SOFIA Science Newsletter

May 2023

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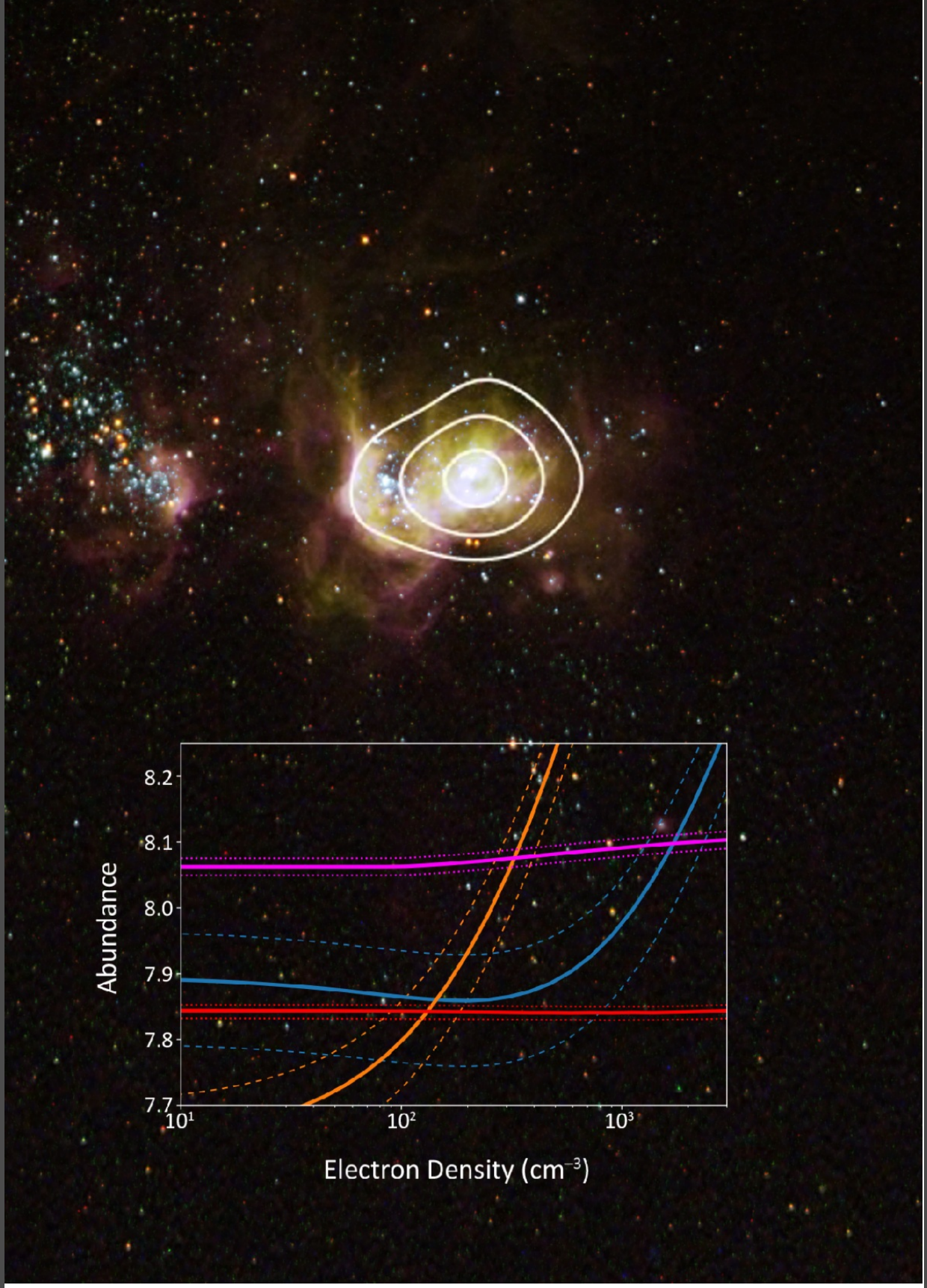
Science Spotlight

The Abundance Discrepancy Factor in Markarian 71

Far-IR measurements from the SOFIA telescope have been combined with optical data to effectively rule out temperature fluctuations as the primary cause of the Abundance Discrepancy Factor (ADF) in the metallicity of galaxy Markarian 71. This finding provides a framework for accurately measuring metallicities in galaxies across cosmic history, a crucial requirement for understanding galaxy evolution.

The heavy element content (metallicity) of the Universe is a record of the total star formation history. Gas-phase metallicity in galaxies and its evolution with time are of particular interest as tracers of the accretion and outflow processes. However, metallicities from the widely used electron-temperature method are typically about two times lower than the values based on the recombination-line method. This ADF is well known and is commonly ascribed to bias due to temperature fluctuations, i.e., an unresolved multithermal distribution of gas. Read more here.



