



# SOFIA

STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY



# EXPLORING THE INFRARED UNIVERSE

## SOFIA's Mission

SOFIA, the Stratospheric Observatory for Infrared Astronomy, is a Boeing 747SP aircraft modified to carry a 2.7-meter (106-inch) reflecting telescope (with an effective diameter of 2.5 meters or 100 inches). Flying into the stratosphere at 38,000–45,000 feet puts SOFIA above 99 percent of Earth's infrared-blocking atmosphere, letting astronomers study the solar system and beyond in ways that are not possible with ground-based telescopes. SOFIA is an 80/20 partnership of NASA and the German Aerospace Center (DLR).

The aircraft is operated and maintained by NASA's Armstrong Flight Research Center Building 703, in Palmdale, California. NASA's Ames Research Center in California's Silicon Valley manages SOFIA's program, science and mission operations in cooperation with the Universities Space Research Association (USRA; Columbia, Md.) and the German SOFIA Institute (DSI; University of Stuttgart).

## A Unique Airborne Observatory

The aircraft is a Boeing 747SP. The "SP" designates that this is a "special performance" version of the 747. The SP aircraft were designed for longer flights than Boeing 747 Classics, and are approximately 48 feet shorter than a 747-200 aircraft.

The mobility of the observatory allows researchers to observe from both of Earth's hemispheres, and enables studies of transient events that often take place over oceans where there are no telescopes. Unlike space-based telescopes, SOFIA lands after each flight, so its telescope instruments can be exchanged, serviced or upgraded to harness new technologies. Because these new instruments can be tested and adjusted, SOFIA can serve as a testbed for technology that may one day fly in space. The observatory can also be used to train NASA's next generation of instrument builders.



Scientists and technicians conduct nighttime observations on SOFIA. (DLR/Fabian Walker)

## SOFIA and the Infrared Universe

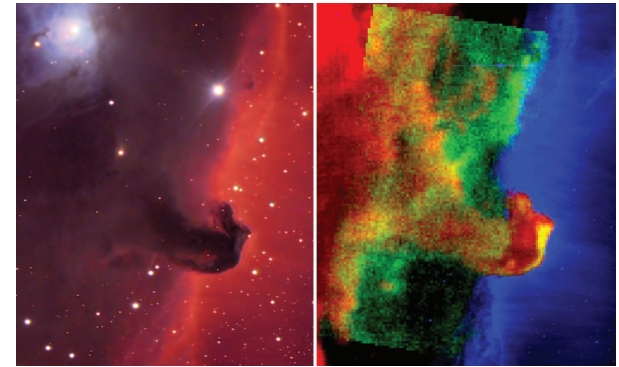
Studying the universe using only visible light results in a very limited view, as you can see from the two images on the right. Visible light — the light you see with your eyes — reveals only part of the universe. Astronomers observe many other types of "light" to expand our views of the universe. SOFIA is designed to specifically observe the infrared universe.

Infrared energy is just one part of the electromagnetic spectrum, which includes visible light, x-rays, radio waves and others. Many objects in space emit almost all their energy at infrared wavelengths. Often, they are invisible when observed in ordinary visible light. In other cases, clouds of gas and dust in space block the light emitted by more distant objects, but allow infrared energy to reach our telescopes. In both cases, the only way to learn about other objects is to study the infrared light they emit.

During 10-hour, overnight flights, SOFIA observes the solar system and beyond at mid- and far-infrared wavelengths gathering data to study:

- Star birth and death
- Formation of new solar systems
- Organic compounds in space
- Nebulae and the ecosystems of galaxies
- Celestial magnetic fields
- Black holes at the center of galaxies
- Planets, comets and asteroids in our solar system

SOFIA's telescope instruments — cameras, spectrometers and polarimeters — operate in the near-, mid- and far-infrared wavelengths, each suited to studying a particular phenomena. Spectrometers spread light into its component colors, in the same way that a prism spreads visible light into a rainbow, to reveal the chemical fingerprints of celestial molecules and atoms. Polarimeters are sensitive to the effect magnetic fields have on dust in and around celestial objects, allowing astronomers to learn how magnetic fields affect the birth of stars and other objects.



Visible (left) and infrared (right) images of the Horsehead Nebula. The infrared image, taken by SOFIA's upGREAT instrument, shows carbon monoxide molecules sheltered in the dense nebula (red area) and carbon atoms and ions that have been affected by the radiation from nearby stars (green area). The dust that forms the Horsehead blocks visible light but glows brightly in the infrared. (Left: Dylan O'Donnell, deography.com; Right: NASA/SOFIA/J. Bally et. al)

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