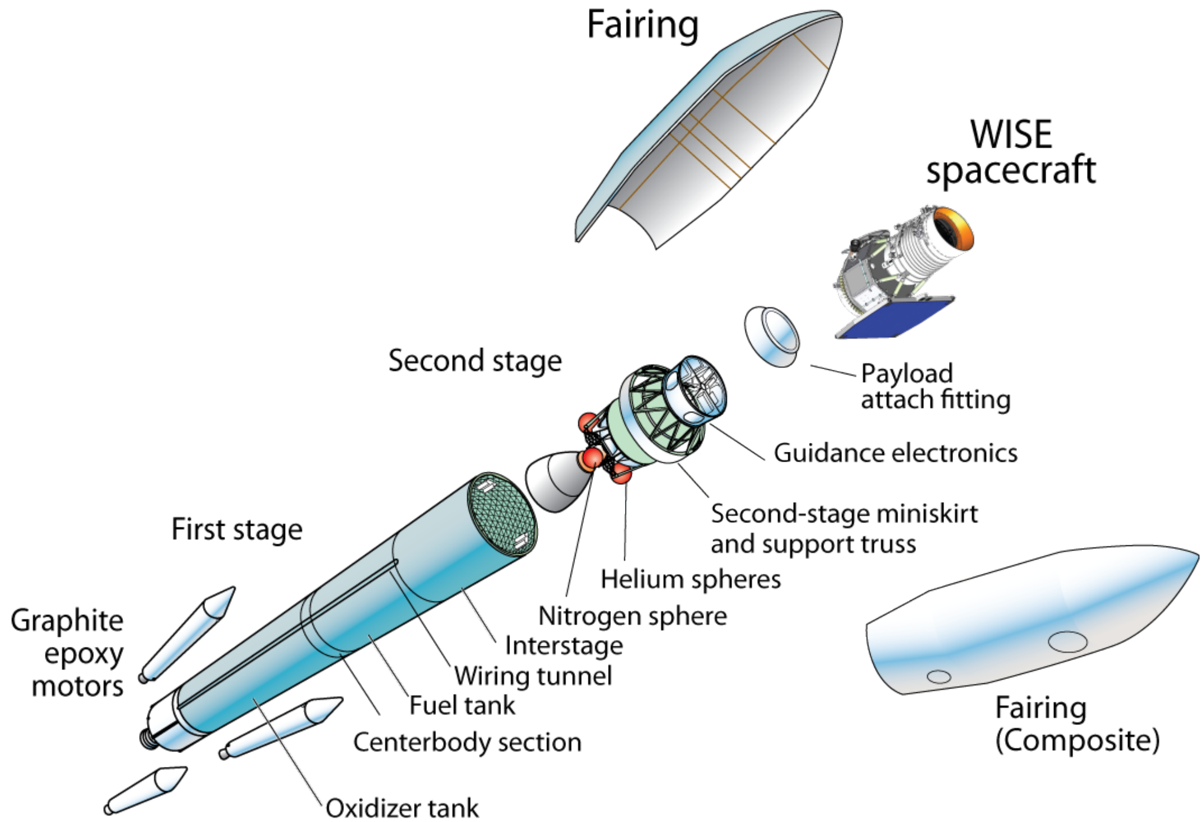
The mission's education and public outreach office is based at the University of California, Berkeley.

Launch Site and Vehicle

WISE will be launched from NASA's Space Launch Complex 2 at Vandenberg Air Force Base, Calif., on a United Launch Alliance Delta II 7320-10 rocket.

This rocket has two stages. The first stage uses a Pratt & Whitney Rocketdyne RS-27A engine burning kerosene and liquid oxygen propellant. This stage has three strap-on solid rocket boosters. The second stage burns hydrazine and nitrogen tetroxide propellant and uses an Aerojet AJ10-118K engine.

The WISE spacecraft is attached to the second stage with a clamp band and interface ring. A 10-foot-diameter fairing encloses the second stage and spacecraft during the early stages of the flight.



Delta launch vehicle

At launch, the Delta II will stand approximately 40 meters (132 feet) tall atop a 7.3-meter-tall (24-foot) launch stand, and weigh approximately 150,000 kilograms (330,000 pounds).

Launch Timing

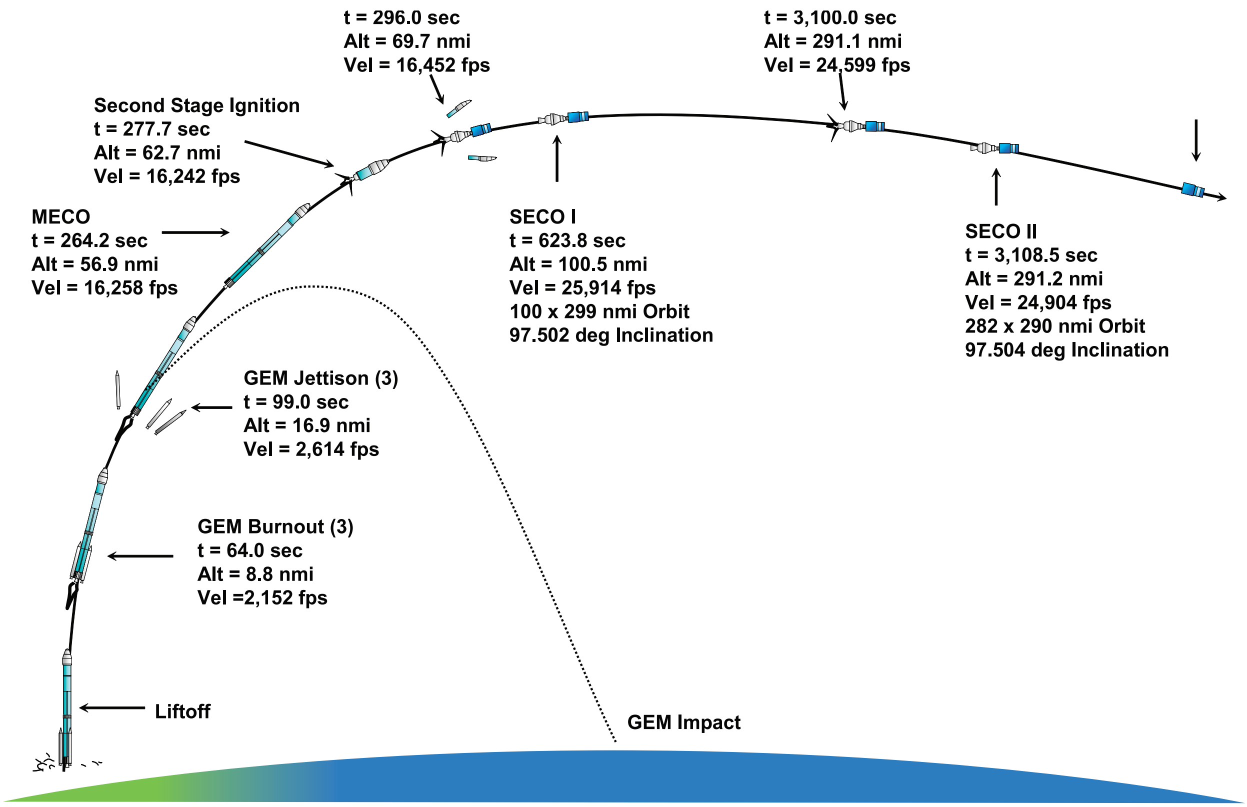
WISE will be launched at a specific time based on the science requirements of the mission. Unlike spacecraft sent to other planets, comets or asteroids, the launches of Earth-orbiting satellites do not need to be timed based on the alignment of the planets. Earth-orbiting satellites do, however, need to be launched during particular windows within any given 24-hour day in order to reach the proper orbit around Earth.

