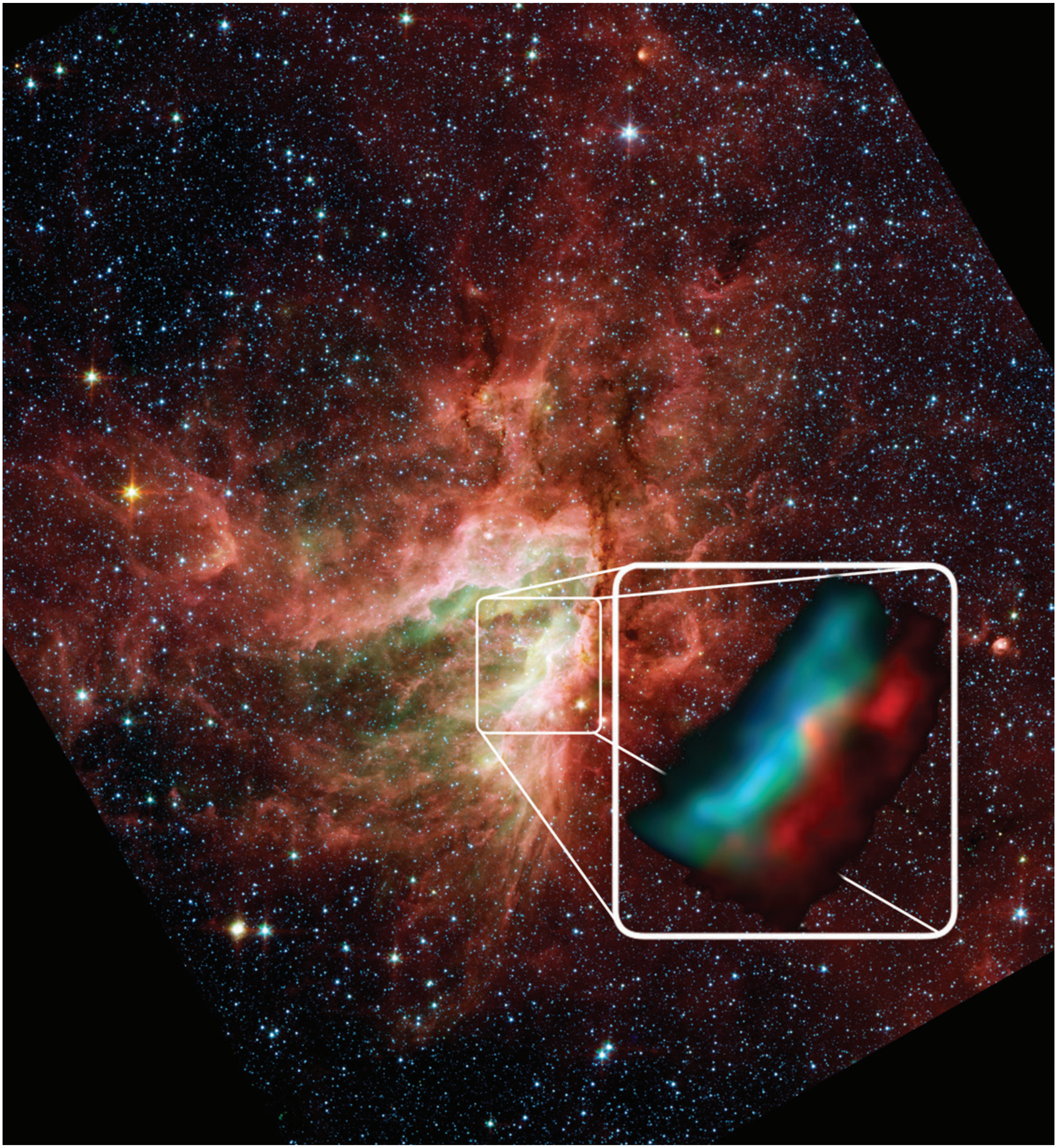
SOFIA Newsletter

June 2018 • Volume 3, No. 2

www.sofia.usra.edu



FIFI-LS Mapping of the HII Region of M17-SW. See Science Highlights, page 3. *(R. Klein, A. Reedy, A. G. G. M. Tielens, and the FIFI-LS team; Spitzer image: NASA/JPL-Caltech/M. Povich [Univ. of Wisconsin])*

Director's Message

Harold Yorke, *Science Mission Operations Director*

This issue of the SOFIA Newsletter finds us in the process of continual change as the observatory has reached its scientific stride but strives for further improvement. Many of these changes are evident in the two Cycle 7 Calls for Proposals (CfP), one extending a regular Guest Observer (GO) opportunity, similar to what has been offered in the past, and a separate CfP for SOFIA Legacy Science proposals. The Legacy Science program is designed for large, coherent programs not reproducible by any reasonable number or combination of smaller GO investigations aimed at generating results, tools, and data sets of general and significant interest to the scientific community.

