SOFIA Science Newsletter

August 2020

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Cycle 9 Proposal Preparation Webinar: Tuesday August 18, 8:00-10:30 am Pacific Time

This interactive event will provide practical information to both experienced and prospective SOFIA users on how to best design a scientifically and technically strong SOFIA proposal for Cycle 9.

For each SOFIA instrument, science staff members will present realistic science examples and demonstrate how to determine the necessary signal to noise, choose the observing strategy, perform observing time estimation with SITE and design the corresponding Astronomical Observation Request with USPOT.

A general presentation will introduce the main science cases addressed by SOFIA, and the general capabilities of the instrument suite, as well as the specific features offered during Cycle 9, including the Dual Anonymous Review framework. There will be ample time for questions.

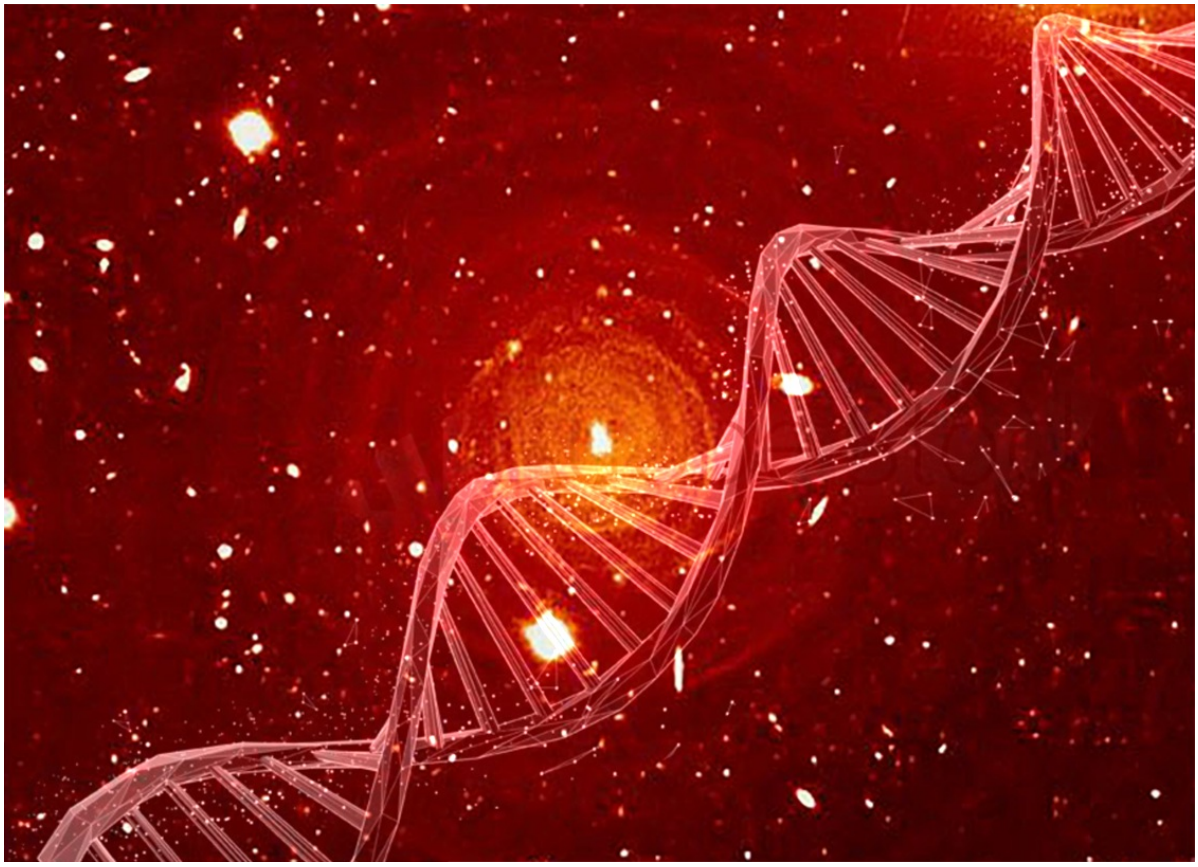
Please connect through this Webex link. The agenda and more connection information are available here.

Science Spotlight: SOFIA Detects Carbon-Rich Winds from Pulsating Mira Star

A fundamental issue in stellar astrophysics is the role of low- and intermediate-mass stars in the chemical enrichment of the Universe. Carbon stars are believed to be the dominant source of dust contributed by stars to the interstellar medium. Recent infrared spectra from FORCAST on SOFIA uncovered a fundamental difference between the dust produced by two types of carbon-rich variable stars, revealing a close relation to the pulsations racking these evolved stars. The Mira variables, with their strong pulsations, are producing significant quantities of amorphous carbon dust. The semi-regular variables, on the other hand, show little dust, and what dust they have is primarily silicon carbide (SiC).