WISE will fly in what is called a “sun-synchronous” orbit, flying with a 97-degree inclination over the poles. The spacecraft will remain over the day-night, or terminator, line for the entire mission, and hence will be launched near dawn, at 6:09:33 a.m. PST (9:09:33 a.m. EST).

To place the satellite into a polar orbit, it must blast off to the north or south. Vandenberg is ideal for polar launches because the Pacific Ocean lies to its south. This ensures that any spent rocket parts or debris from a possible mishap would fall in the ocean and not on populated areas.

The launch date is based not only on the readiness of the satellite, but also the Delta II launch vehicle and the launch range at Vandenberg Air Force Base.

Launch is currently scheduled for no earlier than Dec. 9, 2009. The launch window each day is 14 minutes and 18 seconds, extending from 6:09:33 a.m. to 6:23:51 a.m. PST (9:09:33 a.m. to 9:23:51 a.m. EST).



Launch events

Launch Sequence

At the moment of WISE liftoff, the Delta II main engine and three solid-motor boosters will ignite, providing a total liftoff thrust of more than 1,812,000 newtons (407,000 pounds). Several seconds later, the Delta II will tilt towards the south, cross the California coastline and head upward and out over the open Pacific Ocean. At 36 seconds after liftoff, the launch vehicle will hit the speed of sound, and 14 seconds later it will reach its point of maximum aerodynamic stress.

The three solid motors -- called graphite epoxy motors, or GEMs -- will burn out 64 seconds after liftoff; in another 35 seconds, they will fall away from the rocket. At four minutes and 24 seconds after launch, the main engine will cut off (MECO).

Fourteen seconds later, the vehicle's second stage will ignite. In another 18 seconds, the rocket's nose cone, or "fairing," will split like a clamshell and fall away.

The second-stage engine will cut off (SECO-1) at 10 minutes and 24 seconds after liftoff. Fifty-two minutes after liftoff, the second stage will re-ignite for several seconds and then cut off again (SECO-2). About 55 minutes after WISE leaves Earth, the satellite will separate from its rocket, orbiting Earth on its own.

After the separation, the Delta II rocket will first use a cold gas jet to gently move farther away from the satellite. Later the rocket will maneuver into a stable final orbit well above all low-flying Earth satellites, more than 2,000 kilometers (1,250 miles) above Earth. At this point, WISE will be traveling at 7.59 kilometers per second, or just under 17,000 miles per hour.

Within the first five minutes after separation, the WISE pointing control system and low-gain transmitter and receiver will be turned on, transmitting at a rate of four kilobits per second. Fifteen minutes later, the first of two mission-critical events will occur: opening of the valves on the cryostat. Small pyrotechnic charges will automatically fire, opening the tank valves to the vacuum of space. This will allow the gas that has boiled off from the frozen hydrogen to escape and cool the instrument.

Within two-and-a-half hours after separation, the observatory will stabilize itself with its fixed solar array pointing toward the sun. It will no longer need to operate on power from a lithium battery.

NASA's Tracking and Data Relay Satellite System, a network of geosynchronous Earth-orbiting satellites, should acquire a signal from the spacecraft minutes after separation. Over the next two weeks, the spacecraft's power, commanding, pointing and communications systems will be checked out, including the high-gain antenna used to send images to the ground (transmission rate is 100 megabits per second). The observatory's science instrument will be powered on five days into the mission.

At 16 days after launch, the second of the two mission-critical events will occur: ejection of the cryostat cover. The cryostat is like a giant Thermos bottle -- it chills and insulates the telescope and detectors with frozen hydrogen. To eject the cryostat cover, a ground command signal is sent to fire small pyrotechnic charges, which release three separation nuts holding the cover in place. A set of springs will push the cover away.

With the cover removed, the instrument will begin taking images of the sky, and a two-week checkout and calibration of the science instrument will begin. The primary goal of the calibration is to match the spacecraft scan rate and direction to that of an internal scanning mirror in the instrument. With the scan rate matched, the instrument can continuously take "freeze-frame" images of the sky every 11 seconds as the spacecraft orbits Earth. Science operations will begin at launch plus 30 days.

Mission Operations

The observatory's ground segment includes all facilities required to operate the satellite; acquire its telemetry; and process, distribute and archive data products. JPL is responsible for all ground operations that track and control the spacecraft.

WISE will survey the sky from a sun-synchronous polar orbit. It will circle around the poles at the line where day turns to night, called the terminator. The orbit is designed to precess, or shift, with time, so that it stays over this line. This ensures that WISE's solar panels continuously soak up the sun, while the telescope snaps images of the sky overhead, mapping out a 360-degree strip each orbit. As Earth orbits around the sun, these strips of images sweep across the whole sky in only six months. Adjustments are made every half orbit to keep the telescope pointed at the correct strip of sky, following commands that are planned out a week in advance.

Surveying is interrupted four times a day to transmit images to the ground via the Tracking and Data Relay Satellite System. These satellites first relay WISE data to a ground station at White Sands, New Mexico. From there, spacecraft telemetry is sent to JPL, while image and some telemetry data are transferred to the WISE Science Data Center at the Infrared Processing and Analysis Center at Caltech.

Science Data Processing and Archiving

Once received on the ground, the raw image data from the spacecraft will be processed by Caltech's Infrared Processing and Analysis Center. A specialized hardware and software system combines the raw science data with the spacecraft telemetry and converts them into high-quality images and a catalog of stars and galaxies detected by WISE. These products will be archived and distributed to the user community via the Web-based services of the Infrared Science Archive at the Infrared Processing and Analysis Center.

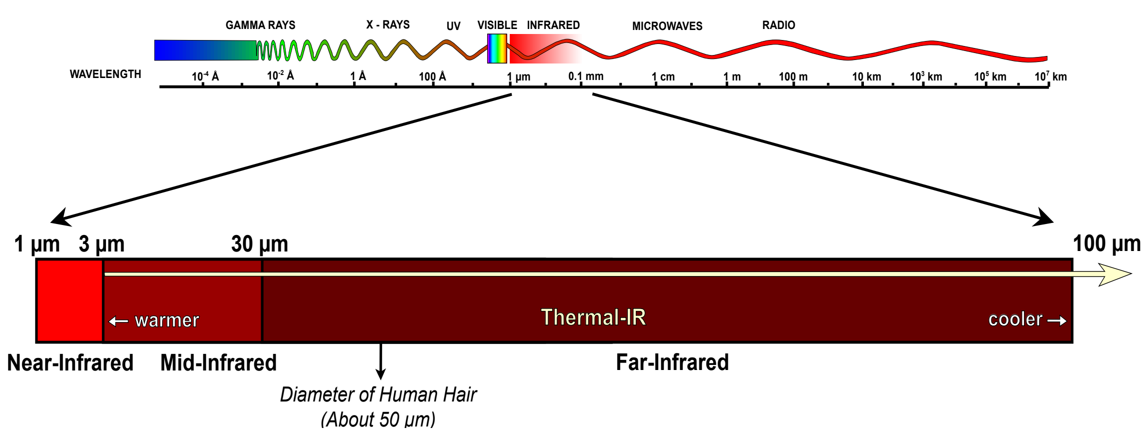
The first release of the WISE images and catalog will take place six months after the end of the survey. It is expected to include about 75 percent of the sky. The final, complete catalog will be made available 17 months after the completion of the survey, or 27 months after launch.

Why Infrared?

Imagine seeing the world around you in only one color. A pink sunset wouldn't look much different from a turquoise sea. Astronomers would face a similar color blindness if they could see only through visible-light telescopes -- they would glimpse just one slice of the total spectrum of light in the universe. Objects in space sizzle and shimmer with a range of light waves, from high-energy gamma rays to mellow radio waves.

