The **Spitzer Space Telescope**, formerly the **Space Infrared Telescope Facility** (**SIRTF**), was an [infrared](https://en.wikipedia.org/wiki/Infrared) [space telescope](https://en.wikipedia.org/wiki/Space_telescope) launched in 2003, that was deactivated when operations ended on 30 January 2020.[[5]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-SciAm_2019-5)[[9]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-NYT-20200130-9) Spitzer was the third space telescope dedicated to infrared astronomy, following [IRAS](https://en.wikipedia.org/wiki/IRAS) (1983) and [ISO](https://en.wikipedia.org/wiki/Infrared_Space_Observatory) (1995–1998). It was the first spacecraft to use an [Earth-trailing orbit](https://en.wikipedia.org/wiki/Earth-trailing_orbit), later used by the [Kepler](https://en.wikipedia.org/wiki/Kepler_space_telescope) planet-finder.

The planned mission period was to be 2.5 years with a pre-launch expectation that the mission could extend to five or slightly more years until the onboard [liquid helium](https://en.wikipedia.org/wiki/Liquid_helium) supply was exhausted. This occurred on 15 May 2009.[[10]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-nasa20090515-10) Without liquid helium to cool the telescope to the very low temperatures needed to operate, most of the instruments were no longer usable. However, the two shortest-wavelength modules of the [IRAC](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#Instruments) camera continued to operate with the same sensitivity as before the helium was exhausted, and continued to be used into early 2020 in the **Spitzer Warm Mission**.[[11]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-spitzer-warm-prospect-11)[[12]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-cycle6-12)

During the warm mission, the two short wavelength channels of IRAC operated at 28.7 K and were predicted to experience little to no degradation at this temperature compared to the nominal mission. The Spitzer data, from both the primary and warm phases, are archived at the [Infrared Science Archive](https://en.wikipedia.org/wiki/Infrared_Science_Archive) (IRSA).

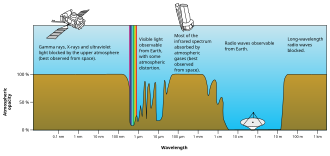
In keeping with NASA tradition, the telescope was renamed after its successful demonstration of operation, on 18 December 2003. Unlike most [telescopes](https://en.wikipedia.org/wiki/Telescope) that are named by a board of scientists, typically after famous deceased astronomers, the new name for SIRTF was obtained from a contest open to the general public. The contest led to the telescope being named in honor of astronomer [Lyman Spitzer](https://en.wikipedia.org/wiki/Lyman_Spitzer), who had promoted the concept of space telescopes in the 1940s.[[13]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-spitzer_bio-13) Spitzer wrote a 1946 report for [RAND Corporation](https://en.wikipedia.org/wiki/RAND_Corporation) describing the advantages of an extraterrestrial observatory and how it could be realized with available or upcoming technology.[[14]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-14)[[15]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-15) He has been cited for his pioneering contributions to [rocketry](https://en.wikipedia.org/wiki/Rocket) and [astronomy](https://en.wikipedia.org/wiki/Astronomy), as well as "his vision and leadership in articulating the advantages and benefits to be realized from the Space Telescope Program."[[13]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-spitzer_bio-13)

The US$776 million[[16]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-jpl-cost-16) Spitzer was launched on 25 August 2003 at 05:35:39 [UTC](https://en.wikipedia.org/wiki/UTC) from [Cape Canaveral](https://en.wikipedia.org/wiki/Cape_Canaveral_Air_Force_Station) [SLC-17B](https://en.wikipedia.org/wiki/Cape_Canaveral_Air_Force_Station_Space_Launch_Complex_17) aboard a [Delta II](https://en.wikipedia.org/wiki/Delta_II) 7920H rocket.[[3]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-sfnow20030825-3) It was placed into a [heliocentric](https://en.wikipedia.org/wiki/Heliocentric) (as opposed to a [geocentric](https://en.wikipedia.org/wiki/Geocentric)) orbit trailing and drifting away from Earth's orbit at approximately 0.1 [astronomical units](https://en.wikipedia.org/wiki/Astronomical_unit) per year (an ["Earth-trailing" orbit](https://en.wikipedia.org/wiki/Earth-trailing_orbit)[[1]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-nasa20070422-1)).

