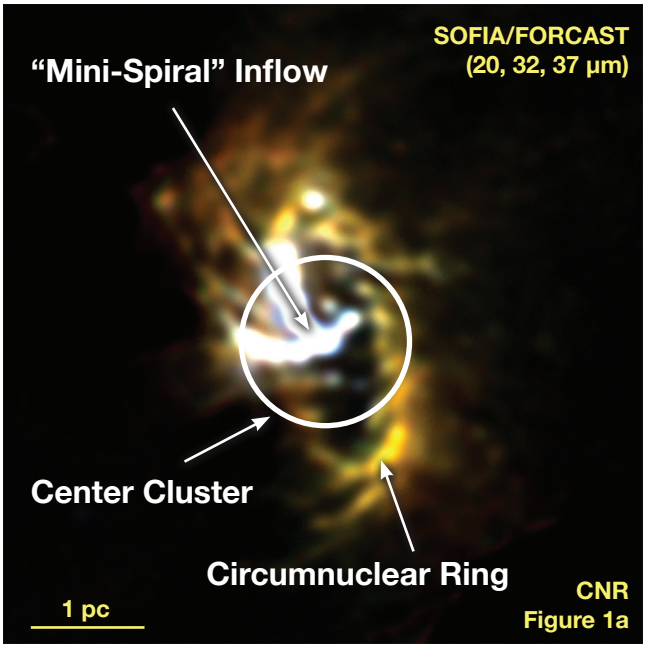
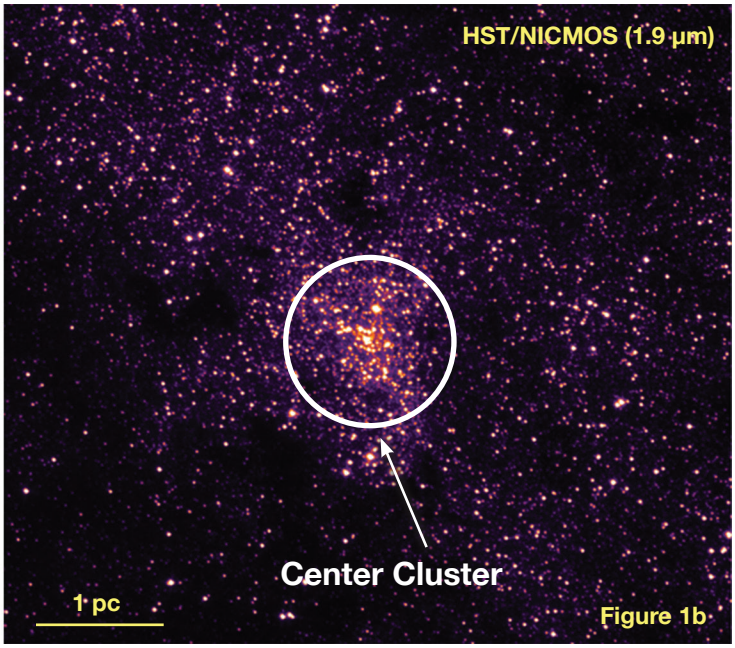
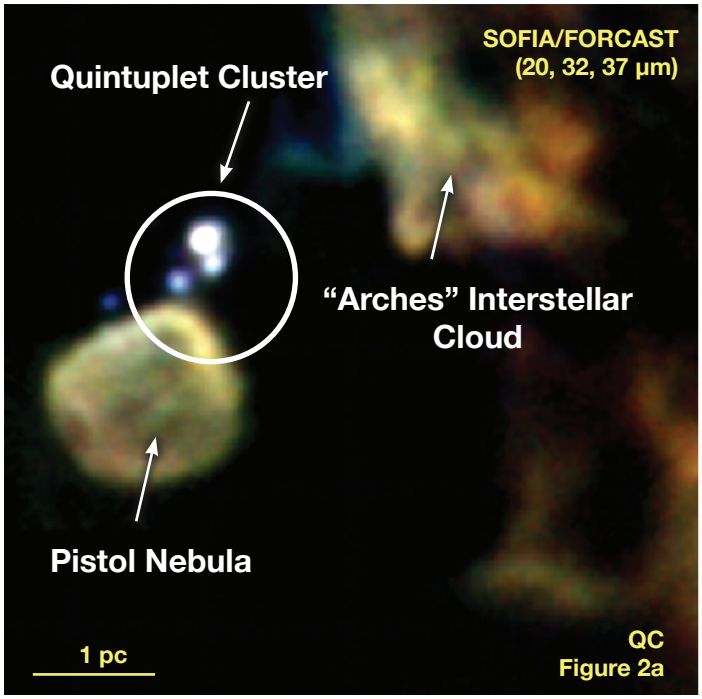
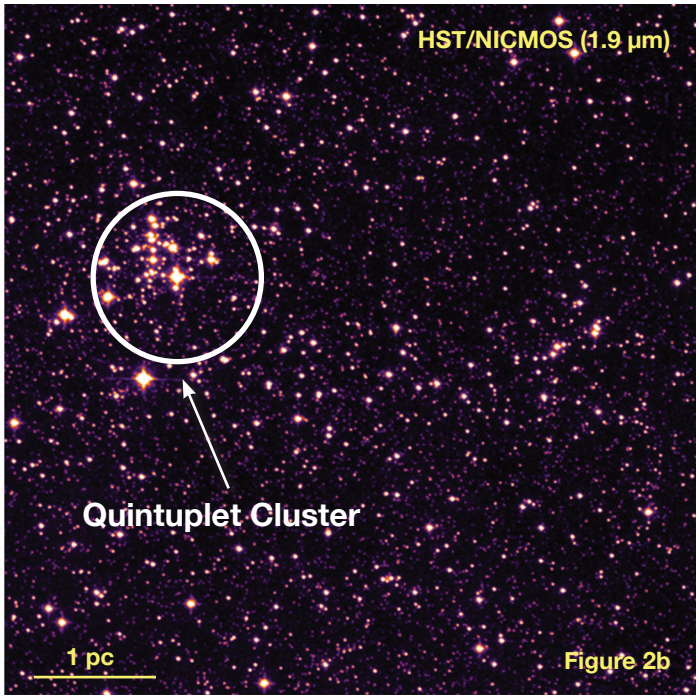
Signs of Recent Starbursts in the Milky Way Galaxy's Center