Infrared is one of the many invisible "colors" of this cosmic rainbow of light. It is similar to visible light but has longer wavelengths and lower energy. Any object with heat, including a human, is aglow with infrared. Current practical uses include medical imaging, military surveillance and ocean studies. Firefighters use infrared goggles to locate hidden hot spots and trapped people or animals.

The astronomer Sir William Herschel discovered infrared light serendipitously in 1800. He had spread visible light into a rainbow using a prism, and was using thermometers to measure the energy of the different colors. As a control, he placed his thermometer below the red end, but to his surprise, the thermometer registered energy. That energy turned out to be from infrared light. That's where infrared got its name -- it's below ("infra" in Latin) the color red.



Electromagnetic spectrum

The whole array of cosmic light is called the electromagnetic spectrum. At the highest energy end are gamma rays, and at the lowest-energy end, radio waves. Visible light lies around the middle, spanning a wavelength range from blue light at 0.4 micrometers, or microns, to red light at 0.7 microns. A human hair is about 50 microns or more in diameter.

Infrared light spans the wavelength region from roughly 1 to 100 microns. Within this range, wavelengths are broken up into subclasses -- near, mid and far -- according to how close they

ALIENS WITH INFRARED EYES?

Why do humans see visible light? The answer has to do with our sun. Our sun pours out light of all wavelengths, from radio waves to gamma rays. But most of what comes out is visible light. It just so happens that our Earth's atmosphere lets this visible light slip through to bathe our planet. Most other wavelengths, including infrared, are shut out. Nature took advantage of this abundance of visible light and developed creatures with eyes that can see it. Humans cannot see infrared light, though a few other species can. Mosquitoes and rattlesnakes, for example, can sense the warm infrared glow of their prey.

If life has evolved, or were to evolve, around a cooler, reddish star, then seeing creatures might possess a different set of eyes. They'd see infrared and not visible. If those hypothetical aliens were to develop technologically and build space telescopes, they too might launch a cadre of observatories, including ones that detect visible light. For them, such telescopes would reveal invisible light that, for us humans, is easy to see!

are to the visible portion of the spectrum. Light with wavelengths from 1 up to a few microns is called "near-infrared," light from roughly 3 to 30 microns is called "mid-infrared," and the longer wavelengths are called "far-infrared." WISE will detect four distinct bands of mid-infrared light with wavelengths of 3.4, 4.6, 12 and 22 microns.

Feeling the Heat

Every object in the universe, even the coldest particles of dust, emits light radiation. The type of light emitted depends on the temperature. Hotter objects, like massive stars, give off most of their light as high-energy waves; cooler objects, like dust grains, emit mostly lower energy light.

Objects that are roughly room temperature, including humans, shine with mid-infrared light, while anything hot enough to burn your fingertips emits higher energy near-infrared light. If an object gives off most of its light in the infrared, then it will give off less visible light. For example, most "failed" stars, called brown dwarfs, emit primarily infrared light and are nearly impossible to see with current optical telescopes.

WISE will preferentially pick up the glow of objects ranging in temperature from roughly minus 200 degrees Celsius (about minus 330 Fahrenheit) to 700 degrees Celsius (about 1,300 degrees Fahrenheit). This range covers objects about as cold as liquid nitrogen and as hot as molten aluminum. This includes cool dust, dim stars, dusty galaxies and other objects that might otherwise be hidden from optical telescopes.

Seeing Through the Dust

Infrared offers astronomers another advantage over visible -- it can sneak right through a thick cloud of dust. Longer wavelengths of light are much less affected by dust. This is the reason why the sun looks red on a smoky day: the sunlight has to travel through our dusty atmosphere, and only the longer, redder wavelengths make it through. Thus, WISE can find objects buried in blankets of dust. For example, WISE can detect powerful distant galaxies enshrouded in dust -- galaxies that appear as black, empty space in visible-light views.

Space: The Best Place to See Infrared

Why do we need to go to space to observe infrared light? There are two reasons. The first is that our atmosphere absorbs many wavelengths of infrared light, preventing them from ever reaching the ground. This is especially true for wavelengths beyond two microns. The second reason has to do with the fact that both air and a warm telescope glow with infrared light. Observing infrared light with a room-temperature telescope on the ground is like doing visible-light astronomy in broad daylight with a telescope whose tube is made out of fluorescent lights. The images would be completely drowned out.

The best views of the cosmos in infrared light are therefore up above our atmosphere in space, using very cold telescopes. Telescopes on airplanes and high-flying balloons can also detect infrared light, but space has the best vantage point.

Science Goals and Objectives

The primary goal of WISE is to scan the entire sky at infrared wavelengths with vastly improved sensitivity and resolution over past missions. All-sky surveys are essential for discovering new targets of interest, and, in some instances, have opened up entire fields of study. Many modern surveys have combed the sky using various wavelengths, but a gap remains at the infrared wavelengths WISE will observe. The best existing infrared all-sky survey at wavelengths beyond 10 microns is from the highly successful Infrared Astronomical Satellite, operated in 1983. The only existing all-sky survey between 3 and 10 microns is from the Cosmic Background Explorer, operated in 1989.

WISE, with its state-of-the-art infrared technology, will scan the sky with far better sensitivity and resolution. Its millions of images will provide the astronomical community with a vast atlas of the infrared universe, populated with hundreds of millions of space objects. Like scanning the grains of sand on a beach with a metal detector, this infrared telescope will find rare gems buried in the vastness of space. WISE will guide other telescopes, such as NASA's Spitzer Space Telescope and NASA's upcoming James Webb Space Telescope, to the most interesting objects for follow-up studies. As with past all-sky surveys, the mission's legacy will endure for decades to come.

In addition, WISE will scan much of the sky a second time. This will reveal even more asteroids, stars and galaxies, and catch objects that have changed brightness or position since they were last observed six months earlier. For example, if a cool star has moved noticeably, astronomers will know it is relatively nearby.

The science goals of the mission are:

- To find the nearest and coolest stars
- To find the most luminous galaxies in the universe
- To find and study asteroids in our solar system
- To better understand the evolution of planets, stars and galaxies

Cool Stars

Not all stars shine brightly like our sun. Some, called brown dwarfs, glow feebly like chunks of heated coal. They start out life like ordinary stars as collapsing clouds of gas and dust. But their clouds don't have enough mass to generate the heat needed to fuse atoms and ignite nuclear fusion. As a result, these cool stars, or brown dwarfs, don't shine with new light but slowly radiate away their internal heat, mostly as infrared. The coolest brown dwarfs have complex atmospheres full of methane, much like that of our solar system giant, Jupiter.

By studying brown dwarfs, astronomers can learn more about star formation, as well as the atmospheres of planets orbiting stars beyond our sun.

Previous surveys have uncovered a few hundred brown dwarfs, nearly all with temperatures above 600 degrees Celsius (1,100 degrees Fahrenheit). From these, it is estimated that there are as many brown dwarfs as stars in the universe. The little orbs should be everywhere, including our own sun's backyard, but they aren't always easy to see. In fact, the most common brown dwarfs are expected to be the faintest and coldest, and thus have largely gone missing. NASA's Spitzer Space Telescope recently spotted a few members of this ultra-cool bunch, with temperatures as low as 125 degrees Celsius (about 260 degrees Fahrenheit), which is slightly above the temperature of boiling water.