The [primary mirror](https://en.wikipedia.org/wiki/Primary_mirror) is 85 centimeters (33 in) in diameter, [*f*/12](https://en.wikipedia.org/wiki/F-number), made of [beryllium](https://en.wikipedia.org/wiki/Beryllium) and was cooled to 5.5 [K](https://en.wikipedia.org/wiki/Kelvin) (−268 °C; −450 °F). The [satellite](https://en.wikipedia.org/wiki/Satellite) contains three instruments that allowed it to perform astronomical imaging and [photometry](https://en.wikipedia.org/wiki/Photometry_(astronomy)) from 3.6 to 160 micrometers, [spectroscopy](https://en.wikipedia.org/wiki/Spectroscopy) from 5.2 to 38 micrometers, and [spectrophotometry](https://en.wikipedia.org/wiki/Spectrophotometry) from 55 to 95 micrometers.[[8]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-handbook3.2-8)

**History**

|  | This section **needs additional citations for** [**verification**](https://en.wikipedia.org/wiki/Wikipedia:Verifiability). Please help [improve this article](https://en.wikipedia.org/wiki/Special:EditPage/Spitzer_Space_Telescope) by [adding citations to reliable sources](https://en.wikipedia.org/wiki/Help:Referencing_for_beginners) in this section. Unsourced material may be challenged and removed. *(January 2020) (*[*Learn how and when to remove this message*](https://en.wikipedia.org/wiki/Help:Maintenance_template_removal)*)* |
| --- | --- |



Rough plot of Earth's atmospheric [transmittance](https://en.wikipedia.org/wiki/Transmittance) (or opacity) to various wavelengths of electromagnetic radiation, including visible light.

By the early 1970s, astronomers began to consider the possibility of placing an [infrared telescope](https://en.wikipedia.org/wiki/Infrared_telescope) above the obscuring effects of Earth's atmosphere. Most of the infrared spectrum is outside the [optical window](https://en.wikipedia.org/wiki/Optical_window), meaning they are strongly absorbed by the atmosphere, except for the [infrared window](https://en.wikipedia.org/wiki/Infrared_window).

In 1979, a report from the National Research Council of the [National Academy of Sciences](https://en.wikipedia.org/wiki/National_Academy_of_Sciences), *A Strategy for Space Astronomy and Astrophysics for the 1980s*, identified a Shuttle Infrared Telescope Facility (SIRTF)[[17]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-NRC_report-17) as "one of two major astrophysics facilities [to be developed] for [Spacelab](https://en.wikipedia.org/wiki/Spacelab)", a shuttle-borne platform. Anticipating the major results from an upcoming Explorer satellite and from the Shuttle mission, the report also favored the "study and development of ... long-duration spaceflights of infrared telescopes cooled to cryogenic temperatures[[18]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-1980_Decadal-18)."

The launch in January 1983 of the [Infrared Astronomical Satellite](https://en.wikipedia.org/wiki/IRAS) (IRAS), jointly developed by the United States, the Netherlands, and the United Kingdom, to conduct the first far-infrared survey of the sky, whetted the appetites of scientists worldwide for follow-up space missions capitalizing on the rapid improvements in infrared detector technology.

Earlier infrared observations had been made by both space-based and ground-based [observatories](https://en.wikipedia.org/wiki/Observatory). Ground-based observatories have the drawback that at infrared [wavelengths](https://en.wikipedia.org/wiki/Wavelength) or [frequencies](https://en.wikipedia.org/wiki/Frequency), both the Earth's [atmosphere](https://en.wikipedia.org/wiki/Earth%27s_atmosphere) and the telescope itself will radiate (glow) brightly. Additionally, the atmosphere is opaque at most infrared wavelengths. This necessitates lengthy exposure times and greatly decreases the ability to detect faint objects. It could be compared to trying to observe the stars in visible light at noon from a telescope built out of light bulbs. Previous space observatories (such as [IRAS](https://en.wikipedia.org/wiki/IRAS), the Infrared Astronomical Satellite, and [ISO](https://en.wikipedia.org/wiki/Infrared_Space_Observatory), the Infrared Space Observatory) were launched during the 1980s and 1990s and great advances in astronomical technology have been made since then.



The SIRTF in a Kennedy Space Center clean room.

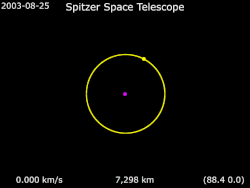


The launch of SIRTF in 2003 aboard the 300th Delta rocket.