SOFIA continues to expand its scientific capabilities as new observing modes and new instruments are added to its offerings to the international astronomical community. Having passed its acceptance review, all existing High-resolution Airborne Wideband Camera-plus (HAWC+) observing modes are offered without caveats in the upcoming Cycle 7 CfP. The German principal investigator-class instrument German REceiver for Astronomy at Terahertz Frequencies (GREAT) is offered in expanded modes of operation, which include all 4GREAT (4G) frequency bands and broader ranges of frequencies of 4G and the Low Frequency Array (LFA). The High Frequency Array (HFA) can be combined with either LFA or 4G, allowing simultaneous observations of up to five different frequency bands (in the HFA/4G configuration) or up to three different frequencies of seven pixels each (in the HFA/LFA configuration). Both LFA frequency bands can be tuned to the C+ line, yielding 14 pixels at this scientifically interesting frequency. Because the GREAT-LFA's receiver noise is reduced by a factor of two with respect to Herschel–Heterodyne Instrument for the Far-Infrared (HIFI) Band 7, SOFIA can map large areas in C+ emission about 50 times faster than was possible with Herschel-HIFI. This capability enabled the square degree map of Orion in C+ (PI: A. Tielens), data which is now publicly available from SOFIA's archive.

After its delivery in 2019, our newest instrument, the High Resolution Mid-Infrared Spectrometer (HIRMES) will undergo commissioning and first light science. Although HIRMES is not offered to the general observer in the Cycle 7 CfP, limited science observations will be possible through the Director's Discretionary Time selection process after commissioning.

Concurrent with these new capabilities, NASA is proceeding with the solicitation of the Next Generation Science Instrument (NGSI) for SOFIA, which is scheduled for delivery in 2022 or possibly earlier. SOFIA cannot continue to add new instruments without retiring some of the old ones, which have since realized most of their scientific potential. After the retirement of the First Light

(continued on page 10)

TABLE OF CONTENTS

SOFIA SENIOR SCIENCE LEADERSHIP

Harold Yorke, *Science Mission Operations Director*
Bernhard Schulz, *Science Mission Operations Deputy Director*
Kimberly Ennico Smith, *NASA Project Scientist*
William T. Reach, *Chief Science Advisor*

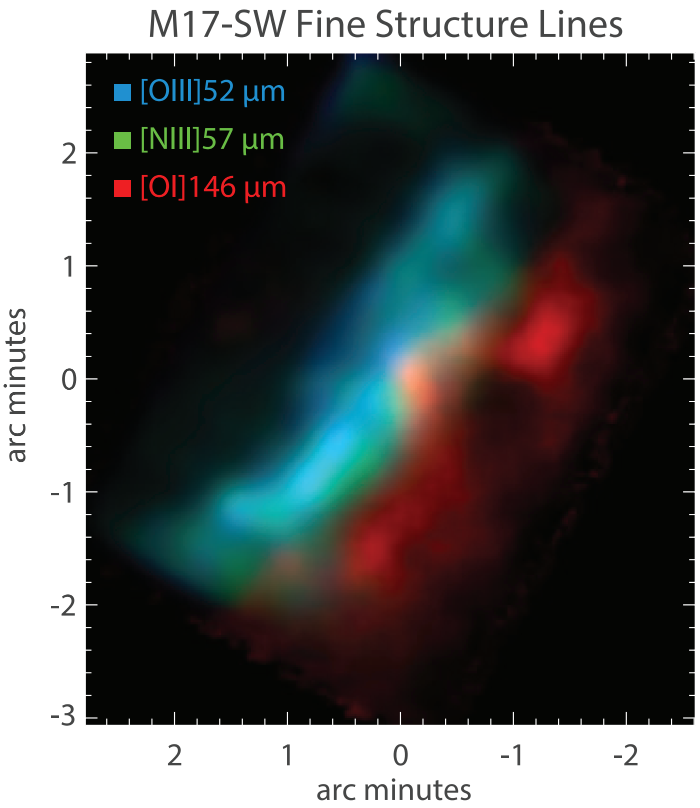
SOFIA NEWSLETTER STAFF

Joan Schmelz, *Executive Editor*
Nicholas A. Veronico, *Editor*
Leslie Proudfit, *Design*

Science Highlights

Randolf Klein, *Science Outreach Lead*
Joan Schmelz, *Associate Director for Science and Public Outreach*

Molecular Cloud Erosion in M17



The erosion of molecular clouds by massive stars is an important astronomical mechanism regulating the process of star formation. Stars form from molecular clouds by gravitational collapse, but when massive stars (more than about 10 times the mass of our sun) form, they inject large amounts of energy in a relatively short time into the surrounding molecular cloud. This process causes the molecular gas first to dissociate and then to ionize. The newly born massive stars eventually destroy the molecular cloud, putting a halt to further star formation in the region. This is a form of feedback in which the process of star formation itself acts to prevent further star formation.

As an example of such a study, the front cover shows the massive star-forming region Messier 17 (M17), which is also known as Omega Nebula, in the constellation Sagittarius. This image from the Spitzer space telescope shows the nebulosity in the mid-infrared. M17 is about 7,000 light years away, a quarter of the way to the Galactic Center. The infrared allows us to peer through the foreground dust clouds into a V-shaped cavity that has been excavated by the winds and ionizing radiation of more than 100 young massive stars. They are also irradiating the giant molecular cloud to the north (up) and the south-west (lower right).