Plot of the measured oxygen abundance [12+log(O/H)] from different emission lines as a function of electron density overlaid on an image of Mrk 71 from HST/WFC3 archival data with [OIII] 52 μm contours from SOFIA/FIFI-LS. The intersection of the [O III] 52 μm (blue) and [O III] 88 μm (orange) curves is consistent with the optical collisionally excited line metallicity (red), not the recombination-line metallicity (magenta), providing direct evidence that temperature fluctuation is not the main cause of ADF in this object. Credit: NASA/ESA/Hubble/Chen et al., 2023

Molecular Cloud Formation

Molecular clouds — clumps of gas and dust in space, where molecules form — make up

the densest regions of the Milky Way, but how they assemble is largely unknown: Some theories point to a slow, long process, while others suggest a fast, dynamic one.

A recent study, published in Nature Astronomy, used data from the SOFIA upGREAT instrument to observe ionized carbon emission from molecular clouds in the Cygnus X region, one of the most massive star formation regions in the Milky Way. The astronomers, led by Nicola Schneider, a researcher at the University of Cologne in Germany, found areas of diffuse gas surrounding two molecular clouds are colliding rapidly, creating a dense region in which new stars can form. Read more here.

Composite image of Cygnus X obtained by NASA's Spitzer Space Telescope, with SOFIA's upGREAT ionized carbon data

overlaid in blue, green, and red. The three colors represent material moving at different velocities: -10 to 4 km/s for blue, 4-12 km/s for green, and 12-20 km/s for red. Credit: NASA/Spitzer/SOFIA

Observatory News

SOFIA Primary Mirror Removed

On May 3, the primary mirror was removed from the telescope in the SOFIA aircraft, which is now at the Pima Air & Space Museum in Tucson, Arizona. A mass dummy replacing the mirror was installed on the telescope on May 4. The 2.7 m (8.9 ft) diameter primary mirror, the largest ever incorporated into a flying observatory, will soon be flown to Germany, where it will be displayed at the Deutsches Optisches Museum in the city of Jena. SOFIA was a joint US-German project executed by NASA and the German Space Agency (DLR). DLR contributed and maintained the telescope, scheduled aircraft maintenance, and provided a variety of other forms of support critical to the project.

Primary Mirror Assembly being removed from the SOFA aircraft. Credit: DSI/Florian Behrens

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In Case You Missed It: 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 stopped 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 has merged with NASA Universe, so if you follow us there, you will automatically be transferred over with the merger.

The NASA Ames Office of Communications has taken over SOFIA blogs and features. 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"

We are pleased to announce the speakers and schedule (subject to change) for the 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 June 5-7.

Please note: on the current AAS schedule, the "Standing on the Wings of SOFIA" Meeting-in-a-Meeting is listed by each individual session and not by its main title. Individual session titles are:

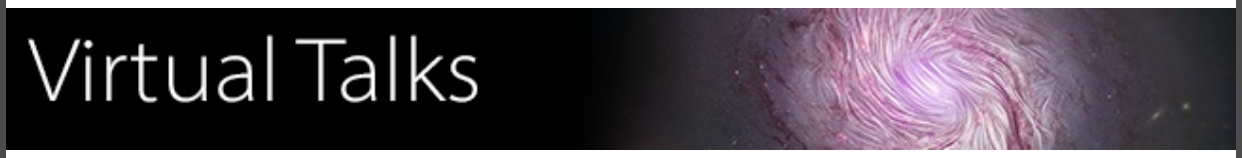
- Galactic Ecosystems: ISM & Star Formation
- Galactic Ecosystems: Magnetic Fields and Dust Physics
- Galactic Ecosystems: Galaxy Structure and Evolution
- New Worlds/Time Domain: Stars and Solar System
- The Future of FIR Astronomy

View the full schedule here.

We look forward to seeing you in Albuquerque!

SOFIA School Wrap-up

The SOFIA School was held on 18-21 April 2023 and featured 14 talks on a variety of subjects, from interstellar magnetic fields to photodissociation regions. This free virtual event was designed for anyone using astronomical mid- and far-IR data in their research. Through scientific analysis and data reduction examples, paired with lectures on fundamental concepts, attendees were introduced to the range of scientific information on a variety of sources leveraged by such data. The school focused on SOFIA, but the content presented was relevant to other mid- and far-IR data from balloon facilities and satellites. If you missed the school, you can still view the talk videos or download the presentations on the school website.



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 31: Akshaya Subbanna M S (KASI); alignment and rotational disruption of dust grains in Sgr A
- 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.