SOFIA Science Newsletter

February 2022

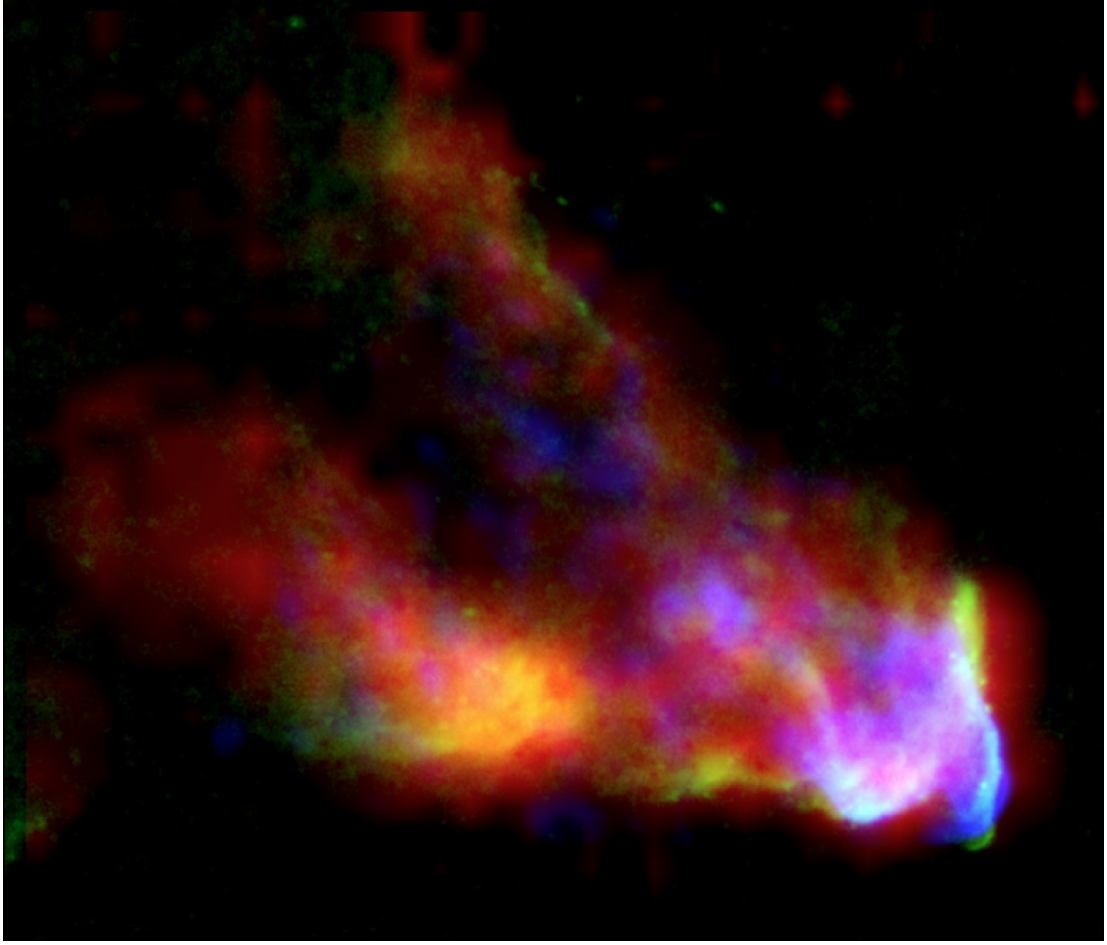
In this issue:

Science Spotlight

Temperature and Density Layers in the Ghost Nebula

Photo-Dissociation Regions (PDRs), where far-ultraviolet radiation controls the gas heating and molecular dissociation, are astrophysically important sites in the evolution of the interstellar medium (ISM), including star formation and cloud destruction.

Using the narrow slit of the EXES instrument onboard SOFIA, researchers observed the Ghost Nebula (IC63), a well-studied PDR at a distance of ~200 pc irradiated by the light from γ Cassiopeia, a B-type star. For the first time, researchers were able to resolve the temperature and density structures of a PDR, and three regions were identified based on the illumination from γ Cas: sunny, where hydrogen exists mainly in atomic form because most of the molecular hydrogen is photo-dissociated by the high-energy UV photons; shady, where hydrogen exists in molecular form and transitions are readily detectable; and ridge, the boundary between the two highlighted by near-infrared line emission. Read more.