The zoom-in to the right shows observations from the Far-Infrared Field-Imaging Line Spectrometer (FIFI-LS) on SOFIA of three fine-structure spectral lines. The emission from doubly ionized oxygen and nitrogen, shown in blue and green respectively, traces the gas at the ionization front. The emission of atomic oxygen, shown in red, traces the surface of the molecular cloud. The layering clearly shows the transition from ionized to atomic gas. The SOFIA team uses these and other spectral lines to derive the densities of the ionized-gas and interface regions. For example, the electron density in the regions where the doubly ionized ions are emitting reaches 10^4 cm^{-3}, about 10 times higher than estimated for a position closer to the center of the cavity. This is where material is being photo-dissociated and ionized by the massive-star radiation as it expands into the cavity.

SOFIA gives us access to the far-infrared spectral lines, which compared to optical and ultraviolet lines, are almost completely unaffected by extinction. As massive star formation proceeds, infrared radiation, which penetrates the dense gas and dust layers, allows SOFIA to peer deep into these clouds for an unobscured view of these vital processes. SOFIA offers high spatial resolution, and FIFI-LS is ideal for mapping larger regions. Together, they provide the full picture of an area being investigated. ■

About this Highlight

Paper: The PDR in M17-SW analyzed with FIFI-LS onboard SOFIA
Authors: R. Klein, A. Reedy, A. G. G. M. Tielens, and the FIFI-LS team
Reference: in prep.

Science Highlights

Andrew Helton, *SOFIA Instrument Scientist*

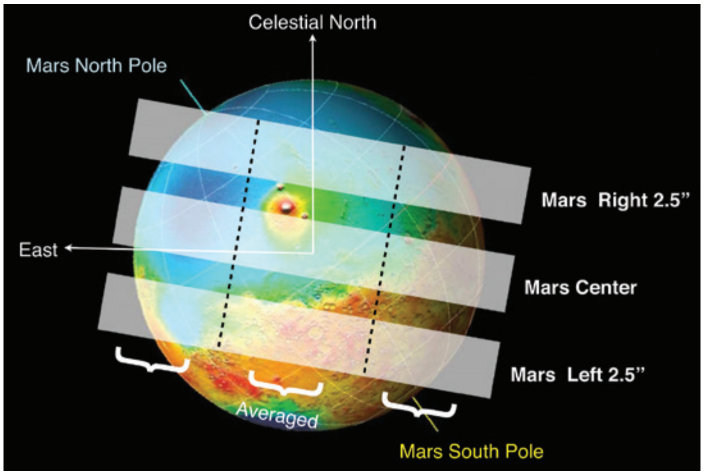
The Quest to Detect Methane in Martian Atmosphere

Scientists and science fiction writers alike have long thought Mars to be a potential candidate for life in our solar system. Since methane is a byproduct of life on Earth, its detection on Mars could suggest truth to the speculation. The first tantalizing report of methane in the atmosphere of Mars was from the Mars Express spacecraft in 2003. Though the discovery led to exciting discussions of the possibility of past or present life on Mars, some noted that methane may also be a byproduct of hydrothermal or other geologic activity. Hence, understanding the location and concentration of methane in the Martian atmosphere is critical to unravelling the mysterious tale of life on Mars.

Previous reports of methane on Mars were inconsistent with one another. Observers using space-borne platforms claimed the detection of CH_4 ranging from ~60–70 parts per billion (ppb) in the atmosphere. However, according to one group the majority of methane was near the polar caps while others suggested a greater concentration near the equator. Further, Earth-based observations found different seasonal variations and far lower concentrations, though with very high uncertainties. The errors in those ground-based observations were driven by contamination from molecules in the Earth's atmosphere, which made it very difficult to isolate the methane lines unambiguously. The only observations of methane made from the Martian surface were conducted by the Curiosity Rover in the Gale Crater. Those observations were highly variable and indicated methane concentrations of only a few ppb, at most.

About this Highlight

Paper: Stringent upper limit of CH_4 on Mars based on SOFIA/EXES observations
Authors: S. Aoki, M.J. Richter, C. DeWitt, A. Boogert, T. Encrenaz, H. Sagawa, H. Nakagawa, A.C. Vandaele, M. Giuranna, T.K. Greathouse, T. Fouchet, A. Geminale, G. Sindoni, M. McKelvey, M. Case, & Y. Kasaba
Reference: A&A, 2018, 610, A78



Recent observations by the EXES instrument on board SOFIA have put much more rigid constraints on the global concentration of methane in the Martian atmosphere. These observations took advantage of being at stratospheric altitudes (~13 km) where absorption by atmospheric constituents is much weaker. The high spatial resolution provided by SOFIA allows EXES to examine a representative portion of the Martian planet (see figure), which helps to localize the source of methane in the Martian atmosphere. The very high spectral resolution of EXES would enable the detection of the narrow Martian methane lines without concern for contamination by Earth's atmosphere.

