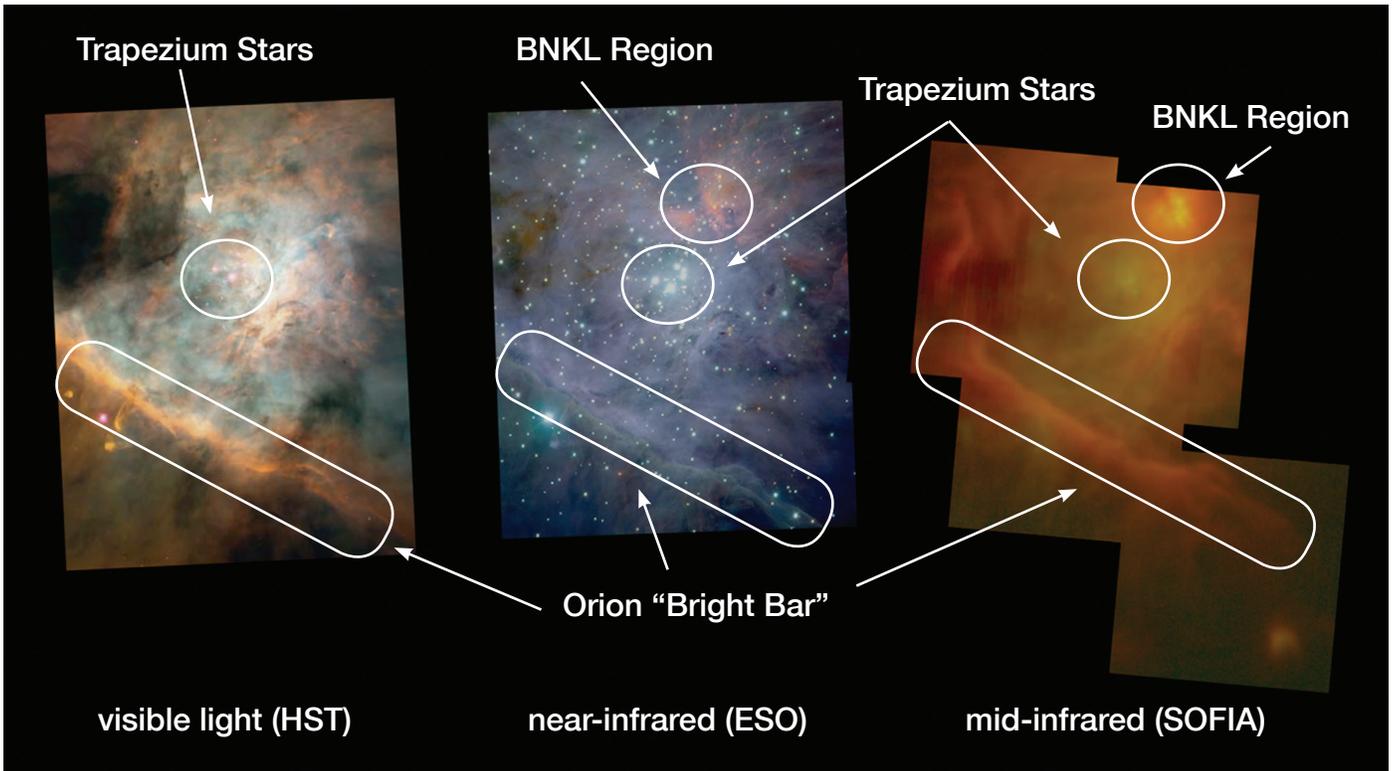




Orion's Messier 42 (M42) region



Comparison of Images of Orion's Messier 42 (M42) Region

Studying the universe at infrared wavelengths enables astronomers to detect stars and planets forming, to view the supermassive black hole at the center of our galaxy through obscuring clouds of interstellar dust, to understand the life cycle of organic substances in space, and to determine the chemical compositions of comets, asteroids, and planetary atmospheres.

The Stratospheric Observatory For Infrared Astronomy, or SOFIA, is a highly modified Boeing 747SP that makes celestial observations using a telescope with an effective diameter of 2.5 meters (100 inches). SOFIA's telescope is optimized to collect infrared radiation and is outfitted with an ensemble of scientific instruments — cameras, spectrometers and photometers - to detect energy at a wider range of wavelengths than any other observatory, on the ground or in space. Infrared energy in certain wavelengths bands will not reach ground-based telescopes because it is blocked by water vapor in the Earth's atmosphere. To get a more complete view of the infrared universe, SOFIA operates at altitudes between 12 and 14 kilometers (39,000 to 45,000 feet), which puts the observatory above more than 99 percent of the water vapor.

This three-panel comparison of Orion's Messier 42 (M42) region is composed of a visible light image from the Hubble Space Telescope, a near-infrared image captured by the European Southern Observatory in Chile, and a mid-infrared mosaic image taken by SOFIA's Faint Object InfraRed Camera for the SOFIA Telescope, or FORCAST. The FORCAST instrument was developed by principal investigator Terry Herter and his team from Cornell University and Ithaca College (both located in Ithaca, N.Y.).

