SOFIA Science Newsletter

April 2023

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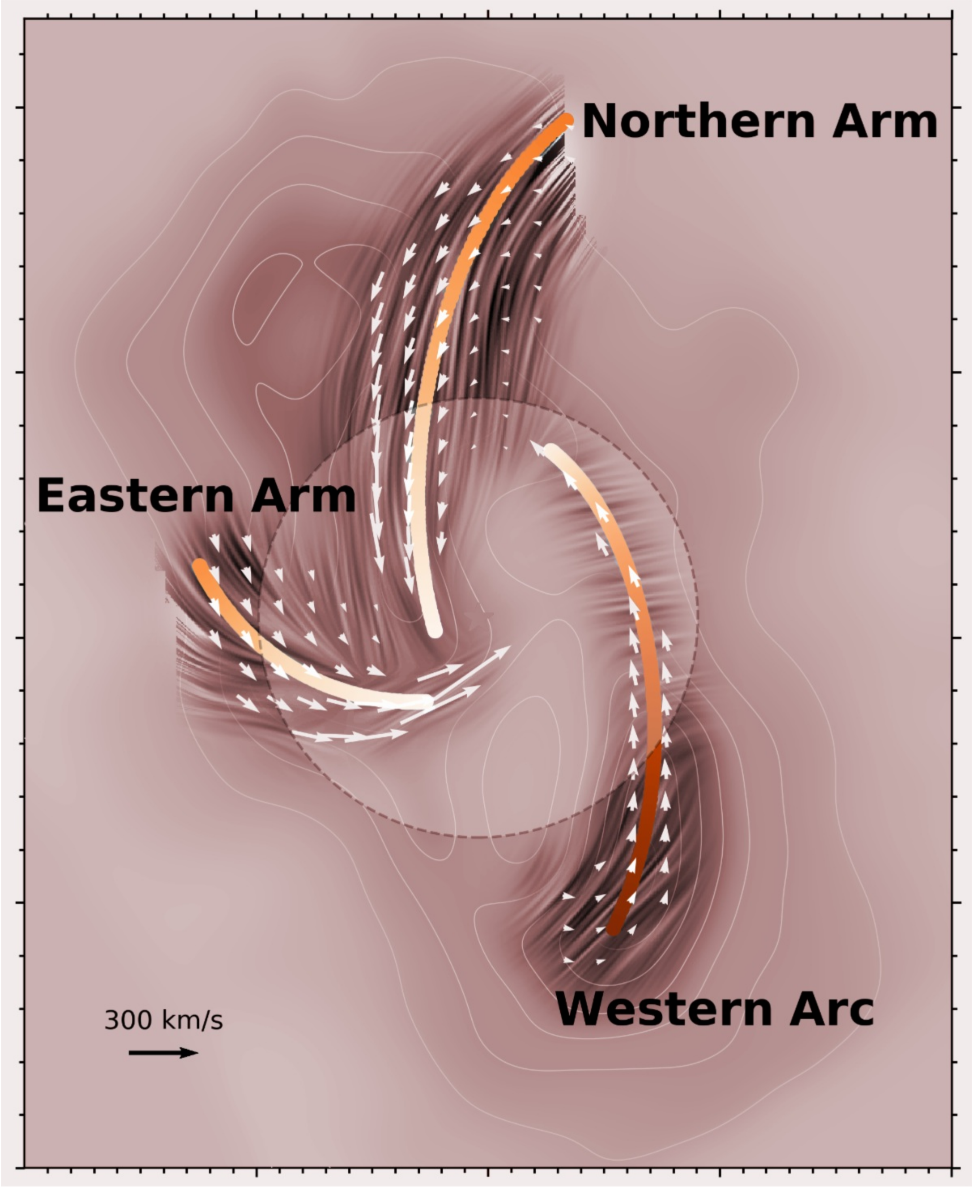
Science Spotlight

Magnetically-Structured Accretion in the Galactic Center's Circumnuclear Disk

In the inner five parsec of the Galactic Center, there exists a region of dense molecular gas and hot dust known as the Circumnuclear Disk (CND). The influence of the central black hole associated with the Sgr A* radio source is so important in this region that astronomers have always assumed that gravity would dominate the dynamics. New findings, however, suggest that magnetic fields in the CND may be strong enough to significantly influence the accretion of material onto Sgr A*.

The gas-dominated version of the CND is motivated, in part, by the detection of three streamers -- the Northern Arm, the Eastern Arm, and the Western Arc (see figure). These streamers consist of ionized material falling toward Sgr A* in approximate Keplerian orbits with velocities of up to 500 km/s. On the other hand, polarimetry data obtained with the High-resolution Airborne Wideband Camera Plus (HAWC+) onboard SOFIA indicates that the magnetic fields that thread the hot dust co-located in the CND are largely aligned with the direction of the streamers. Read more here.