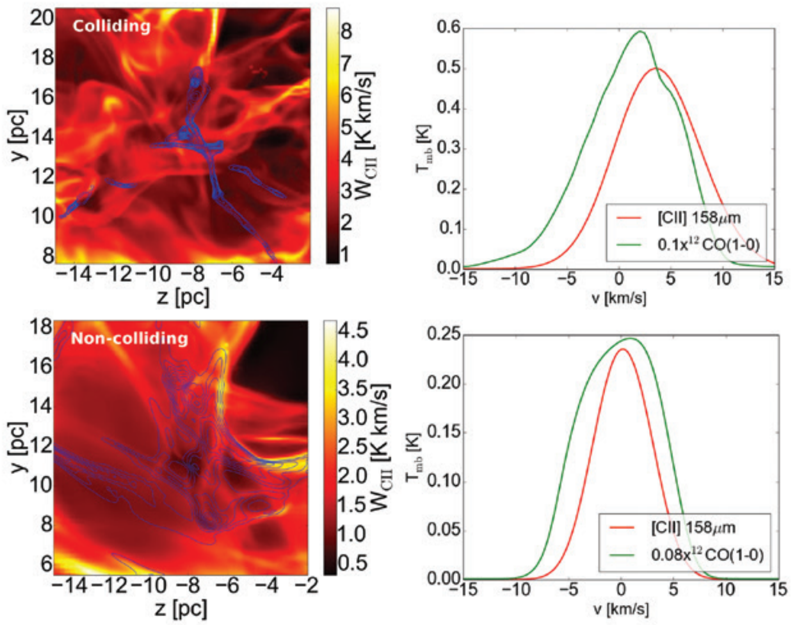
There are examples in science when a non-detection is extremely important. One such experiment concerns the presence of methane in the Martian atmosphere. The EXES observations detected no significant amount of atmospheric methane on Mars with a stringent upper limit of 1–9 parts ppb across the planet. This suggests that the methane in the Martian atmosphere must be either highly variable, very localized, or both. Alternatively, and perhaps disappointingly, it might also suggest that earlier detections of methane were in error and that the Martian atmosphere is devoid of methane entirely. ■

Science Highlights

William T. Reach, *Chief Science Advisor*
Joan Schmelz, *Associate Director for Science and Public Outreach*

The Formation of Star Clusters

At a remote time in the past the sun was spawned along with dozens of siblings in a cluster that has long since dispersed. There are no traces of this creation event except that the sun and its attendant planets continue to roam through the realms of interstellar space. Star formation can now be observed in the hearts of dark clouds filled with dust particles and molecular gas. Those otherwise dark clouds are seen in infrared light and appear to lie along elongated filaments. But just what triggers the process of star formation in those filaments? Do the infrared dark clouds form by gravitational collapse of the interstellar medium with the gas perhaps rushing along magnetic field lines, or are the filamentary clouds the result of cloud-cloud collisions?



Bisbas, et al. used the upGREAT instrument to map the [C II] ground-state fine-structure line at 157.7 microns for Infrared Dark Cloud H (IRDC H). Such observations are possible because of the scan-mapping agility of the SOFIA telescope and the multi-beam upgrade to the Terahertz receiver. Those data reveal motion within the cloud that offers a clue as to how the feature was created.

The carbon in the infrared dark cloud is mostly in the form of solid grains and molecules. However, carbon can be ionized in cloud envelopes by diffuse interstellar radiation from nearby stars. The ionized carbon [C II] images trace the material surrounding the filament. The authors showed that the [C II] emission is spatially offset from the dark molecular filament and that the envelope is dynamically offset, with a velocity shift of 3 km/s between [C II] (envelope) and ^{13}CO (molecular cloud).

The offsets are signatures of the filament formation process. The figure shows synthetic observations from the 3D magnetohydrodynamic simulations of colliding (top row) and non-colliding (bottom row) molecular clouds along the line-of-sight. The left column shows the [CII] emission where the blue contours indicate the highest peaks of the total hydrogen column density. In the colliding case, there is an offset of a few parsecs between [CII] emission and the column density peaks, but there is no such offset in the non-colliding case. The right column shows the average velocity spectrum of [C II] and ^{12}CO lines. The colliding case shows a significant offset, but there is no such offset in the non-colliding case. The authors therefore conclude that molecular filaments are likely to form from cloud-cloud collisions rather than direct collapse. This field remains an active one, and we expect more such observations to test this scenario. ■

About this Highlight

Paper: The Inception of Star Cluster Formation Revealed by [CII] Emission Around an Infrared Dark Cloud

Authors: Thomas G Bisbas, Jonathan C. Tan, Timea Csengeri, Benjamin Wu Wanggi, Lim Paola Caselli, Rolf Güsten, Oliver Ricken, Denise Riquelme

Reference: 2018, MNRAS.DOI: 10.1093/mnrasl/sly039, ADS Bibliographic Code: 2018MNRAS.tmpL.40B

Eyes Like a HAWC: Polarimetry of Active Galaxies with HAWC+

Raquel Destefano, *Science & Technical Communications Specialist*

The High-Resolution Airborne Wideband Camera Plus (HAWC+) began commissioning observations in late 2016, and has produced truly spectacular science results with a particular emphasis on extragalactic observations. Configured for continuum bandpasses from 50 to 240 microns, HAWC+ is the only instrument in the world conducting far-infrared polarimetry research.