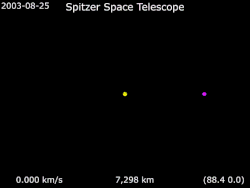
Most of the early concepts envisioned repeated flights aboard the NASA Space Shuttle. This approach was developed in an era when the Shuttle program was expected to support weekly flights of up to 30 days duration. A May 1983 NASA Announcement of Opportunity described SIRTF as a Shuttle-attached mission with an evolving scientific instrument payload. Several flights were anticipated with a probable transition into a more extended mode of operation, possibly in association with a future space platform or space station. SIRTF would be a 1-meter class, cryogenically cooled, multi-user facility consisting of a telescope and associated focal plane instruments mounted on a general-purpose Instrument Pointing System to be developed by [NASA Ames](https://en.wikipedia.org/wiki/NASA_Ames). SIRTF would be launched on the Space Shuttle and remain attached to the Shuttle as a [Spacelab](https://en.wikipedia.org/wiki/Spacelab) payload during astronomical observations, after which it would be returned to Earth for refurbishment prior to re-flight. The first flight was expected to occur about 1990 with the succeeding flights anticipated beginning approximately one year later. However, the Spacelab-2 flight aboard [STS-51-F](https://en.wikipedia.org/wiki/STS-51-F) showed that the Shuttle environment was poorly suited to an onboard infrared telescope due to contamination from the relatively "dirty" vacuum associated with the orbiters. By September 1983, NASA was considering the "possibility of a long duration [free-flyer] SIRTF mission".[[19]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-nasa-spitzer-infrared-19)[[20]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-ask-mag-25-20)

Spitzer is the only one of the [Great Observatories](https://en.wikipedia.org/wiki/Great_Observatories) not launched by the [Space Shuttle](https://en.wikipedia.org/wiki/Space_Shuttle), as was originally intended[[*citation needed*](https://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]. However, after the 1986 [Challenger disaster](https://en.wikipedia.org/wiki/STS-51-L), the [Shuttle-Centaur](https://en.wikipedia.org/wiki/Shuttle-Centaur) upper stage, which would have been required to place it into its final orbit, was abandoned. The mission underwent a series of redesigns during the 1990s, primarily due to budget considerations. This resulted in a much smaller but still fully capable mission that could use the smaller Delta II expendable launch vehicle.[[21]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-21)

**Animation of Spitzer Space Telescope**

****

Around the Earth

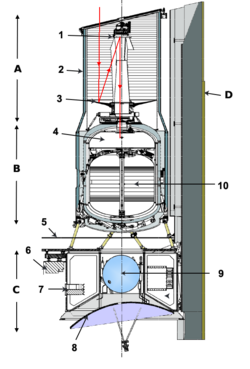


Around the Sun - Frame rotating with the Earth

Spitzer Space Telescope **·** [Earth](https://en.wikipedia.org/wiki/Earth) **·** [Sun](https://en.wikipedia.org/wiki/Sun)

One of the most important advances of this redesign was an [Earth-trailing orbit](https://en.wikipedia.org/wiki/List_of_orbits#Special_classifications).[[1]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-nasa20070422-1) Cryogenic satellites that require liquid helium (LHe, T ≈ 4 K) temperatures in near-Earth orbit are typically exposed to a large heat load from Earth, and consequently require large amounts of LHe coolant, which then tends to dominate the total payload mass and limits mission life. Placing the satellite in solar orbit far from Earth allowed innovative passive cooling. The sun shield protected the rest of the spacecraft from the Sun's heat, the far side of the spacecraft was painted black to enhance passive radiation of heat, and the spacecraft bus was thermally isolated from the telescope. All of these design choices combined to drastically reduce the total mass of helium needed, resulting in an overall smaller and lighter payload, resulting in major cost savings, but with a mirror the same diameter as originally designed. This orbit also simplified telescope pointing, but did require the [NASA Deep Space Network](https://en.wikipedia.org/wiki/NASA_Deep_Space_Network) for communications.[[*citation needed*](https://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]