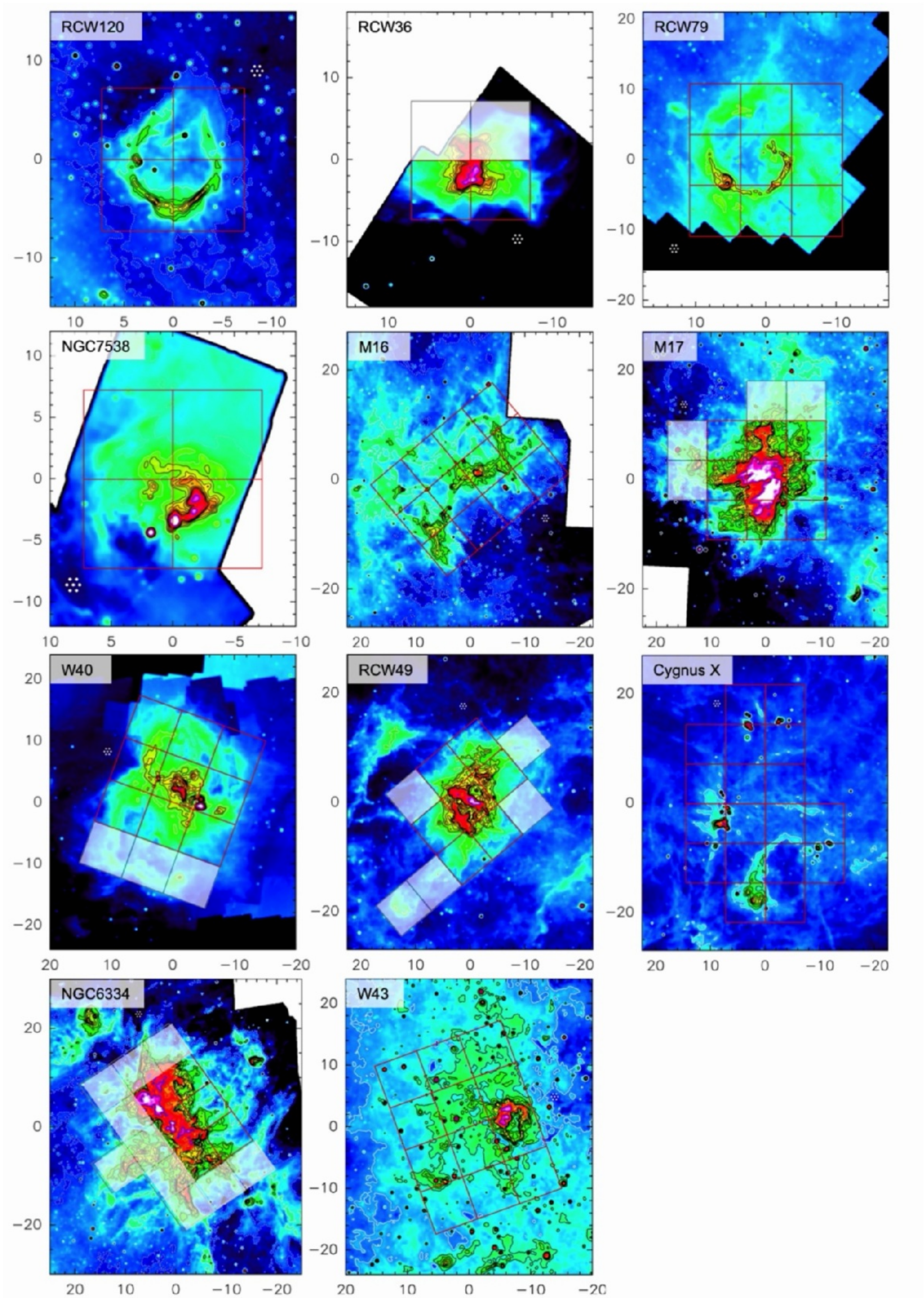
The Circumnuclear Disk in the Galactic center as observed by SOFIA/HAWC+. The magnetic field streamlines from the polarization data are shown superposed on the 53-μm intensity map with an angular resolution of ~5 arcsec. White vectors represent the direction and magnitude of the shear flows in each of the streamers of ionized material. Magnetic field strength along the flow direction is depicted by the color-coded stripes with values ranging from 0.9 mG (light) to 27 mG (dark). The star shows the position of Sgr A*. The dashed circle represents the approximate boundary between the magnetic-dominated region (outside) and the gas-dominated region (inside). Credit: Guerra et al., 2023

Featured Legacy Dataset

The SOFIA Legacy Program FEEDBACK

The interaction of massive stars with their environments regulates the evolution of galaxies through a process called feedback. Mechanical input by massive stars stirs up the interstellar medium, greatly influencing the star formation efficiency of molecular clouds as, on the one hand, this disperses star forming molecular cloud cores and, on the other hand, it creates dense shells of swept up gas that are prone to gravitational collapse. In addition, the radiative energy input by massive stars creates ionized gas regions surrounded by dense photo-dissociation regions, and the spectral characteristics of these regions dominate the emission of galaxies. This gas heating also controls the cloud and intercloud phases of the interstellar medium and thereby the overall structure of the interstellar medium.