For extragalactic explorers like the Universities Space Research Association's HAWC+ instrument scientist, Enrique Lopez-Rodriguez, opting for these capabilities on SOFIA presented a unique research opportunity. "You need to do something that no one has done before," explained Lopez-Rodriguez, "so you need to observe in an unprecedented wavelength range and observing mode combination." Polarimetry allows you to explore the universe in a different way — to observe magnetic fields and to obtain properties of dust that total intensity imaging and spectroscopy simply do not provide.

To achieve polarimetry, HAWC+ utilizes a rotating half-wave plate with individual plates corresponding to the instrument's four bandpasses and other settings. After passing through one of the half-wave plates, a filter wheel and polarizing grid split incoming light into two orthogonal components of linear polarization: reflected and transmitted. A 64x40 detector array, comprised of two co-mounted 32x40 subarrays, then detects the incoming polarized light. "Advances in far-infrared detector technology in the past two decades and the significantly larger SOFIA telescope allowed us to field a much more capable instrument," said HAWC+ Principal Investigator Darren Dowell. "This has enabled us to investigate classes of objects such as galaxies and cold, dark clouds that were not previously possible."

So why far-infrared? To observe its dominant features, a galaxy must be examined at its peak blackbody wavelength. Relatively cold galaxies need to be studied at longer wavelengths, which correspond to lower temperatures — observed only in the far-infrared and exclusively with SOFIA. Research failing to view a galaxy at the wavelength of its peak emission is likely to miss crucial information that can help astronomers understand the physics of the galaxy.

The significance of this demand is highlighted by the recent study of the massive spiral galaxy NGC 1068 by HAWC+ [Figure 1]. Galactic magnetic fields tend to be progressively more ordered with increasing age, and the structural organization of a spiral galaxy implies evolutionary maturity. While the ordered nature of its magnetic field has been observed in previous polarimetry studies, NGC 1068 has an unusually high rate of star formation and an active galactic nucleus that produces relativistic jets arising from accretion onto the supermassive black hole at the galactic center. Early polarimetry observations of NGC 1068 in the visual wavelength range were unable

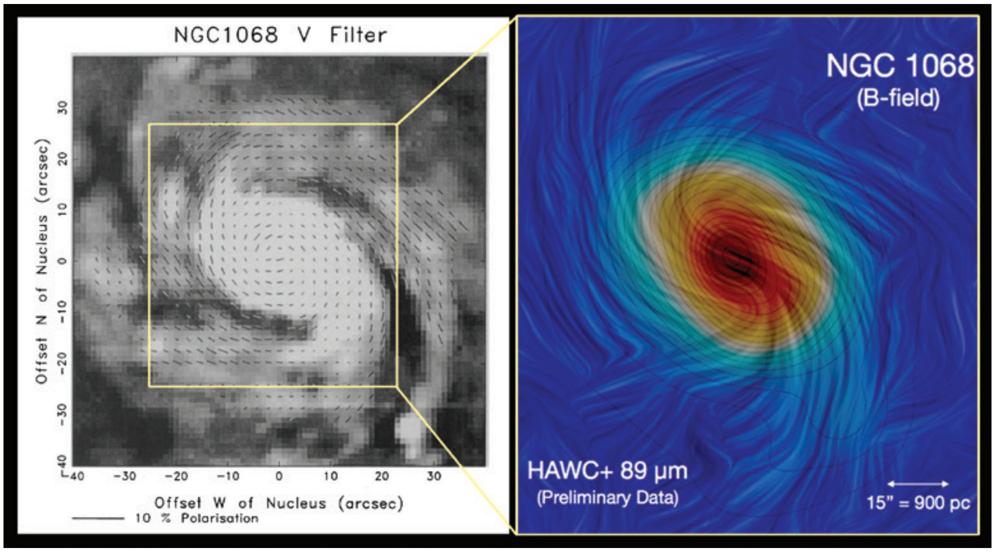


Figure1. Spiral galaxy NGC 1068 linear polarization data in the optical at 0.55 micron by the Durham imaging polarimeter *(left)* compared to HAWC+ preliminary polarization data in the far-infrared at 89 micron *(right)*. While both datasets capture the spiral arms, only HAWC+ is able to reveal the S-shape of the magnetic field at the galactic center.

to reveal the central effects of the spiral arms dominating the magnetic field by disk rotation. By observing at the galaxy's peak wavelength of 89 microns with a high enough spatial resolution, HAWC+ was able to unveil the central S-shape of the magnetic field that was obscured by scattering at visible wavelengths.

The detection of magnetic fields is indirect by nature. "In the case of far-infrared polarimetry," Dowell explained, "the direction of polarization tells us the direction of the magnetic field in a dust cloud because the dust particles align in an asymmetric way with the magnetic field." Under predominantly static conditions, this implies that the magnetic field will align itself with the shape of the galaxy. "We live in an empirical universe," Lopez-Rodriguez emphasized, "so the universe will tell you what is right and what is not." Case in point: galaxies with significant activity should exhibit deviations from this expectation, and that's where things get interesting.