Three-color image of the Ghost Nebula with C^+ emission from SOFIA/upGREAT (red), molecular hydrogen fluorescence from the Canada-France-Hawaii Telescope (green), and HCO^+ gas emission from CARMA (blue). The *ridge* described in the text is the green-white vertical structure in the lower right corner. *(Soam et al. 2021)*

Signal, Noise and Artifacts in FORCAST Images: March 7th, 9-9:45 am PST

This webinar -- presented by James Radomski (SOFIA/USRA) -- will describe through concrete examples how to evaluate the quality of FORCAST imaging products, how to identify typical artifacts which may affect images and what are possible solutions to perform the most accurate data analysis. Join through Webex: connection information here.

This event is a follow up of the SOFIA school, which gathered more than 200 attendees for a series of talks on practical data analysis and modeling examples, as well as instrument-specific considerations and tips on how to handle data from HAWC+, EXES, GREAT and FIFI-LS, and a demonstration of the archive searching and plotting features. All school talks are now available to be viewed online.

EXES Data Cookbooks Available

A series of new SOFIA data analysis “cookbooks” recipes is now available for EXES data.

This includes a jupyter notebook for EXES data inspection, and another for telluric correction with models from the Planetary Spectrum Generator.

All cookbooks have been reformatted as jupyter notebooks, and a new GREAT cookbook for data inspection and visualization in python has also been added.

More information here.

New Public Data Pipeline: HAWC+

We are pleased to announce that the HAWC+ data processing and calibration pipeline is now available to the public for all HAWC+ modes. Users may run the pipeline to better understand the different calibration steps, to customize their own data reductions (e.g. spatial binning), or to reprocess older archival data which may benefit from recent pipeline improvements. The pipeline software is available through SOFIA's pipeline GitHub repository. A detailed description of the data reduction process and pipeline capabilities is available in the pipeline user manual which can be found on our Data Pipelines web page.

A Message from the PRIMA Science Leadership Team

Following the recommendation in Pathways to Discovery in Astronomy and Astrophysics for the 2020s, we are formulating a cryogenic far-infrared Probe mission to address a number of identified science priorities: the PRobe far-Infrared Mission for Astrophysics (PRIMA).

The balance of instrumentation capabilities is still to be determined. To ensure the best outcome, we would like to solicit input from the community at this critical early stage to fully specify and understand the scientific drivers and their required instrumentation. Key areas of study include the trade between resolving power, wavelength coverage, and mapping speed for low-resolution spectroscopy (R~200), and the potential for medium-resolving-power spectroscopy (R~5000). In this Google form, we invite you to describe your science interest and its requirements, ideally with some indication of the dependence of the scientific return with performance. We request submissions by March 14.

We also encourage you to attend our virtual community workshop on March 22. The workshop webpage, including registration, agenda, and further information for how you can participate will be available soon; the link will be posted on the IPAC events page.

Looking forward to hearing from you.
The PRIMA science leadership team

Jets and Outflow in Protostellar Cores of Orion

The Orion molecular clouds (OMCs) are the most active star forming region in the solar vicinity and thus an ideal target to study individual low- to intermediate mass star forming cores. Observations carried out with GREAT detected the [OI] line at 63 μm and the CO(16-15) line towards four protostars in the OMCs.

The wings of the [OI] 63 μm spectra trace the jet that originates from the disk around the protostar. Furthermore, theory predicts that the [OI] luminosity of the jet is a direct tracer of

the amount of mass ejected. CO(16-15) on the other hand traces the momentum injected by the jet in the cavities of the protostellar core. Both lines, with complementary archival data (e.g. from Herschel), thus provide a complementary view on protostellar feedback in Orion.

Four positions were observed in project 03_0097 towards the HOPS 370 protostellar core and one towards HOPS 108. These cores are the most luminous targets of the HOPS survey. In project 06_0142, the area containing HOPS 108 and HOPS 370 is fully mapped which allows to spatially resolve the jets and possible associated bowshock. Project 03_0097 also carried out observations of two less bright targets (HOPS 60 and HOPS 66). The observations thus cover four protostellar cores with different properties (e.g. luminosity) which allows to compare the outflow properties of different targets.

All the data from the GREAT receiver towards the HOPS sources can be found on the SOFIA IRSA Archive.