WISE is expected to uncover about 1,000 nearby brown dwarfs, most of them colder than 600 degrees Celsius. The sensitive telescope can even detect the frostiest of brown dwarfs registering at minus 70 degrees Celsius (minus 94 degrees Fahrenheit) out to four light-years away. That's about as cold as an Antarctic winter. WISE should also find warmer, 225-degree-Celsius (437-degree-Fahrenheit) brown dwarfs out to 50 light-years. The discoveries will double or triple the number of known star-like bodies in our neck of the galaxy, within 25 light years of the sun.

One of these cool stars may be sitting right under our noses, even closer to us than our closest known star, Proxima Centauri, which is four light-years away. If so, WISE will pick up its glow. A nearby star could also mean nearby planets. Observations from Spitzer suggest that brown dwarfs, like their hotter stellar cousins, may host planetary systems.

Star-Making Machines

Decades ago, the Infrared Astronomical Satellite uncovered a new class of galaxies bursting with young stars. Called ultra-luminous infrared galaxies, or ULIRGs, these objects shine with the light of trillions of suns, and churn out some 1,000 new stars per year. For comparison, our Milky Way galaxy produces one or two stars in the same amount of time. Nowadays, galaxies with intense starbursts are rare, but back when the universe was young, they packed the cosmic scene. The rare, nearby infrared luminous galaxies may form when smaller galaxies collide and mingle, and gas is compressed enough to ignite and create new generations of stars. Those from the younger universe may be even more extreme -- galaxies in their cataclysmic formation. Over time, the galaxies fade out and evolve into modern galaxies common around us today -- galaxies that have, for the most part, ceased their star-making ways.

Ultra-luminous infrared galaxies are largely invisible to optical telescopes. Their star-forming nests are choked with dust that blocks visible light. The dust is heated up and radiates infrared light that WISE can see. Some ultra-luminous galaxies might be powered by supermassive black holes at the cores. Dust clouds around the black holes would also block visible light, while emitting infrared.

WISE will be able to detect millions of ultra-luminous infrared galaxies billions of light-years away, back to a time when the universe was only three billion years old. Chances are good that it may even find the most luminous galaxy in the universe. By studying large populations of these energetic galaxies, the mission will also gain a better understanding of their history and evolution.

Space Rocks Abound

Millions of asteroids are estimated to reside in our solar system, but most have gone unidentified. WISE will detect hundreds of thousands of asteroids, thousands of which are too black and faint to be seen with visible light telescopes. The mission will detect most asteroids in our main asteroid belt with a diameter of at least three kilometers (1.86 miles). It will also find hundreds of never-before-seen near-Earth objects, which are asteroids and comets with orbits that pass close to Earth's orbit.

WISE will spot the rocky bodies by taking repeated exposures of the same swath of sky. As the telescope progresses through its sky scan, it takes overlapping images. The stars and galaxies will appear fixed on the sky in each exposure, but asteroids will move over short amounts of time. When candidate asteroids are identified, the data will be sent to the Minor Planet Center, Cambridge, Mass., within days. Professional and amateur astronomers can follow up and help gather more observations to refine the orbits of the space rocks.

The result will be mountains of asteroidal data, which astronomers will mine for a very long time. A key result of these data will be much better estimates of the actual sizes of asteroids. Nearly all estimates of asteroid sizes today are derived from how bright an asteroid appears in visible light. But this can be misleading. The visible light being measured is reflected sunlight, and how much sunlight gets reflected depends not just on size but also color, or more precisely the reflectivity of the surface. A tiny, bright space rock will look the same as a bulky, dark one when viewed with an optical telescope.

Infrared light doesn't have this problem. It is emitted from the asteroid itself, not reflected, and therefore depends mainly on size. A big, black rock will look a lot brighter in infrared than a little, white one.

Knowing the size of an asteroid in combination with how much visible light it reflects gives a rough indication of its composition. Some asteroids might be fluffy and crumbly, and others solid metal. Astronomers still don't have a good idea of how compositions vary across our solar system's asteroid population.

Both the size and make-up of asteroids are important factors in determining their potential threat to Earth. A big, dense rock, if headed toward Earth, will pose more danger than a small, fluffy one. WISE will, therefore, provide an improved census of potentially harmful asteroids in our solar system. This information will guide future missions designed to study potentially hazardous asteroids, as well as future strategies for mitigating asteroids that might be headed near Earth.

Sunbathing Asteroids

WISE will also help us understand what causes an asteroid circling around in our main asteroid belt to veer off course, sometimes toward Earth. By surveying the sky more than once within its 10-month expected lifetime, WISE will observe both the morning and afternoon sides of many rotating asteroids, measuring their changing surface temperatures. Like Earth, asteroids rotate, experiencing day and night, morning and afternoon. And like Earth, they get warmer in the afternoon, emitting more infrared light. That excess light causes a tiny force away from the warmer side, gradually changing an asteroid's orbit, a phenomenon known as the Yarkovsky effect. If the Yarkovsky effect changes an asteroid's orbit enough to get in sync with Jupiter's orbit, then its orbit can change dramatically. This is one way that main-belt asteroids evolve into near-Earth objects, and may explain how the asteroid that killed the dinosaurs came to crash into Earth.

The Yarkovsky effect is also a major factor in predicting just how close a near-Earth object might come to Earth. WISE will, therefore, give astronomers not just a better sampling of asteroid numbers and sizes, but also a better idea of how their orbits evolve over the history of the solar system.

Other Goodies

Because WISE is scanning the entire sky, it is going to see all kinds of cosmic wonders, both odd and expected. It will detect many varieties of stars and galaxies, including thousands of dusty, planet-forming disks swirling around stars, factories pumping out newborn stars, clusters of distant galaxies and more. Surprises are also sure to come, as was the case with previous all-sky surveys. In the end, the data will help astronomers piece together the evolution of stars and galaxies, and gain a better understanding of how our own planet, sun and galaxy came to be.

SCIENCE TEAM

Name	Institution
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J. Davy Kirkpatrick	*Caltech*
David Leisawitz	*Goddard Space Flight Center*
Carol Lonsdale	*University of Virginia*
John Mather	*Goddard Space Flight Center*
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Robert McMillan	*University of Arizona*
Bryan Mendez	*University of California, Berkeley*
Deborah Padgett	*Caltech*
Michael Ressler	*JPL*
Michael Skrutskie	*University of Virginia*
S. Adam Stanford	*University of California, Davis*
Russ Walker	*Monterey Institute for Research and Astronomy*

Spacecraft

The WISE spacecraft is about the height and weight of a big polar bear, only wider. It measures 2.85 meters tall (9.35 feet), 2 meters wide (6.56 feet), 1.73 meters deep (5.68 feet) and weighs 661 kilograms (1,457 pounds). It is composed of two main sections: the instrument and the spacecraft bus.

The Space Dynamics Laboratory in Logan, Utah, designed, fabricated and tested the instrument. They also manufactured the electronics used to control the instrument and perform onboard processing of the detector images. The spacecraft bus was built by Ball Aerospace & Technologies Corp, Boulder, Colo. Ball was also responsible for integrating the instrument to the spacecraft bus and testing the completed spacecraft.