Young starburst galaxies like M82 are characterized by an immensely high rate of star formation — significantly more than NGC 1068. In fact, while both M82 and NGC 1068 are relatively cold galaxies, the immense quantity of star formation in M82 produces enough energy to yield a substantially higher blackbody temperature and, therefore, a shorter blackbody wavelength — 53 microns for M82 compared to 89 microns for NGC 1068.

In a typical galaxy, the magnetic field should be parallel to its midplane. Preliminary polarimetry results produced by HAWC+ paint a very different picture for M82: the magnetic field lines are almost globally perpendicular to the galactic midplane [Figure 2]. The orientation of these lines is evidence of starbursts violently ejecting matter out of the galaxy. Outside the central region of the galaxy, far from the effects of star formation, the magnetic field lines display the classical planar orientation — emphasizing the magnitude of the distortion of the magnetic field implied by the central perpendicular lines.

The distinctions between the preliminary polarimetry data of NGC 1068 and M82 provide a detailed analysis of these eccentric galaxies. NGC 1068 is a well-ordered, massive spiral galaxy with spiral magnetic arms strong enough to affect even the magnetic field toward the galactic center with an S-shape curvature. An edge-on view of the younger, less-ordered starburst galaxy M82 reveals the polarized nature of the galactic dusty outflows that dominate the galaxy's magnetic field. Analysis of the distinctions between such contrasting environments provide the basis for more understanding of the generation, sustainment, and evolution of galactic magnetic fields.

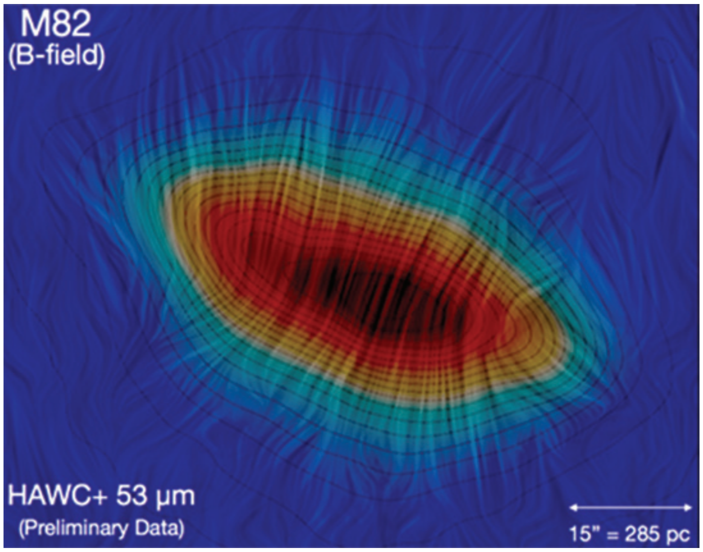


Figure 2. HAWC+ preliminary polarimetry data of the starburst galaxy M82. Note the vertical lines through the center of the galaxy are perpendicular to the galactic midplane. This 90-degree deviation from the expected orientation of the magnetic field is evidence of the impact of stellar formation on host galaxies.

This comparative study performed by HAWC+ on SOFIA is a glimpse into the instrument's potential for using far-infrared polarimetry to decode the physical phenomena of extragalactic regions. Additionally, the instrument excels at observations focused on dark clouds, supernova remnants, gravitationally lensed galaxies, young stellar objects, and the galactic center. The instrument acceptance review of HAWC+ was completed in late 2017, and it will continue to be offered for community use in SOFIA's Cycle 7 series of observations, which begin in 2019. ■

German Perspective

Bernard Schulz, *Science Mission Operations Deputy Director*

Having just started my new assignment as deputy director for SOFIA Science Mission Operations in March, my life could not be more exciting. Discovering the intricacies of this highly complex machine and all the essential services and systems around it, very much reminds me of the Infrared Space Observatory, Herschel Space Observatory, and the Spitzer Space Telescope missions that I have dedicated most of my past professional life to. With just Spitzer remaining as a "warm" mission from this truly Golden Age of Infrared Astronomy, SOFIA is now the only facility that provides regular access to the large range of infrared wavelengths that are absorbed by our atmosphere. Yet, this wavelength range is essential for our understanding of fundamental astrophysical themes like star formation or the interstellar medium. In particular its spectroscopic and the new polarimetric capabilities make SOFIA entirely unique among current infrared observatories. Even the James-Webb Space Telescope will only cover wavelengths short of ~30 μm — once operational —while the entire range up to the Atacama Large Millimeter Array's wavelengths remains SOFIA's exclusive domain for the next decade or longer.

There is another rather important aspect of this project that also excites the instrument builder and engineer in me. In this project the science instruments are neither technologically baselined — "frozen" in a remote cleanroom, nor floating out in space, but can be touched, repaired and improved as they are returned safely back to the hangar after every observing flight. Thus, SOFIA is open to constant innovation that no space mission can provide at an acceptable cost. Yet, machines are nothing without their operators, and, as I am spending my first weeks obtaining an overview by visiting the centers at Moffett Field and Palmdale, California, and the German SOFIA Institute (DSI) at the University of Stuttgart, I am very impressed by this fine, diverse, dedicated, and very professional team, one that works together across continents, masters many technological difficulties, and provides observers with unique data.