The primary instrument package (telescope and cryogenic chamber) was developed by [Ball Aerospace & Technologies](https://en.wikipedia.org/wiki/Ball_Aerospace_%26_Technologies), in [Boulder, Colorado](https://en.wikipedia.org/wiki/Boulder,_Colorado). The individual instruments were developed jointly by industrial, academic, and government institutions. The principals were [Cornell University](https://en.wikipedia.org/wiki/Cornell_University), the [University of Arizona](https://en.wikipedia.org/wiki/University_of_Arizona), the [Smithsonian Astrophysical Observatory](https://en.wikipedia.org/wiki/Smithsonian_Astrophysical_Observatory), [Ball Aerospace](https://en.wikipedia.org/wiki/Ball_Aerospace), and [Goddard Spaceflight Center](https://en.wikipedia.org/wiki/Goddard_Spaceflight_Center). The shorter-wavelength infrared detectors were developed by [Raytheon](https://en.wikipedia.org/wiki/Raytheon) in [Goleta, California](https://en.wikipedia.org/wiki/Goleta,_California). Raytheon used [indium antimonide](https://en.wikipedia.org/wiki/Indium_antimonide) and a [doped](https://en.wikipedia.org/wiki/Dopant) [silicon](https://en.wikipedia.org/wiki/Silicon) detector in the creation of the infrared detectors. These detectors are 100 times more sensitive than what was available at the beginning of the project during the 1980s.[[22]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-raytheon-20040108-22) The far-infrared detectors (70–160 micrometers) were developed jointly by the University of Arizona and [Lawrence Berkeley National Laboratory](https://en.wikipedia.org/wiki/Lawrence_Berkeley_National_Laboratory) using [gallium](https://en.wikipedia.org/wiki/Gallium)-doped [germanium](https://en.wikipedia.org/wiki/Germanium). The spacecraft was built by [Lockheed Martin](https://en.wikipedia.org/wiki/Lockheed_Martin). The mission was operated and managed by the [Jet Propulsion Laboratory](https://en.wikipedia.org/wiki/Jet_Propulsion_Laboratory) and the *Spitzer Science Center*,[[23]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-23) located at IPAC on the [Caltech](https://en.wikipedia.org/wiki/Caltech) campus in Pasadena, California.[[*citation needed*](https://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]



Schematic view of Spitzer:

**A Optics** : 1 - secondary mirror; 3 - primary mirror; 2 - outer shell;

**B Cryostat**: 4 - instruments; 10 - helium tank;

**C Service module**: 5 - service module shield; 6 - star tracker; 7 - batteries; 8 - high-gain antenna; 9 - nitrogen tank;

**D Solar panels**

**Launch and commissioning**

| **[icon]** | **This section is empty.** You can help by [adding to it](https://en.wikipedia.org/w/index.php?title=Spitzer_Space_Telescope&action=edit&section=). *(December 2021)* |
| --- | --- |

**Warm mission and end of mission**

Spitzer ran out of liquid helium coolant on 15 May 2009, which stopped far-IR observations. Only the IRAC instrument remained in use, and only at the two shorter wavelength bands (3.6 μm and 4.5 μm). The telescope equilibrium temperature was then around 30 K (−243 °C; −406 °F), and IRAC continued to produce valuable images at those wavelengths as the "Spitzer Warm Mission".[[24]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-nasa-20090508-24)

Late in the mission, ~2016, Spitzer's distance to Earth and the shape of its orbit meant the spacecraft had to pitch over at an extreme angle to aim its antenna at Earth.[[25]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-nasa20160825-25) The solar panels were not fully illuminated at this angle, and this limited those communications to 2.5 hours due to the battery drain.[[26]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-Sp-life-26) The telescope was retired on 30 January 2020[[5]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-SciAm_2019-5) when NASA sent a shutdown signal to the telescope from the [Goldstone Deep Space Communications Complex](https://en.wikipedia.org/wiki/Goldstone_Deep_Space_Communications_Complex) (GDSCC) instructing the telescope to go into safe mode.[[27]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-wired-20200129-27) After receiving confirmation that the command was successful, Spitzer Project Manager Joseph Hunt officially declared that the mission had ended.[[28]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-jpl-20200130-28)

**Instruments**

****

Cryogenic Telescope Assembly (CTA)

Spitzer carries three instruments on board:[[29]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-spitzer-geninfo-29)[[30]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-ssc-obs-overview-30)[[31]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-31)[[32]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-ssc-obs-man-32)

[**Infrared Array Camera**](https://en.wikipedia.org/wiki/Infrared_Array_Camera) **(IRAC)**

An infrared camera which operated simultaneously on four wavelengths (3.6 μm, 4.5 μm, 5.8 μm and 8 μm). Each module used a 256×256-pixel detector—the short-wavelength pair used [indium antimonide](https://en.wikipedia.org/wiki/Indium_antimonide) technology, the long-wavelength pair used arsenic-doped silicon [impurity band conduction](https://en.wikipedia.org/wiki/Impurity_band_conduction) technology.[[33]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-IRAC-33) The principal investigator was [Giovanni Fazio](https://en.wikipedia.org/wiki/Giovanni_Fazio) of [Center for Astrophysics | Harvard & Smithsonian](https://en.wikipedia.org/wiki/Harvard-Smithsonian_Center_for_Astrophysics); the flight hardware was built by [NASA](https://en.wikipedia.org/wiki/NASA) [Goddard Space Flight Center](https://en.wikipedia.org/wiki/Goddard_Space_Flight_Center).

