SOFIA Science Newsletter

November 2020

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Science Spotlight

Cold Quasars and the Evolution of Galaxies

Astronomers observed that the early universe is filled with galaxies with an average star formation rate hundreds of times that of today, but the population over time has become more dominated by galaxies where stars are no longer born. Star formation can be shut down through many routes, one of which relies on the supermassive black hole in the heart of massive galaxies. When a supermassive black hole actively accretes interstellar gas, the surrounding material becomes luminous across the electromagnetic spectrum. The energetic output from the resulting quasar has a tremendous effect on the host galaxy, heating and expelling the gas, and shutting down star formation. This process is difficult to investigate, as the hot material surrounding the black hole outshines the host galaxy at nearly all wavelengths of interest. The one exception is the far infrared.

SOFIA/HAWC+ observations at 89 μm published in Cooke et al., 2020 targeted the cold quasar CQ4479, a galaxy caught in that astronomically brief transition phase when the supermassive black hole is actively accreting but a significant amount of the infrared-luminous gas remains. Combined with optical observations from the Sloan Digital Sky Survey, infrared data from the Spitzer and Herschel space telescopes, and X-ray data from XMM-Newton, the data indicate that the stellar population and black hole mass in CQ4479 are growing at the same rate, which is surprising since theory predicts that black hole growth succeeds stellar growth. Read more.

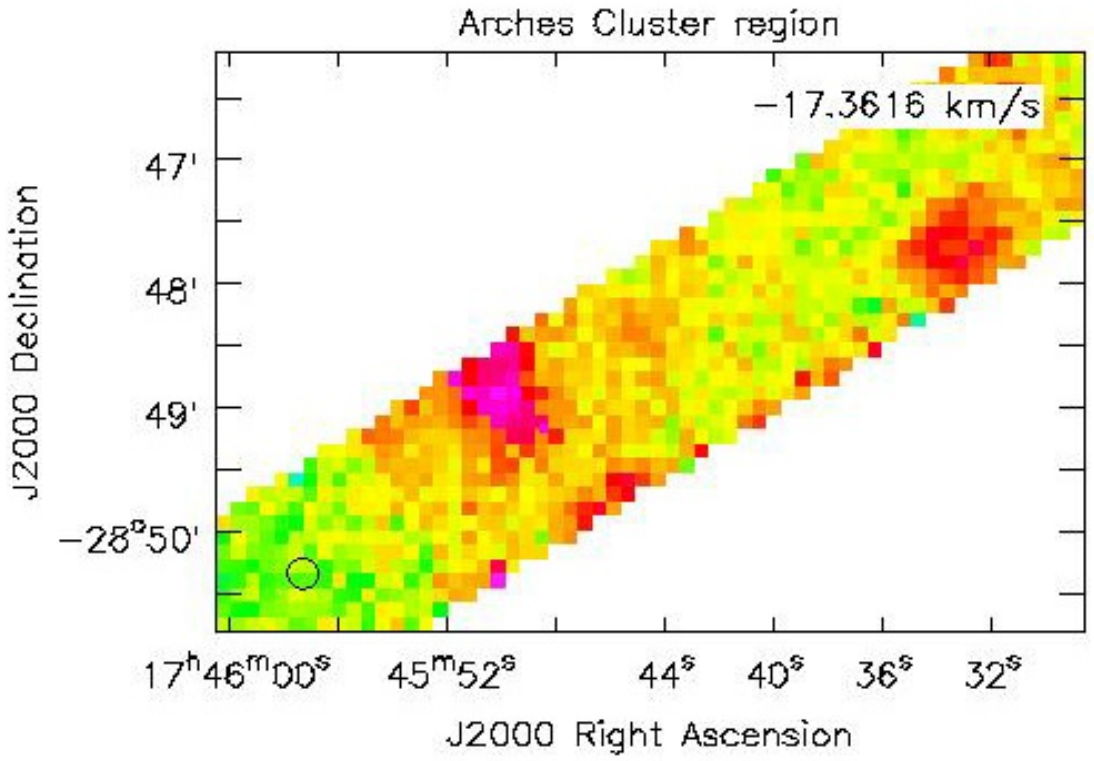
Illustration of the galaxy called CQ4479. The extremely active black hole at the galaxy's center is consuming material so fast that the material is glowing as it spins into the black hole's center, forming a luminous quasar. Quasars create intense energy that was thought to halt all star birth and drive a lethal blow to a galaxy's growth. But SOFIA found that the galaxy CQ4479 is surviving these monstrous forces, holding on to enough cold gas, shown around the edges in brown, to birth about 100 Sun-sized stars a year, shown in blue. The discovery is causing scientists to re-think their theories of galactic evolution. Credit: NASA/ Daniel Rutter

Featured Public Archival Data

Exploring the CMZ: the Arches Cluster

The **Arches Cluster,** the densest star cluster in our galaxy, is located within the Galactic Center's Central Molecular Zone (CMZ), just about 25 pc from Sagittarius A*. Named after the arch-shaped radio-bright structures in its line of sight, it is believed to be an important ionization source, powering the major star formation area in the CMZ (the Galactic Center bubble). The physical and dynamical characterization of the cluster's environment is key to evaluating the stellar feedback from its hot young stars, and can in large part be derived from the analysis of publicly available archival SOFIA maps.