The high sensitivity, high spectral resolution, and fast mapping speed of the upGREAT heterodyne instrument on SOFIA provides a unique tool to study this feedback of massive stars on their surrounding medium. This instrument can probe the dominant cooling line of moderate density gas illuminated by strong far-UV radiation fields, allowing us to quantify the relationship between the energy injected by star formation activity and the feedback processes involved. Read more here.



Feedback source sample. The red boxes outline the tiles proposed to be observed for each source. The slightly opaque ones were not observed. Colored background: The IRAC 8μm map of the sources tracing the PDRs in these regions convolved to the 14” upGREAT beam. Contours are predicted [CII] 1.9 THz integrated line intensity based upon the [CII]-8 μm relation derived for L1630, Orion, and 30 Dor. Contour levels are: white dashed (50 K km/s), white (100 K km/s), black (150(50)400 K km/s), red (500 K km/s), blue (1000 K km/s). Box units are in arcmin. The upGREAT 7 beam pattern is plotted alongside the outlined area in each box, illustrating that much finer detail than visible in these images can be traced. Credit: Robert Simon, University of Cologne

Good to Know

New FORCAST Cookbook

There are a variety of periodic noises observed in the data from the FORCAST instrument. Occasionally the small errors in the telescope's nod cause a periodic noise pattern in FORCAST 19.7um observations. Rachel Vander Vliet and Karishma Bansal have developed a Jupyter notebook that demonstrates two methods to handle this noise and improve the image quality. Both methods use Fourier transforms and notch filtering. The first is a manual approach, which walks the user through the mechanics of how notch filtering works. Here, the frequencies that contribute to the noise need to be visually identified by the user. The second method is an automated approach that identifies the noise frequencies based on a few initial parameters. The notebook shows examples of how different kinds of sources suffer from this effect and how these techniques can be used to deal with it.

Observatory News

Social Media & Blog Changes

Now that the SOFIA mission has ended, it is time for our social media news to take off from somewhere else. Our Twitter and Instagram accounts will stop posting on Friday, May 5 — but we still have more science to share! Please follow us at our new home at @NASAUniverse on Twitter or NASA Universe on Facebook for the most up-to-date SOFIA stories. Our Facebook page will merge with NASA Universe on Monday, May 15 — if you follow us there, you will automatically be transferred over with the merger.

The NASA Ames Office of Communications will take over SOFIA blogs and features starting on Monday, April 24. If you have potentially newsworthy results to share, please contact Abby Tabor (abigail.s.tabor@nasa.gov).

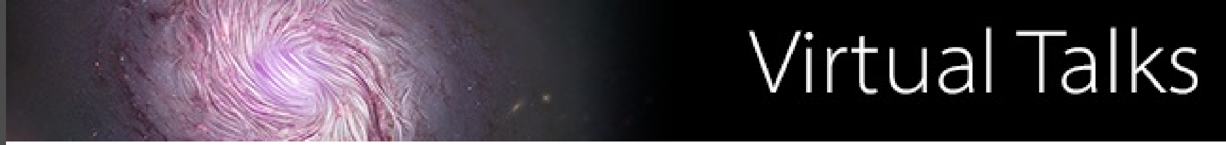
Upcoming Events

AAS Meeting-in-a-Meeting, "On the Wings of SOFIA"

This June there will be a Meeting-in-a-Meeting during the 242nd gathering of the American Astronomical Society (AAS) in Albuquerque, NM entitled, "Standing on the Wings of SOFIA." This event will be a forum to discuss key results from SOFIA's decade-long mission, with topics ranging from the Solar System to distant galaxies, and will explore how the SOFIA legacy can provide a foundation for the FIR Probe concepts currently under development in response to the recommendations by the 2020 Decadal Survey.

This event will consist of five 90-min sessions over three days and will cover four general topics where SOFIA has had a significant impact to the development of infrared astronomy: ISM/Star formation, Magnetic Fields/Dust physics, Galaxy Structure, and Stars/Solar system. The last day will be dedicated to discussion of future far-IR instrumentation and missions, especially the four FIR Probes.

We look forward to seeing you in Albuquerque!



Join Science Talks Remotely: Tele-Talks

Tele-Talks are scientific presentations given via phone, with slides distributed ahead of time. The talks are held approximately twice a month on Wednesdays at 9:00 a.m. Pacific, noon Eastern. For information on how to participate, check the SOFIA Tele-Talk webpage.

Upcoming Tele-Talks

- May 10: Randolf Klein (SSC); PDR fronts in M17-SW
- May 24: Akshaya Subbanna M S (KASI); alignment and rotational disruption of dust grains in SgrA
- June 7: Aiden Kaminsky (RIT); morphology and dynamics of the Musca filament
- June 21: Mark Heyer (UMass); converging flows of atomic gas onto a molecular cloud

Please direct questions and comments to the SOFIA Science Center help desk: sofia_help@sofia.usra.edu.