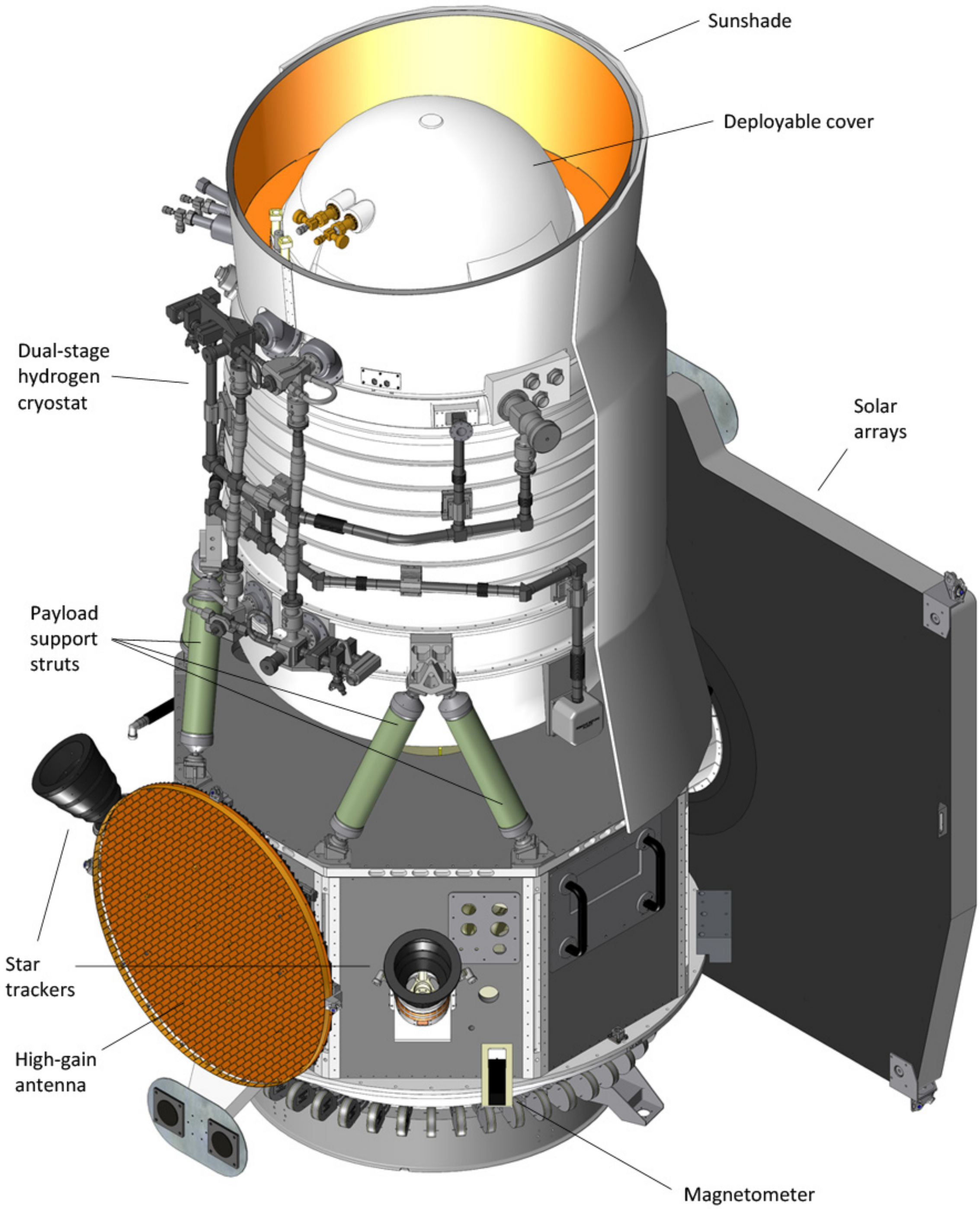
The instrument includes a 40-centimeter-diameter (16-inch) telescope and four infrared detectors containing one million pixels each, all kept cold inside an outer cylindrical, vacuum-tight tank filled with frozen hydrogen, called a cryostat. Some say the whole assembly looks like a giant Thermos bottle, while others see a resemblance to the Star Wars robot R2-D2. After launch, the hydrogen vents on the cryostat are opened and the instrument cover is ejected. Once these events have occurred, a scan mirror in the telescope will be the only moving part in the instrument.

At the bottom of the instrument is a three-axis stabilized, eight-sided spacecraft bus that houses the computers, electronics, battery and reaction wheels needed to keep the observatory operating and oriented correctly in space. Two star trackers for precision pointing are mounted on the sides of the spacecraft bus. A fixed solar panel that provides all the spacecraft's power is mounted on one side of the bus, and a fixed high gain antenna for transmitting science images to the ground is mounted on the opposite side. The bus structure is composed of aluminum honeycomb panels sandwiched between aluminum skin. It has no deployable parts -- the only moving parts are four reaction wheels used to turn the satellite.

The base of the spacecraft structure includes a "soft-ride" system of springs to reduce stress from the rocket on the satellite. A metal clamp band attaches the second stage of the rocket to the base of the satellite, and is released to allow the spacecraft to separate from the launch vehicle once in orbit.

Command and Data Handling

The command and data handling system is the spacecraft's brain, responsible for monitoring and controlling all spacecraft functions. It consists of a single box, called the Spacecraft Control Avionics, which was developed by the Southwest Research Institute, San Antonio. The box includes a single-board RAD750 computer, memory, a command and telemetry interface, an instrument interface, a flash memory card and spacecraft interface cards. This box can operate the spacecraft either with commands stored in its memory or via "real-time" commands radioed from Earth. It also handles engineering and science data to be sent to Earth.



WISE spacecraft

Electric Power

WISE is powered entirely by a fixed solar panel. The panel is approximately 2 meters (80 inches) wide by 1.6 meters (61 inches) tall. To ensure that sunlight will hit the solar panel properly, the satellite is always oriented with its solar panel facing the sun and the instrument pointed 90 degrees away from the sun. The panel contains 684 solar cells manufactured by Spectrolabs, Sylmar, Calif. The maximum power produced is 551 Watts.

Attitude Determination and Control

The spacecraft attitude determination and control system is used to adjust the orientation of WISE in space. It consists of a complementary set of four reaction wheels used for maneuvering and three torque rods, which use Earth's magnetic field to slow down the wheels. Momentum build-up in the reaction wheels is periodically dumped via the torque rods as WISE flies over the poles. Two star trackers, a fiber-optic gyroscope, a magnetometer and 14 sun sensors provide measurements of the spacecraft's position.

The star trackers are small telescopes with visible-light electronic cameras called charge-coupled devices (CCDs). They are capable of acquiring, tracking and identifying multiple stars in their fields of view. The positions of the observed stars are compared with an onboard star catalog to help orient the spacecraft. WISE will use both trackers simultaneously during its survey. The two trackers are pointed in different directions, so that, for example, if the moon interferes with measurements from one star tracker, the other one can be used. Ball Aerospace & Technologies Corp. manufactured the CT-633 star trackers.

Telecommunications

WISE will communicate with Earth via NASA's Tracking Data Relay Satellite System, a network of Earth-orbiting satellites. The spacecraft has one fixed high-gain radio antenna, which uses Ku-band frequencies to relay science data, as well as stored spacecraft health and telemetry, down to the ground at a rate of 100 megabits per second. The high-gain antenna is turned toward NASA's tracking satellites four times per day, an average of 15 minutes each time, while WISE is orbiting over the poles. Because WISE observes the sky over the poles every orbit, the survey can be interrupted there without creating gaps in the all-sky map.

The NASA satellites relay the spacecraft health and science data to a ground facility in White Sands, New Mexico. From there the spacecraft telemetry is sent to JPL, and the science data to the Infrared Processing and Analysis Center at Caltech.

The NASA satellites also relay commands and spacecraft data between JPL and WISE using four omni-directional antennas on the spacecraft, which operate at S-band frequencies. Two of these antennas can receive commands from the ground at a speed of two kilobits per second; the other two transmit spacecraft health and telemetry data down to Earth at speeds of either four or 16 kilobits per second.

Flight Software

The observatory uses stored commands to perform its normal operations and also receives commands and sequences from Earth. The software on the flight computer translates the stored and ground commands into actions for various spacecraft subsystems. The flight software also gathers science data as well as engineering telemetry for all parts of the spacecraft and continuously monitors the health and safety of the observatory.