1 pc (parsec) = 3.3 light years = 25 arcsec for a galactic center distance of 8,300 pc





Signs of Recent Starbursts in the Milky Way Galaxy's Center

Researchers using the Stratospheric Observatory for Infrared Astronomy (SOFIA) have captured new images of a ring of gas and dust ten light-years in diameter surrounding the supermassive black hole at the center of the Milky Way, and of a neighboring cluster of extremely luminous young stars embedded in dust cocoons.

The images of our galaxy's Circumnuclear Ring (CNR) and the neighboring Quintuplet Cluster (QC) are the subjects of research by Ryan Lau and his collaborators from Cornell University who studied the CNR, and Matt Hankins of the University of Central Arkansas in Conway who, along with his colleagues, studied the QC.

SOFIA is a modified Boeing 747SP aircraft carrying a telescope with an effective diameter of 100 inches (2.5 meters) to altitudes as high as 45,000 feet (14 km). The images were obtained during SOFIA flights in 2011 using the Faint Object infraRed Camera for the SOFIA Telescope (FORCAST) instrument built by a team with principal investigator Terry Herter of Cornell.

Together SOFIA and FORCAST offer astronomers the ability to see celestial objects which are cooler than stars. Infrared radiation from such objects can pass through interstellar dust that blocks visible light, but infrared is blocked by water vapor in Earth's atmosphere. Thus, these SOFIA/FORCAST images reveal exotic features in the galactic center that cannot be observed either by ground-based observatories or by the Hubble Space Telescope.

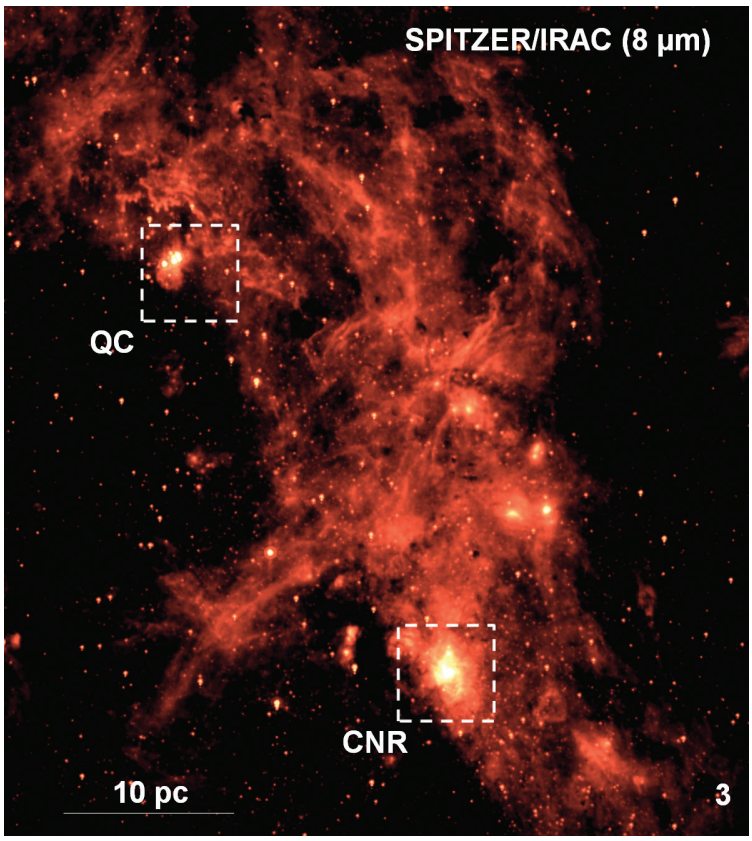
Each FORCAST image is a combination of multiple exposures at wavelengths of 20, 32, and 37 microns (μm). **Figure 1a** shows the CNR and **Figure 2a** shows the QC. The CNR and other denizens of the galactic center seen by SOFIA's FORCAST camera are invisible to Hubble's near-infrared camera, NICMOS, as shown for comparison in figures 1b and 2b. **Figure 3** shows the two fields studied in these papers as square insets on a large-scale image of the galactic center made by the Spitzer Space Telescope at an infrared wavelength of 8 microns.