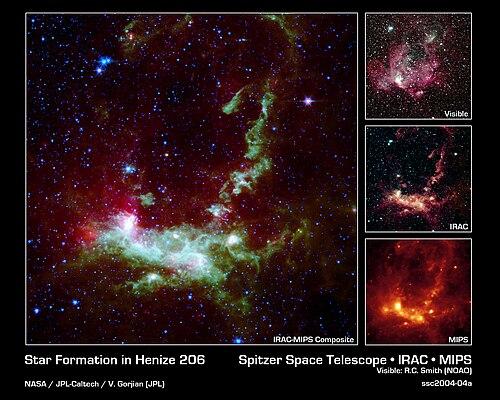
**Infrared Spectrograph (IRS)**

An infrared spectrometer with four sub-modules which operate at the wavelengths 5.3–14 μm (low resolution), 10–19.5 μm (high resolution), 14–40 μm (low resolution), and 19–37 μm (high resolution). Each module used a 128×128-pixel detector—the short-wavelength pair used arsenic-doped silicon blocked impurity band technology, the long-wavelength pair used antimony-doped silicon blocked impurity band technology.[[34]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-IRS-34) The principal investigator was [James R. Houck](https://en.wikipedia.org/wiki/James_R._Houck) of [Cornell University](https://en.wikipedia.org/wiki/Cornell_University); the flight hardware was built by [Ball Aerospace](https://en.wikipedia.org/wiki/Ball_Aerospace).

**Multiband Imaging Photometer for Spitzer (MIPS)**

Three detector arrays in the mid- to far-infrared (128 × 128 pixels at 24 [μm](https://en.wikipedia.org/wiki/%CE%9Cm), 32 × 32 pixels at 70 μm, 2 × 20 pixels at 160 μm). The 24 μm detector is identical to one of the IRS short-wavelength modules. The 70 μm detector used gallium-doped germanium technology, and the 160 μm detector also used gallium-doped germanium, but with mechanical stress added to each pixel to lower the bandgap and extend sensitivity to this long-wavelength.[[35]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-MIPS-35) The principal investigator was [George H. Rieke](https://en.wikipedia.org/wiki/George_H._Rieke) of the [University of Arizona](https://en.wikipedia.org/wiki/University_of_Arizona); the flight hardware was built by [Ball Aerospace](https://en.wikipedia.org/wiki/Ball_Aerospace).

All three instruments used liquid helium for cooling the sensors. Once the helium was exhausted, only the two shorter wavelengths in IRAC were used in the "warm mission".



A [Henize 206](https://en.wikipedia.org/wiki/Henize_206) viewed by different instruments in March 2004. The separate IRAC and MIPS images are at right.

**Results**

While some time on the telescope was reserved for participating institutions and crucial projects, astronomers around the world also had the opportunity to submit proposals for observing time. Prior to launch, there was a proposal call for large, coherent investigations using Spitzer. If the telescope failed early and/or ran out of cryogen very quickly, these so-called Legacy Projects would ensure the best possible science could be obtained quickly in the early months of the mission. As a requirement tied to the funding these Legacy teams received, the teams had to deliver high-level data products back to the Spitzer Science Center (and the [NASA/IPAC Infrared Science Archive](https://en.wikipedia.org/wiki/Infrared_Science_Archive)) for use by the community, again ensuring the rapid scientific return of the mission. The international scientific community quickly realized the value of delivering products for others to use, and even though Legacy projects were no longer explicitly solicited in subsequent proposal calls, teams continued to deliver products to the community. The Spitzer Science Center later reinstated named "Legacy" projects (and later still "Exploration Science" projects) in response to this community-driven effort.[[36]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-ipac-spitzer-legacy-36)

Important targets included forming stars ([young stellar objects](https://en.wikipedia.org/wiki/Young_stellar_object), or YSOs), planets, and other galaxies. Images are freely available for educational and journalistic purposes.[[37]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-ipac-image-policy-37)[[38]](https://en.wikipedia.org/wiki/Spitzer_Space_Telescope#cite_note-38)