The flight software can perform a number of autonomous functions, such as attitude control and fault protection, which involve frequent internal checks to determine whether a problem has occurred. If the software senses a problem, it will automatically perform a number of preset actions to resolve the problem or put the spacecraft in a safe mode until ground controllers can respond.

Thermal Control System

The spacecraft is protected by an onboard thermal control system that consists primarily of passive elements: multilayer insulation blankets, radiator panels, thermal coatings and finishes. In addition, thermostatically controlled heaters provide precise temperature control where necessary for the instrument camera and scan mirror electronics, for example. Heaters are also used for maintaining electronics above survival temperatures in contingency modes.

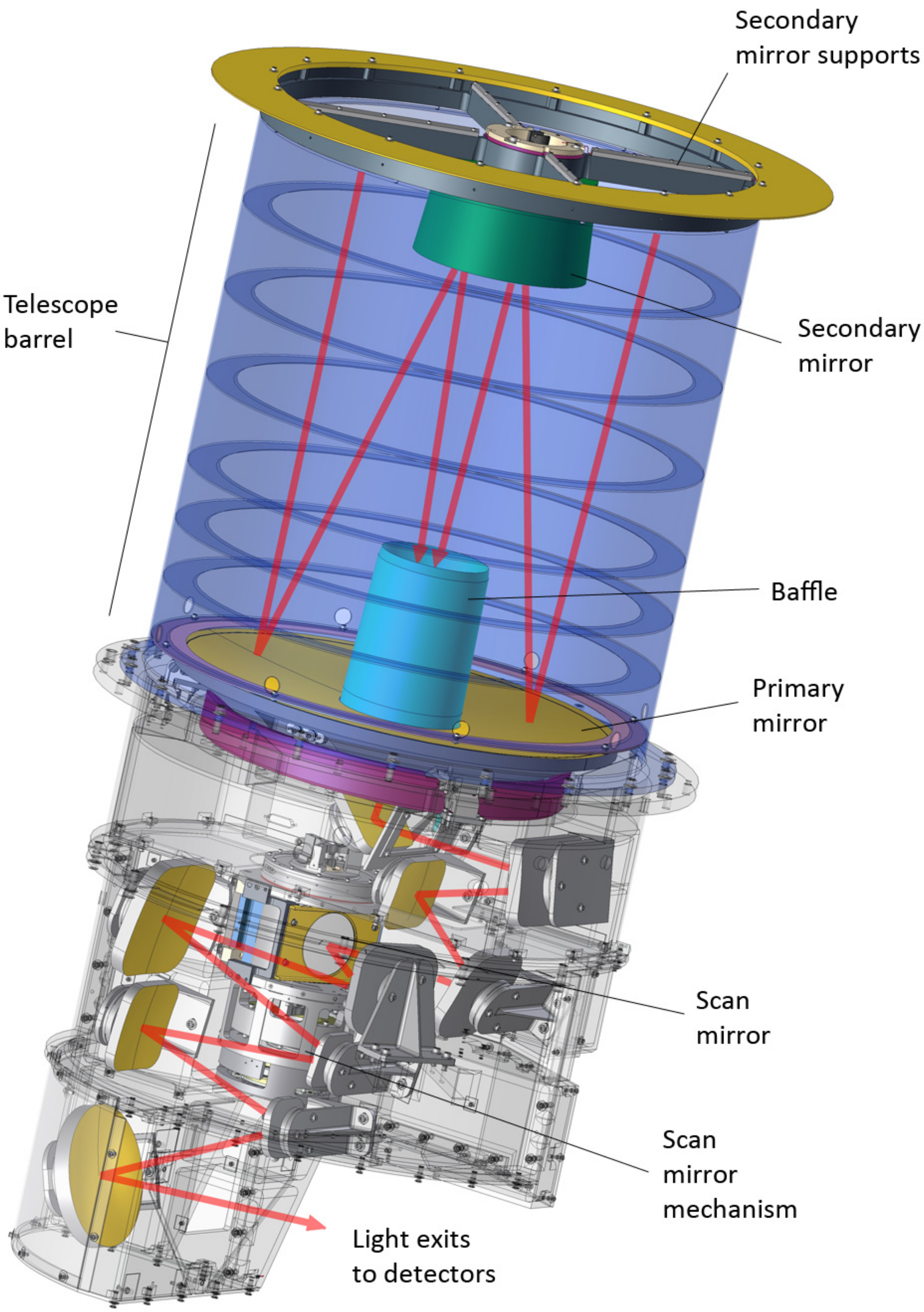
Science Instrument

The WISE telescope has a 40-centimeter-diameter (16-inch) aperture and is designed to continuously image broad swaths of sky at four infrared wavelengths as the satellite wheels around Earth. The four wavelength bands are centered at 3.4, 4.6, 12 and 22 microns. The field of view is 47-arcminutes wide, or about one-and-a-half times the diameter of the moon.

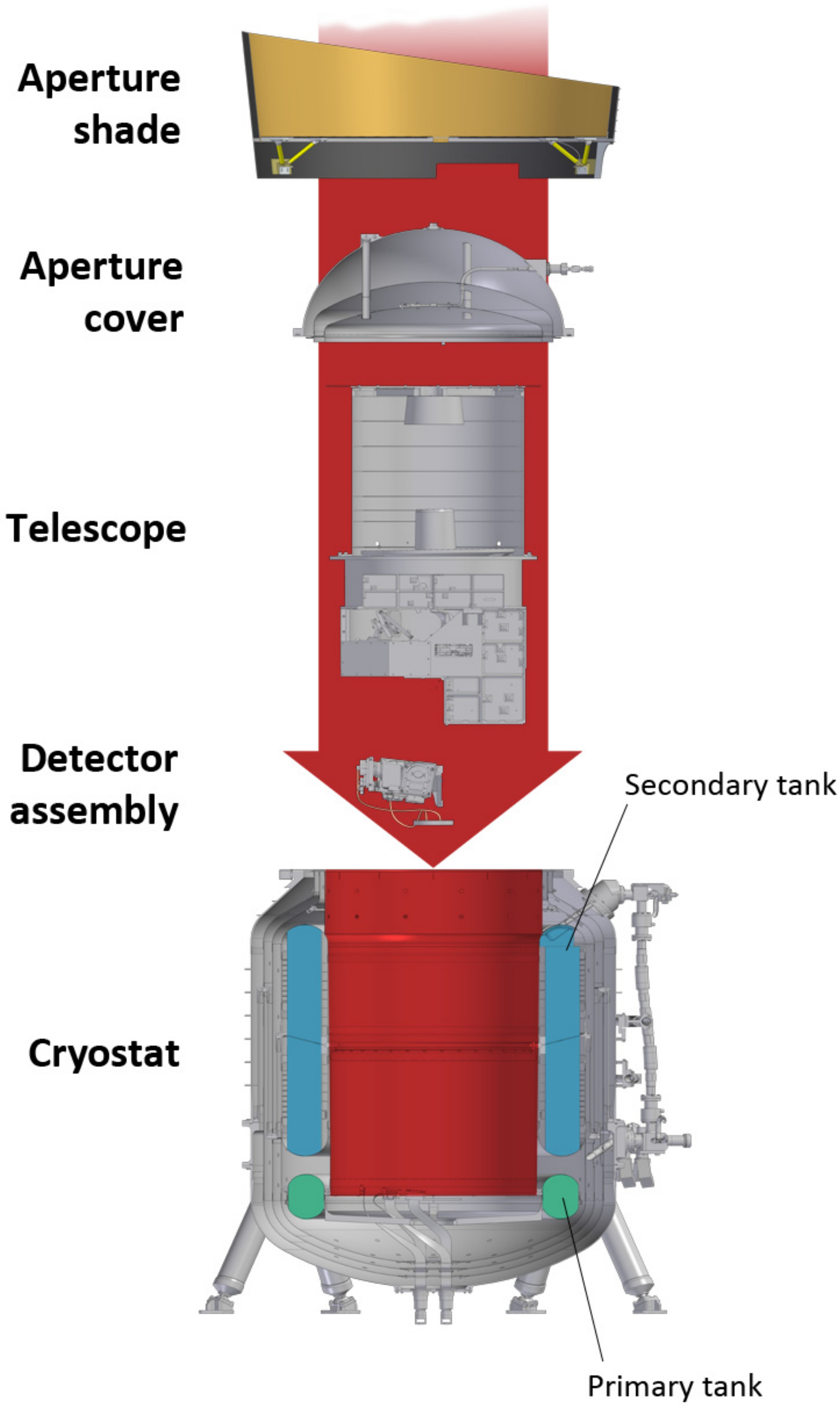
The telescope was built by L-3 SSG-Tinsley in Wilmington, Mass. Its design uses a total of 10 curved and two flat mirrors, all made of aluminum and coated in gold to improve their ability to reflect infrared light. Four of the mirrors form an image of the 40-centimeter primary mirror onto the flat scan mirror. The scan mirror moves at a rate that exactly cancels the changing direction of the spacecraft on the sky, allowing freeze frame images to be taken every 11 seconds. The scan mirror then snaps back to catch up with the spacecraft as it continues to survey the sky.