"The focus of our study has been to determine the structure of the Circumnuclear Ring with the unprecedented precision possible with SOFIA", said Lau. "Using these data we can learn about the processes that accelerate and heat the ring."

The nucleus of the Milky Way is inhabited by a black hole with 4 million times the mass of the sun that is orbited by a large disk of gas and dust. The CNR seen in Figure 1a is the inner edge of that disk. The bright Y-shaped feature is understood to be material falling from the ring toward the black hole that is located where the arms of the "Y" intersect.

The galactic center also hosts several exceptionally large star clusters containing some of the most luminous young stars in the galaxy, one of which is the Quintuplet Cluster seen in Figure 2. The QC is a group of young stars near the left margin of the frame, located about 35 parsecs (100 light years) from the galaxy's nucleus. The compact bright objects rendered white and blue in this image are dust cloud "cocoons" heated from within by the highest-luminosity stars in the cluster to temperatures that make them prominent at mid-infrared wavelengths. Other features in this image are interstellar clouds of gas and dust. The large fan-shaped Pistol Nebula below the QC is an expanding cloud of debris produced by violent ejections of material from a massive star nearing the end of its life. The combination of SOFIA's airborne telescope with the FORCAST camera produced the sharpest images of those regions ever obtained at mid-infrared wavelengths, allowing discernment of new clues about what is happening near the central black hole.

"Something big happened in the Milky Way's center within the past 4 million to 6 million years that resulted in several bursts of star formation, creating the Quintuplet Cluster, the Central Cluster, and one other massive star cluster," said Hankins, lead author of the QC paper. "Many other galaxies also have so-called 'starbursts' in their central regions, some associated with central black holes, some not. The Milky Way's center is much nearer than other galaxies, making it easier for us to explore possible connections between the starbursts and the black hole."



SOFIA Chief Scientific Advisor Eric Becklin, who is working with the CNR group, determined the location of the galaxy's nucleus as a graduate student in the 1960s by laboriously scanning a single-pixel infrared detector to map the central region.

"The resolution and spatial coverage of these images is astounding, showing what modern infrared detector arrays can do when flown on SOFIA," Becklin said. "We hope to use these data to substantially advance our understanding of the environment near a supermassive black hole."

SOFIA is a joint project of NASA and the German Aerospace Center. SOFIA is based and managed at NASA's Dryden Aircraft Operations Facility in Palmdale, Calif. NASA's Ames Research Center in Moffett Field, Calif., manages the SOFIA science and mission operations in cooperation with the Universities Space Research Association headquartered in Columbia, Md., and the German SOFIA Institute at the University of Stuttgart.

For more information about SOFIA, visit:
http://www.nasa.gov/sofia • http://www.dlr.de/en/sofia

For information about SOFIA's science mission, visit:
http://www.sofia.usra.edu • http://www.dsi.uni-stuttgart.de/index.en.html

The SOFIA images in this lithograph, plus supplementary images and information, may be seen by visiting **http://www.sofia.usra.edu/News/news_2013/01_08_13/** or **http://www.sofia.usra.edu/Gallery/science/science.html**

Credits
Figure 1a: NASA/DLR/USRA/DSI/FORCAST Team/Lau *et al.* 2013
Figure 1b: NASA/ESA/STScI/AURA
Figure 2a: NASA/DLR/USRA/DSI/FORCAST Team/Hankins *et al.* 2013
Figure 2b: NASA/HST/STScI/AURA
Figure 3: NASA/Spitzer/Caltech-JPL

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