M42 is a star-forming region located 1500 light years from Earth that is visible to the naked eye as a fuzzy patch in Orion's "sword". Within that patch of the sky are three areas of significance: The Trapezium Stars, the Orion "Bright Bar," and the Becklin-Neugebauer/Kleinmann-Low (BNKL) region. These areas have been identified in the photographs attached.

Trapezium Stars

Theta Orionis, commonly referred to as The Trapezium:

- Located at the center of M42.
- Formed approximately 1 million years ago
- One of the youngest known star clusters.
- Approximately 1,000 stars in The Trapezium region.
- The Trapezium is about four light years (40 trillion kilometers or 24 trillion miles) in diameter.

Near-infrared image: The Trapezium stars are more easily discerned because the view at those wavelengths penetrates the thin clouds of dust particles around them and along our line of sight. For that reason, this view also sees into the dense dust cloud behind the Trapezium, revealing dozens of stars in the process of condensing from the cloud, termed "protostars", that are not seen in the Hubble visible-light image.

Mid-infrared image from SOFIA: The Trapezium stars are almost undetected because those stars radiate comparatively little radiation at these wavelengths compared with the clouds themselves. The dust clouds throughout M42 are opaque in the Hubble visible-light view, nearly transparent in the near-infrared image, and are seen glowing with their own heat in this mid-infrared image.

The Orion "Bar"

- The Orion Bar is sometimes called the "Bright Bar."
- Located at the boundary between the relatively sparse region in the center of the images and a cold dense cloud of gas and dust at lower left.
- The Bar is an "ionization front" or Photo-Dissociation Region (PDR), meaning it is the outer edge of a bubble of gas that is being heated by intense ultraviolet radiation from the Trapezium stars, expanding away from them and "eating into" the cold dense cloud. Astronomers hypothesize that pressure from the bubble's expansion will stimulate the formation of more stars in the rest of M42.

Visible light image shows the Bar as a mostly opaque cloud illuminated from the side by the Trapezium stars.

Near-infrared view sees partly into the Bar, and reveals the glow of excited gas within the Bar.

Mid-infrared view reveals heat radiation from dust in the Bar, including emission from plentiful organic molecules called Polycyclic Aromatic Hydrocarbons (PAHs).

The BNKL (Becklin-Neugebauer/Kleinmann-Low) region

- The BNKL region contains a deeply embedded protostar dubbed the Becklin-Neugebauer object that eventually will become a B-type star with more than 1,000 times the sun's luminosity.
- The adjacent Kleinmann-Low nebula is a cooler cloud, evidently at an earlier stage of development, that is beginning to contract and will eventually form one or more stars.

Visible light: The BNKL region can not be seen because it is so deep in the opaque dust clouds behind the Trapezium that none of that light can reach Earth.

Near-infrared: BNKL can be seen as a bright complex with relatively cool temperature (represented here by orange color). BNKL is understood to be a star cluster that will eventually resemble the Trapezium.

Mid-infrared: Image reveals heat radiating from the BNKL complex as well as detailed structures in the clouds of star forming material throughout M42. This young stellar cluster was originally identified in 1967 by Eric Becklin and Gerald Neugebauer. Dr. Becklin, who today serves as SOFIA's Chief Science Advisor, was on SOFIA's initial science flight (Dec. 1, 2010) that continued the studies of these objects.

How and Why?

SOFIA's mid-infrared image was taken at two wavelengths (20 microns, represented by green and 37 microns represented by red) that cannot be accessed by any telescope on the ground or currently in space, giving the SOFIA airborne observatory a unique window on the universe.

The SOFIA images allow astronomers to better understand the details of the star formation process.

- Star formation occurs when dense clouds of interstellar material such as the ones in M42 contract due to a combination of their own internal gravity plus external pressures.
- In the case of M42, the Trapezium stars have finished forming; their radiation is disturbing and pushing on distant material in both the BNKL and Bar regions in a way that astronomers expect that will lead to more star formation
- In a million years or so the protostars in the BNKL region may look like a new Trapezium cluster.

SOFIA is a joint program between NASA and the German Aerospace Agency, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Germany. The SOFIA program is managed at NASA's Armstrong Flight Research Center, Palmdale, Calif. NASA's Ames Research Center, Moffett Field, Calif., manages the SOFIA science and mission operations in cooperation with the Universities Space Research Association (USRA), Columbia, Md., and the Deutsches SOFIA Institut (DSI), Stuttgart, Germany.

For more information about SOFIA, visit: <http://www.nasa.gov/sofia>

For information about SOFIA's science mission, visit:

<http://www.sofia.usra.edu> and <http://www.dlr.de/en/sofia>

Credits

Visible-light image: NASA/ESA/HST/AURA/STScI/O'Dell & Wong

Near-IR image: ESO/McCaughrean et al.

Mid-IR image: NASA/DLR/SOFIA/USRA/DSI/FORCAST Team

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