The remaining mirrors form a focused image of the sky onto the detector arrays. Before reaching the arrays, the light passes through a series of flat “dichroic” filters that reflect some wavelengths and transmit others, allowing WISE to simultaneously take images of the same part of the sky at four different infrared wavelengths.

The image quality, or resolution, of WISE is about six arcseconds in its 3.4, 4.6 and 12 micron bands, meaning that it can distinguish features one six-hundredth of a degree apart. At 22 microns, the resolution is 12 arcseconds, or one three-hundredth of a degree. This means WISE can distinguish features about five times smaller than the Infrared Astronomical Satellite could at 12 and 25 microns, and many hundred times smaller than NASA’s Cosmic Background Explorer could at 3.5 and 4.9 microns.



WISE telescope



WISE instrument

Detectors

Light gathered by WISE's telescope is focused onto what are called focal planes, which consist of four detector arrays, one for each infrared wavelength observed by WISE. Each of the detector arrays contain about one million pixels (1,032,256 to be exact). This is a giant technology leap over past infrared survey missions. The Infrared Astronomical Satellite's detectors contained only 62 pixels in total.

The 3.4- and 4.6-micron detectors convert light to electrons using an alloy made of mercury, cadmium and tellurium. The electrons from each of the million-plus pixels are measured on the spot every 1.1 seconds, and the result sent to the instrument electronics. These detector arrays, a type known as the HAWAII 1RG, were manufactured by Teledyne Imaging Sensors, Camarillo, Calif. They need to be warmer than the rest of the instrument to improve their performance. The 12- and 22-micron detectors sense light using silicon mixed with a tiny amount of arsenic. They have readout electronics specially developed for the low-temperatures of WISE and were manufactured by DRS Sensors & Targeting Systems, Cypress, Calif.

Cryostat

Because WISE is designed to detect infrared radiation from cool objects, the telescope and detectors must be kept at even colder temperatures to avoid picking up their own signal. The WISE telescope is chilled to 12 Kelvin (minus 261 degrees Celsius or minus 438 degrees Fahrenheit) and the detectors for the 12- and 22-micron detectors operate at less than 8 Kelvin (minus 265 degrees Celsius or minus 447 degrees Fahrenheit). The shorter wavelength 3.4- and 4.6-micron detectors operate at a comparatively balmy 32 Kelvin (minus 241 degrees Celsius or minus 402 degrees Fahrenheit). To maintain these temperatures, the telescope and detectors are housed in a cryostat, which is essentially a giant Thermos bottle. The cryostat is extremely efficient at keeping heat away from the detectors -- its insulating power is equivalent to a home insulation rating of "R-300000."

The WISE cryostat, manufactured by Lockheed Martin Advanced Technology Center, Palo Alto, Calif., has two tanks filled with frozen hydrogen. The colder, or primary cryogen tank, the smaller of the two tanks, cools the 12- and 22-micron detector arrays. To achieve this low operating temperature, a larger 12-Kelvin secondary tank protects the primary tank from nearly all the heat from the outer structure of the cryostat, which is comparatively warm at about 190 Kelvin (minus 83 degrees Celsius or minus 117 degrees Fahrenheit). This secondary tank also cools the telescope and the 3.4- and 4.6-micron detectors. Small heaters are used to warm the 3.4- and 4.6-micron detectors from 12 to 32 Kelvin.

It is important to maintain a vacuum inside the cryostat when it is cold and on the ground; otherwise air would freeze inside it. It would become a giant popsicle. A deployable aperture cover seals the top of the cryostat while on the ground to prevent air from getting in. After WISE is safely in orbit, a signal is sent to eject the aperture cover. Three pyrotechnic separation nuts will fire, and the cover will be pushed away from the spacecraft by a set of springs.

An aperture shade is mounted at the top of the telescope to shield the open cryostat system from the sun and Earth's heat.

The expected lifetime of WISE's frozen hydrogen supply is 10 months. Since it takes WISE six months to survey the sky, this is enough cryogen to complete one-and-a-half surveys of the entire sky after a one-month checkout period in orbit.

Infrared Missions, Past and Present

WISE is joining two infrared missions already in space, NASA's Spitzer Space Telescope, and the European Space Agency's Herschel Observatory, in which NASA plays an important role. Herschel is similar to Spitzer, but it observes primarily longer wavelengths of infrared light. Why do we need another infrared space telescope?

WISE is different in that it is a survey mission designed to see everything in the sky. Spitzer focuses on specific objects or regions of interest and studies them in detail. So far, it has targeted about one percent of the sky. For this purpose, Spitzer has a higher sensitivity and resolution than WISE -- it's like a telephoto lens, while WISE is like a wide-angle camera.

Survey missions are important for finding the oddballs of space -- the superlative objects, such as, in the case of WISE, the nearest stars and the most luminous galaxies. The more sky you scour, the more likely you are to uncover the hidden and rare gems. Survey missions also serve as tour guides for future missions, pointing them to the most interesting objects for follow-up studies. Spitzer, Herschel, NASA's Hubble Space Telescope, NASA's upcoming SOFIA airborne telescope, NASA's upcoming James Webb Space Telescope and the most powerful ground-based telescopes will all study the most interesting targets found by WISE in more detail.

Space-based Missions

- **Infrared Astronomical Satellite**, commonly referred to by its acronym IRAS (NASA/Netherlands/United Kingdom): Launched Jan. 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 include 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. WISE is hundreds of times more sensitive than the Infrared Astronomical Satellite.

- NASA's **Cosmic Background Explorer**, commonly referred to as COBE: Launched Nov. 1989, this Nobel Prize-winning mission studied both infrared and microwave radiation emitted by remnants of the Big Bang, the cataclysmic event that marks the beginning of the physical universe. In addition, it mapped the brightness of the sky at infrared wavelengths from 1.25 to 240 microns, but with relatively coarse sensitivity and resolution (42 arcminutes or 0.7 degrees). 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 led to the formation of galaxies. WISE is hundreds of thousands of times more sensitive than the Cosmic Background Explorer at the overlapping infrared wavelengths.