On my recent trip to Germany I also visited the observatory at the Lufthansa Technik facility in Hamburg, where it was in the dock for maintenance. It was a perfect opportunity for me to let my dad tag along and show him what his son is occupied with these days. We received a very insightful tour conducted by Corvin Müller (DSI) and Dave McAllister (NASA), allowing me yet again to appreciate the meticulous attention to detail that is applied to ensure the safe operation of this facility. Being used to complex international projects that require a lot of interaction and communication, I am excited to be able to contribute that expertise to keep this U.S.-German science partnership strong and provide truly exceptional data to the international science community.

As the Telescope Assembly (TA) is the special German responsibility, the DSI team intensively utilized SOFIA's maintenance period in Hamburg. While a wide variety of scheduled and preventive maintenance has been applied to the TA, many improvements and new features, hardware and software, have been developed, tested and installed on the aircraft. As Michael Hütwohl (DSI) and Eddie Zavala (NASA) explained to me back at the Palmdale NASA facility, these activities are key to maintaining a state of high reliability of the TA for the upcoming observing missions, making SOFIA a successful and attractive observatory for its projected 20-year lifetime.

As already announced by Holger Jacob (DSI) in the previous issue (January 2018), FIFI-LS received a filter upgrade that improves the transmission of the second order of the blue channel considerably. Based on laboratory data, Christian Fischer and Sebastian Colditz (both DSI) predict a reduction of the integration times by about a factor of two around the important [OIII] 51.8μm Line. They will seek confirmation during the next flight series in Cycle 6 on this unique SOFIA capability. ■

Next Generation Science Instrument Call for Proposals Now Open

Alan C. Rhodes, *SOFIA Science Instrument Development Manager*

The multi-million dollar call to expand SOFIA's capabilities is focused on compelling scientific investigations that require development and use of a next generation science instrument or upgrades/modifications to an existing instrument for SOFIA.

Proposals are due on **August 1, 2018**.

Key Points of the Call for Proposals:

- The next generation science instruments (NGSI) must be motivated by compelling science.
- Allows for schedule and budget flexibility; make selections based on science return on investment.
- Reduces requirements for the instrument concept study phase compared to previous solicitations.
- Makes instrument development and acceptance process easier for teams (using lessons learned from past experience)
- Selected team(s) must execute and deliver well-defined Legacy Science Program(s) (LSP) of high scientific value that the team will execute with the instrument they build and deliver. The LSP is a scientifically ambitious investigation with long-lasting and impactful science that motivates development of the proposed instrument.
- Prioritizes instruments that enable broad community usage and/or data of high archival value, but also allows for agile, "niche" instruments to solve important/outstanding science questions.
- Allows for new instruments or upgrades/modifications to existing instruments; also allows for flexibility for future enhancements and modifications to NGSI.
- Allows for a nominal three-year development period after funding begins but also allows for longer or shorter development timescales for optimal science return.

Links to the Call for Proposals, information on Pre-Proposal Workshops, Frequently Asked Questions, and more information can be found at: www.sofia.usra.edu/science/instrument-call

The SOFIA team requests that you share this information with any of your colleagues that would be interested in proposing.

As we embark upon this new era of exploration with SOFIA, we invite you all to review and share this information and Come Explore With Us! ■

Fig 1 (revised): TIMELINE FOR SOFIA's NEXT GENERATION INSTRUMENTATION

SOFIA Observers Resources

Need Observing Help?

The SOFIA Science Center provides a wealth of information for researchers working with the observatory. Information about proposing and observing, our instrument suite, publications, meetings, and announcements can be found at: **www.sofia.usra.edu/science**

Observer's Handbook

The Observer's Handbook provides detailed information about the instruments that will be available for observations during the current cycle. This document is the primary technical reference for astronomers who wish to submit a proposal in response to the Call for Proposals.

Observer's Handbook for Cycle 6: www.sofia.usra.edu/science/proposing-and-observing/sofia-observers-handbook-cycle-6

Unified SOFIA Proposal and Observation Tool (USPOT)

All proposals are to be prepared and submitted using the Unified SOFIA Proposal and Observation Tool (USPOT). Initial submission is completed during Phase I, and those proposals awarded observing time will be required to submit further specifications regarding their observations during Phase II — all of which is completed via USPOT.

USPOT: dcs.sofia.usra.edu/observationPlanning/installUSPOT/uspotDownload.jsp

The USPOT Manual is designed to guide users through the procedures for submitting SOFIA Observing Proposals containing Astronomical Observation Requests (AORs). The USPOT Manual includes specific instructions for each instrument for both Phase I and Phase II.

USPOT Manual: www.sofia.usra.edu/science/proposing-and-observing/uspot-manual

Exposure Time Estimation Calculators

Estimations of exposure times for imaging with FLITECAM, FORCAST, FPI+, and HAWC+ can be made using the SOFIA Instrument Time Estimator (SITE), a web-based tool that provides total integration time or S/N for a given instrument, filter(s), source type (point, extended, emission line), and water vapor overburden.

SITE: dcs.sofia.usra.edu/proposalDevelopment/SITE/index.jsp

Atmospheric Transmission (ATRAN)

The atmospheric transmission as a function of wavelength may be obtained using the online tool ATRAN. The use of ATRAN is necessary for planning SOFIA high-resolution spectroscopic observations.