The GREAT map of the fine structure [C II] line at 158 μm offers the high spectral resolution necessary to identify distinct gas components along the line of sight, and to map out the region's kinematics (project 05_0076, strip map 5A). Wide FIFI-LS maps of that same [C II] line as well as the [N III] line at 57 μm trace the distribution of dense gas on a larger spatial scale, and can be used to derive the temperature field (project 04_0032). Finally, thermal dust emission and compact IR-bright sources, including candidate young stellar objects, can be located from the 25 μm and 37 μm FORCAST maps, part of the Galactic Center Legacy program (project 07_0189). All these datasets are publicly available from the IRSA archive.



Channel map at the C[II] emission maximum in the region of the Arches Cluster. From GREAT program 05_0076.

Upcoming Events

AGU Fall Meeting, December 1-17, 2020

Monday December 14th, 1-2pm PST, Poster Pod 2
Live iPoster Session P056 "SOFIA, An Asset for Planetary Science". Learn more.

AGU attendees are welcome to join this live session which will include a discussion on the role of SOFIA for the Solar System community, after the following short presentations on highlights from the latest SOFIA Solar System results:

- Z. Landsman (UCF): A Mid-Infrared Survey of M-type Asteroids with SOFIA+FORCAST
- E. Young (SWRI): Occultations from SOFIA
- I. de Pater (UC Berkeley): SOFIA FORCAST Observations of Jupiter in the JWST-Era
- C. Honniball (NASA Goddard): A Legacy of Lunar Water through SOFIA

AAS Winter Meeting, January 11-15, 2021

Tuesday January 12, 1:10-2:40pm PST
Special oral and iPoster Session: "Assessing the Impact of Stellar Feedback". Learn more.

AAS attendees are invited to join the special session, which will include recent theoretical and observational results which contribute to the understanding of the role of stellar feedback across different scales, from protostellar clouds to galaxies. We will place a particular focus on the exploration of the link between feedback and star formation, the shaping of ISM structures, and the chemistry in shocks regions and ionization fronts. Recent observations (IR surveys and high-resolution mm-wave images) of the kinematics and temperature gradients in stellar environments, displaying in detail the interaction of various types of stars and their surrounding ISM, will be presented. Speakers include:

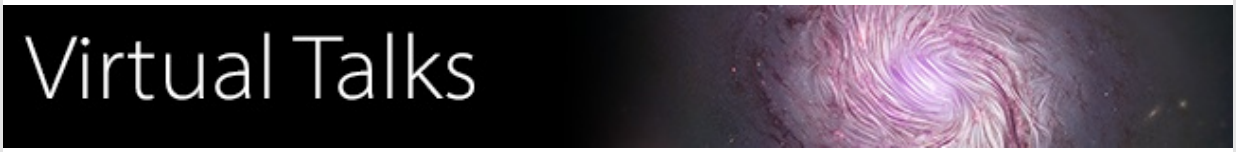
- Xander Tielens (U. Leiden) - PI of SOFIA Legacy program FEEDBACK: The C+ Universe
- Laura Lopez (OSU): Assessing the Dynamical Role of Stellar Feedback using Multiwavelength Observations
- Mélanie Chevance (U. Heidelberg): The Lifecycle of Molecular Clouds in Nearby Galaxies
- Hector Arce (Yale): Outflow Feedback from Low-Mass Protostars
- Susanna Widicus Weaver (U. Wisconsin-Madison): UV Photodissociation and Thermal Processing in Interstellar Ice
- Crystal Martin (UCSB): Galactic Winds and Supernovae

Friday January 15, 10:40am PST
SOFIA Town Hall - with Margaret Meixner, SMO Director (SOFIA/USRA)

Throughout the meeting:
Connect with SOFIA staff at the Virtual Exhibit Booth

Collaborate with SOFIA's Outreach Team

Did you know the Outreach team can help promote your SOFIA science result? If you would like to see your science highlighted in this newsletter, on SOFIA's websites, and possibly in a press release, please keep the Outreach team informed about the status of your publication so we can assess opportunities. Please contact Kassandra Bell before or at the moment of paper submission (the earlier, the better). Communicating with the SOFIA Outreach team is considered internal communications and does not violate the embargo policies of scientific journals. More information.



Join Science Talks Remotely: Colloquia & Tele-Talks

SOFIA colloquia are held via WebEx on Wednesdays at 3:30 pm Pacific. See the complete schedule and connection information.

Upcoming Colloquia
- December 2: Ellen Howell (LPL)
- December 9: Henry Hsieh (PSI)
- December 16: John Tobin (NRAO)

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 SOFIA Tele-Talk webpage.

Upcoming Tele-Talks
- December 9: Accretion around Massive Young Stellar Objects; Andrew Barr (Leiden)
- January 20: Magnetized Filamentary Gas Flows; Thushara Pillai (Boston University)
- January 27: [CII] in the Barred Galaxy NGC7479; Dario Fadda (SOFIA/USRA)
- February 3: Magnetic Fields in Galaxies as Seen by HAWC+; Terry Jones (University of Minnesota)

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.