The different pulsational properties of Miras and semi-regulars are almost certainly responsible for the differences in the dust. Miras are experiencing radial pulsations in the fundamental mode, so that their entire atmosphere is moving inward and outward in unison, which will push gas further away from the photosphere and enhance the condensation of dust. Semi-regulars pulsate more weakly and often in overtone modes, which will result in lower pulsation velocities and smaller changes in radius. As a result, less gas will cool to temperatures low enough for dust to condense. These weak

pulsations appear to be more conducive for the formation of just SiC. Read more here.



Infrared spectra from SOFIA help reveal fundamental differences between the dust produced by two types of carbon-rich variable stars. Miras, well-known for their long pulsation periods and strong amplitudes, are producing copious amounts of amorphous carbon dust, while the semi-regulars form mainly SiC. These results help unravel the mystery of how the carbon produced inside stars gets out into the interstellar medium to provide not only the raw material for future generations of star formation, but also the methane in the atmospheres of planets and exoplanets as well as the DNA that forms the basis of life as we know it.Credit: Izan Leao; the Very Large Telescope/© Viks_jin - stock.adobe.com

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SOFIA Instrument Roadmap: Workshops Summary and Community Survey

In response to a request from NASA to develop a plan and timeline, or a "roadmap," for SOFIA's instrument development during 2020-2025, the SOFIA Science Center hosted two workshops this summer to collect community input. The first event was focused on science cases (proceedings here) and the second event on concepts and technology readiness for instrument upgrades and new instruments (proceedings here). We are happy to report that both events were sound successes, with more than 300 attendees in total, and engaging talks by more than 40 invited speakers followed by vibrant and fruitful discussions.

During the next month, the SOFIA SMO will develop the SOFIA Instrument Roadmap proposal, as requested by NASA. This will be based on the inputs from the two workshops. We continue to solicit and encourage suggestions and comments to this effort. Please do not hesitate to send those to Jim Jackson (jjackson@sofia.usra.edu). We invite you to respond to this short survey on priorities for science cases and instrument capabilities.

Featured Public Archival Data: Organic Inventories in Young Stellar Objects and Disks with EXES

The 5.5-8 microns spectral region is rich in vibrational and rovibrational transitions of

organic molecules and their isotopologues, including pre-biotic molecules. Spectral signatures from water (in particular the ground state v2 vibrational band), formaldehyde, methane, ammonia, CH_3, HCN, and more complex organics can be emitted from warm and hot regions around young stellar objects, as well as the inner regions (<a few AU) of protoplanetary disks. High resolution mid-IR spectra are hence an important tool to understand the mechanics of dust grain evaporation in stellar environments, and eventually to retrace chemical evolution during planet formation.

While the 5.5-8 microns region is inaccessible from the ground, it is observable with the EXES instrument aboard SOFIA. Thanks to its high spectral resolution modes up to R~90000, much higher than what Spitzer IRS could offer, profiles of blended and individual transitions can be analyzed to estimate molecular abundances and excitation temperatures. In addition, measurements of the gas velocity through Doppler-shifts can help to identify the source region for each molecule.

Over the past several years, EXES observations have contributed to a rich inventory of mid-IR spectra from YSOs and protoplanetary disks. The available public database includes sources such as: GV Tau's disk (project 05_0097, Carr et al., in prep), and massive protostars AFGL 2136, AFGL 2591 (projects 04_0120/05_0041 - Barr et al. 2020, 2018, Indriolo et al. 2020), Orion IRc2 (project 05_0043/06_0061, Nickerson et al. in prep) and high-mass YSOs NGC 7538 IRS 1 and IRS 9 (project 75_0024).All calibrated data is available from the IRSA SOFIA Archive.

We're Hiring! Instrument Scientist Positions Open

We are currently seeking two scientists to support the HAWC+, GREAT, and FIFI-LS facility instruments. Instrument scientists are experts on the operation of, and data produced by, the SOFIA scientific instruments, generally with a primary focus on one instrument and a supporting role on another.

Instrument scientists duties include:

- Serving as the point of contact between the observatory and the guest observers
- Preparing, planning, and overseeing the execution of observations during flight operations (as part of a team with the instrument operator, telescope operator, and mission director)
- Carrying out the inspection, calibration analysis, and quality assurance assessment of data reduced by the automatic pipelines to ensure that high quality calibrated products are generated, ingested into the archive, and distributed to the community

We invite qualified candidates to apply on the USRA website. Application deadline is September 14, 2020.

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 in the Tele-Talks, please check the SOFIA Tele-Talk webpage.

Upcoming Tele-Talk Schedule

- September 9: [CII] in LMC; Vianney Leboutellier (University of Paris-Saclay)
- September 16: CO-dark Molecular Gas Mass in 30 Dor; Mélanie Chevance (University of Heidelberg)
- October 7: First Detection of 13CH; Arshia Jacob (Max Plank Institute for Radioastronomy)
- October 14: 13CII in LMC; Yoko Okada (University of Cologne)

- November 4: Mass Motions in Orion A; Cornelia Pabst (Leiden)

e-Newsletter Editors: Kassandra Bell and Arielle Moullet

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