- **Infrared Space Observatory** (European Space Agency, with participation of Japan and NASA): The mission, launched Nov. 1995, observed at wavelengths between 2.5 and 240 microns, covering a broad wavelength range with greater sensitivity and higher resolution than any previous mission. It operated for two-and-a-half 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 discovery of traces of water around the planets in our solar system and as far away as the Orion nebula.

- **Akari** (Japan): This was the first Japanese space telescope dedicated to infrared astronomy. It was launched in 2006 and surveyed 94 percent of the sky between wavelengths of 9 and 180 microns with sensitivity similar to that of IRAS. Its scan was completed by 2007.

- NASA's **Spitzer Space Telescope**: This infrared member of NASA's family of Great Observatories, a group that includes the Hubble and Chandra space telescopes, launched in Aug. 2003. It used up its liquid-helium coolant in May 2009, but two of its infrared channels still function perfectly. The telescope continues to probe stars, galaxies and more, and has taken on some new projects, such as sizing up near-Earth asteroids and comets, and measuring the expansion rate of the universe. Some of Spitzer's greatest achievements include the discovery of a huge halo around Saturn and its rings; the first direct detection of light from a planet around a star other than our sun; the unmasking of hundreds of dark and dusty black holes; and the identification of massive galaxies that formed less than one billion years after the Big Bang.

- **Herschel Observatory** (European Space Agency with important NASA participation): Launched into space from French Guiana in May 2009, Herschel is the largest infrared space telescope ever flown, with a mirror 3.5 meters (11.5 feet) in diameter. Herschel can see the coldest and dustiest objects in space. It observes longer wavelengths in the far-infrared and submillimeter ranges (55 to 672 microns). Like Spitzer, it is designed to observe particular objects and regions of interest in detail, and will cover only about one percent of the sky.

- **James Webb Space Telescope** (NASA/European Space Agency): This telescope, scheduled to launch in 2014, 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 will study the early universe and the formation of galaxies, stars and planets.

Airborne Missions

- NASA's **Kuiper Airborne Observatory**: From 1971 to 1995, the 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.

- NASA's **Stratospheric Observatory for Infrared Astronomy**, commonly referred to as SOFIA: The Stratospheric Observatory for Infrared Astronomy incorporates a 2.5-meter (98-inch) infrared-sensitive telescope onboard a modified Boeing 747-SP aircraft. The observatory is scheduled to fly in 2010, and will observe targets of interest at wavelengths from 1 to 650 microns. Astronomers plan to use the airborne telescope to study star birth and death, nebulas and black holes.

Ground-based Projects

- **Two-Micron Sky Survey** (California Institute of Technology): This was the first infrared survey of the sky from the ground, taken at Mount Wilson Observatory in Southern California in the 1960s. The survey, conducted at a wavelength of 2.2 microns, covered about 75 percent of the sky and produced a catalog of 5,000 celestial objects.

- **Two-Micron All-Sky Survey**, commonly referred to as 2MASS (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 project conducted the most thorough high-resolution digital survey of the entire sky, observing nearly 500 million objects at wavelengths of 1.2, 1.6, and 2.2 microns. The Arizona telescope began observations in June 1997, while the Chilean telescope began in March 1998. The survey concluded in February 2001. The project's major contributions are 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 disk of the Milky Way, and discoveries of numerous dust-obscured galaxies and quasars in the distant universe.

- NASA's **Infrared Telescope Facility**: A ground-based, 9.8-foot (3-meter) diameter telescope, designed to observe at infrared wavelengths from 1 to 25 microns. 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, in Honolulu. The telescope was established in 1979 and is still operating today. It provides infrared support of NASA missions such as the Voyager spacecraft. Fifty percent of its observing time remains reserved for study of solar system objects, mainly planets and their moons.

NASA's Explorer Program

WISE was developed as a medium-class Explorer mission under NASA's Explorer Program.

The Explorer Program is the oldest continuous program within NASA. It has launched more than 90 missions, beginning with the Explorer 1 launch in 1958 and including the Nobel Prize-winning Cosmic Background Explorer (COBE) Mission. The early Explorer missions were managed by JPL for the U.S. Army.

The objective of the Explorer Program is to provide frequent flight opportunities for world-class scientific investigations from space. Explorer missions are focused science missions led by a principal investigator and occur over relatively short periods of time. They are selected via a highly competitive announcement of opportunity process. The program currently administers only principal investigator-led heliophysics and astrophysics science investigations; in the past, it covered more fields of science.

The Explorer Program seeks to enhance public awareness of and appreciation for space science and to incorporate educational and public outreach activities as integral parts of space science investigations.

Individual Explorer missions are mutually independent, but share a common funding and NASA oversight management structure. The program is designed to accomplish high-quality scientific investigations using innovative, streamlined and efficient management approaches. It seeks to contain mission cost through commitment to, and control of, design, development and operations costs.

The Explorer Program is directed by the Heliophysics Division within NASA's Science Mission Directorate. The Explorer Program Office is hosted at NASA's Goddard Space Flight Center in Greenbelt, Md.

OPERATING EXPLORER MISSIONS

Mission name, launch date

Rossi X-Ray Timing Explorer (XTE): December 30, 1995

Advanced Composition Explorer (ACE): August 25, 1997

Transition Region and Coronal Explorer (TRACE): April 1, 1998

Wilkinson Microwave Anisotropy Probe (WMAP): June 30, 2001

Ramaty High Energy Solar Spectroscopic Imager: February 5, 2002

Galaxy Evolution Explorer (GALEX): April 28, 2003

Swift: November 20, 2004

Suzaku: July 10, 2005

Two Wide Angle Imaging Neutral-Atom Spectrometers (TWINS): A) June 2006; B) March 2008

Time History of Events and Macroscale Interactions during Substorms (THEMIS): February 17, 2007

Aeronomy of Ice in the Mesosphere (AIM): April 25, 2007

Coupled Ion-Neutral Dynamics Investigations (CINDI): April 16, 2008

Interstellar Boundary Explorer (IBEX): October 19, 2008

EXPLORER MISSIONS IN DEVELOPMENT

Mission name, expected launch date

Wide-Field Infrared Survey Explorer: no earlier than December 7, 2009

Nuclear Spectroscopic Telescope Array (NuSTAR): August 15, 2011

ASTRO-H: February 2014

Interface Region Imaging Spectrograph (IRIS): December 2012

Gravity and Extreme Magnetism Small Explorer: May 2014

Program/Project Management

The WISE mission is managed for NASA's Science Mission Directorate, Washington, by NASA's Jet Propulsion Laboratory, Pasadena, Calif.

At NASA Headquarters, Edward Weiler is the associate administrator for the Science Mission Directorate. Charles Gay is deputy associate administrator for the Science Mission Directorate. Jon Morse is director of the astronomy and physics division. Anne-Marie Novo-Gradac is the WISE program executive. Hashima Hasan is the WISE program scientist. At NASA's Goddard Space Flight Center in Maryland, Andrea I. Razzaghi is the mission manager and David Leisawitz is the mission scientist.

The mission's principal investigator, Edward L. (Ned) Wright, is at UCLA.

At JPL, William Irace is the project manager, and Fengchuan Liu is the deputy project manager. Peter Eisenhardt is the project scientist, and Amy Mainzer the deputy project scientist. The California Institute of Technology in Pasadena manages JPL for NASA.

At NASA's Kennedy Space Center in Florida, the NASA Launch Services Program is responsible for government oversight of launch vehicle preparations at Vandenberg Air Force Base; the engineering, certification and testing of the United Launch Alliance launch vehicle; spacecraft ground support and integration with the rocket; the Space Launch Complex 2 pad facilities; countdown management; launch vehicle tracking; data acquisition; and telemetry monitoring.

The Tracking and Data Relay Satellite System is managed by NASA's Goddard Space Flight Center.

12-3-09