ATRAN: atran.arc.nasa.gov/cgi-bin/atran/atran.cgi

Additional resources can be found at the SOFIA Science Center website: **www.sofia.usra.edu** ■

Director's Message

(continued from page 2)

Infrared Test Camera, known as FLITECAM, and the High Speed Imaging Photometer for Occultations, HIPO, all existing SOFIA instruments have recently undergone an external review to evaluate their future scientific potential in light of SOFIA's current and future instrument complement and as potential synergistic partners to other observatories, such as the Atacama Large Millimeter Array and James Webb Space Telescope.

This brief introduction can only be a teaser for the upcoming opportunities for participating in SOFIA's broad science program. I invite the interested reader to study our evolving website and come see us at the upcoming AAS meetings (June in Denver, January 2019 in Seattle) and at the July COSPAR meeting in Pasadena. ■

SOFIA Staff Win Awards

SOFIA Chief Science Advisor Eric Becklin (USRA) was recognized by the American Astronomical Society (AAS) for his pioneering career in infrared astronomy. Becklin (shown in photo 1 with AAS President Christine Jones) presented the Henry Norris Russell Lectureship: "Fifty-four Years of Adventures in Infrared Astronomy," at the 231st meeting of the AAS in January in Washington, DC.

USRA also presented two awards at the AAS for research conducted aboard SOFIA. The USRA award for the best SOFIA-based research publication went to Kate Su for her work showing a nearby planetary system is similar to our own. The USRA award for best SOFIA-based Ph.D. thesis went to Ryan Lau for his research on the ring of dust and gas around the supermassive black hole at the center of the Milky Way Galaxy. The awards were presented by Nick White, USRA Senior Vice President for Science, with (photo 2) Kate Su, University of Arizona and (photo 3) Ryan Lau, California Institute of Technology.

SOFIA's Data Cycle System Team won the USRA Team Excellence Award. During the past year, the team successfully developed and released several new software tools with capabilities that greatly improve the ease and efficiency of flight planning and observing. The award was presented at the annual USRA President and Chief Executive Officer's Awards Dinner in March in Washington, DC. Lan Lin, Sun Li, Kaori Nishikida, and Tomas Lau (photo 4, pictured left to right) make up the SOFIA Data Cycle System Team. ■

THE
American Astronomical Society
hereby honors
Eric Becklin
Henry Norris Russell Lecturer 2017

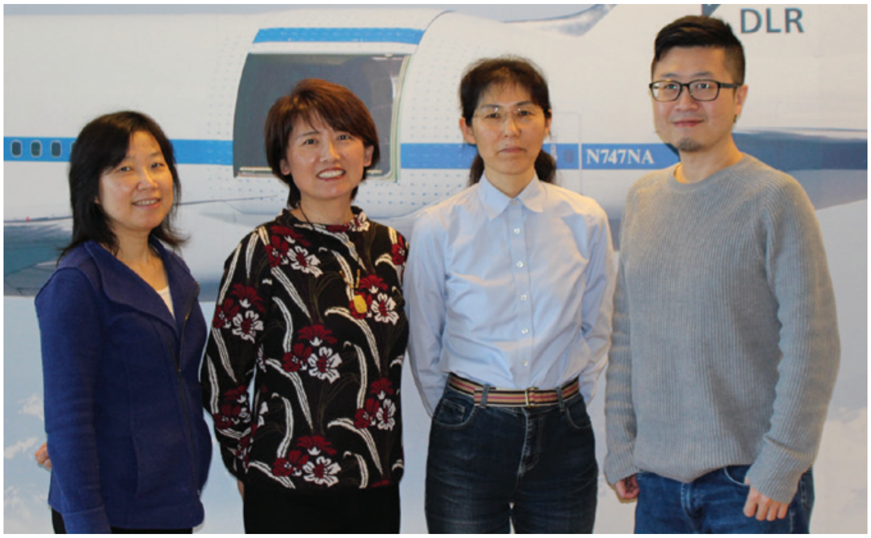
For his leadership role over the last half century in turning infrared astronomy into a fundamental tool for understanding the universe. Becklin has made pioneering discoveries using infrared observations in a wide range of contexts — including the galactic center, star-forming regions, evolved stars, brown dwarfs, exoplanets, and the obscured nuclei of other galaxies — with telescopes on the ground, in the stratosphere, and in space.

Presented in January 2018

❶

❷

❸



❹

SOFIA Events and Awards

"Black Holes: the Science and Science Fiction" panel presented by SOFIA at Silicon Valley Comic Con 2018. *(NASA/USRA/N. Veronico)*

Silicon Valey Comic Con attendees experience a virtual tour of SOFIA. *(NASA/USRA/N. Veronico)*

Sir Roger Penrose speaks about dark matter at a SOFIA colloquium on Apri 10, 2018. *(NASA/Dominic Hart)*

Visitors enjoy seeing themselves in infrared at the SOFIA exhibit at the Livermore Innovation Fair, April 14, 2018. *(NASA/SOFIA/ L. Strichartz)*