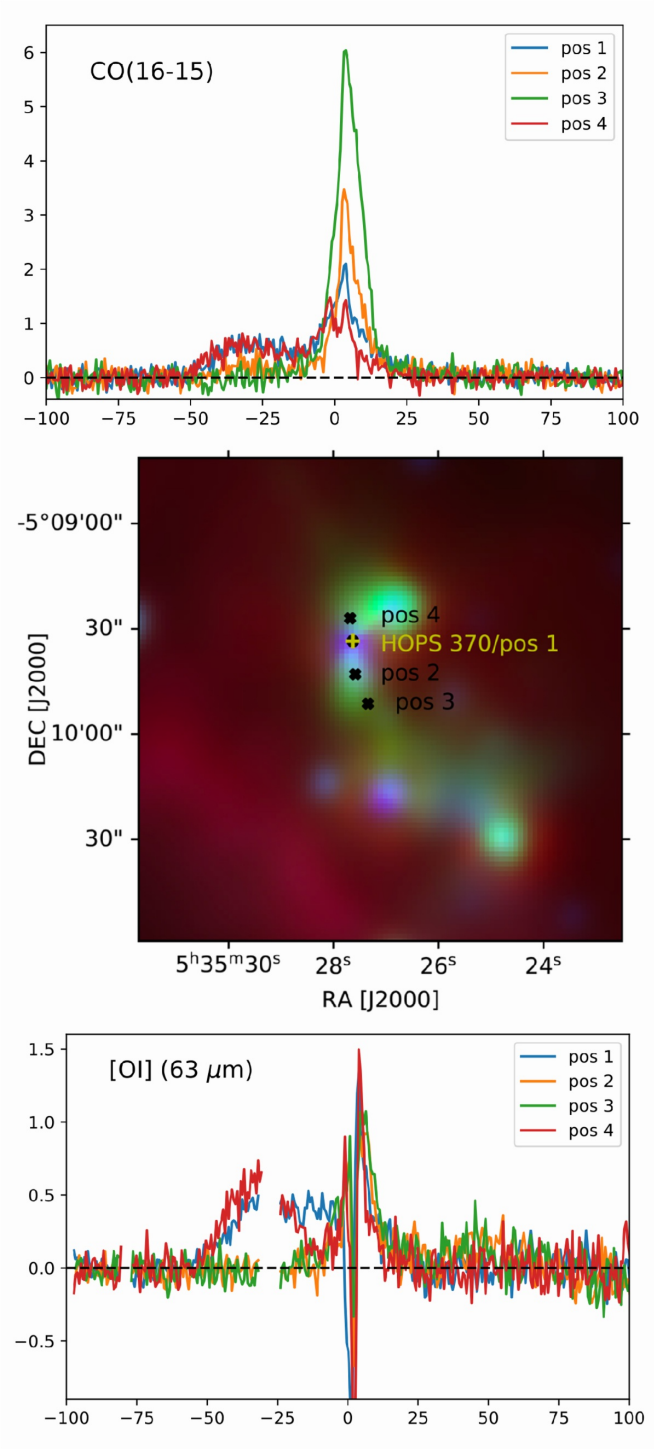
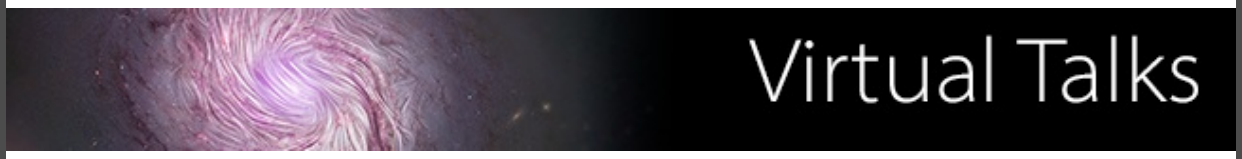


Fig. 1: (top) CO(16-15) spectra towards the 4 positions observed around HOPS 370. (middle) WISE RGB image (R: WISE 3, G: WISE 2, B: WISE 1) of the region around HOPS 370 that indicates the 4 observed positions with

GREAT on SOFIA. (bottom) [OI] spectra at 63 μm towards the same 4 observed positions around HOPS 370.



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 am Pacific, noon Eastern. For information on how to participate, check the SOFIA Tele-Talk webpage.

Upcoming Tele-Talks

- March 9: Jessica Sutter (SOFIA Science Center); [CII] Mapping of NGC7331
- March 23: Nicola Schneider (University of Cologne); [CII] in Tracing Colliding Flows
- April 6: Yao-Lun Yang (University of Virginia); Atomic Shocks in L1551 IRS5 from Observations of [OI]
- April 20: Nima Chartab (University of California Irvine); Gas Phase Metallicities in Local ULIRGs
- May 25: Niko Zielinski (University of Kiel); Magnetic Field Structure in OMC-3

See full list of Tele-Talks.

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