Infrared Science Interest Group

Newsletter I Number 3 I January 2020

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Letter from the SIG Leadership Council

We are delighted to share with you the third newsletter from the Infrared Science Interest Group (IR SIG).

Welcome to a new year and new edition of the IR SIG newsletter! We are excited to kick-off another year of SIG activities with an active presence at this year's winter AAS meeting in Honolulu, Hawaii. Make sure to stop by the IR SIG splinter session on Tuesday, January 7th from 9:30 to 11:30am, which will feature invited talks and a panel discussion to consider topics such as

- What science themes will drive IR science in the next decade?
- How do we keep IR science in the forefront of the community's mind? How do we best engage the community?
- What are the 'unexpected surprises' we might look forward to seeing in IR science and technology in the next 5-10 years?
- What technology development investments should we pursue in the mid-term, with an eye out to 2030 and beyond?

But, don't forget that there are many other sessions throughout the week highlighting IR science (a full schedule is at the end of this newsletter).

As always, the key objective of our SIG is to collect community input and help shape the long-term goals of IR astrophysics. Our main priorities for this new year are (1) to ensure we are reaching out to a healthy and diverse fraction of the community (i.e., improving our mailing list and subscription), and (2) reaching out to this community for input on what types of activities they would like IR SIG LC to organize or help organize. This newsletter series is a part of this effort, and will continue to be published semi-annually. We want to highlight results, technological developments, and events from the IR community. To that end, please send us your updates! These can be submitted to irsiglc@gmail.com or via http://bit.ly/irsig_newsletter.

Throughout the year, we will continue our previous activities, including hosting our monthly webinar series (see our website for the schedule and recordings of past webinars: https://fir-sig.ipac.caltech.edu). In all of our efforts, we are keen to increase the participation of early-career scientists of diverse backgrounds. Reach out to the IR SIG leadership council to get involved yourself or to suggest possible webinar speakers. In addition, we will be recruiting up to three new SIG members this year (see last page of this newsletter for additional details).

Sincerely,
Meredith MacGregor (newsletter editor)
and the entire IR SIG Leadership Council

How Massive Galaxy Progenitors Evolved With Redshift and Local Environment

Written by: Kevin C. Cooke (University of Kansas; Rochester Institute of Technology, Ph.D. 2019)

Paper: Stellar Mass Growth of Brightest Cluster Galaxy Progenitors in COSMOS Since z ~ 3
Cooke et al., ApJ, 22 August 2019, doi: 10.3847/1538-4357/ab30c9

Using Spitzer and Herschel observations of the COSMOS field, researchers have found that the stellar mass growth of high redshift massive galaxy progenitors evolves through three phases. A high redshift ($z > 2.25$) starforming phase gives way to an intermediate star formation and merger driven growth phase below $z \sim 2.25$, eventually requiring mergers to be the dominant mechanism by $z < 1.25$. Progenitor star formation behavior is only found to be dependent on local environment at $z < 1.25$. This work addresses the current open question of whether the environmental density of galaxies in protoclusters at high redshift is correlated with their star formation as it is at present day.

The brightest and most massive galaxies in the universe tell a unique story of galaxy evolution. Today, they are most often quiescent ellipticals hosted in relaxed galaxy clusters, e.g. Brightest Cluster Galaxies, with pasts fraught with the mergers and high star formation rates (SFRs) required to form their exceptional stellar masses. At low redshift, dense environments have been found to host galaxies with lower star formation rates and more spheroidal morphological features than field environments. Whether this correlation is limited to low redshift is still an open debate, with recent works probing $z > 1$ finding the same correlation, a correlation only in specific SFR, or no correlation at all. Finding the redshift evolution of a galaxy population's environmental dependencies will shed important light on how large-scale structure influences galaxy evolution.

In a recent publication, Cooke et al. (2019) selected a massive galaxy progenitor sample from the COSMOS field using a stellar mass cut motivated by an evolving number density method. To estimate star formation rates of this sample, they fit NUV-FIR spectral energy distributions (SEDs) with stellar, dust, and AGN models. The constraints put upon the SEDs by the Spitzer and Herschel surveys of the COSMOS field constrain the starlight reprocessed into the far-infrared by the dust content of each galaxy. This is a critical consideration, as at high redshift a significant portion of star formation may be obscured by their own birth clouds.

This work finds that massive galaxy progenitors gain stellar mass in three phases. First, at $z > 2.25$, there is an era where the median star formation at that redshift is sufficient to account for the total stellar mass growth and galaxies in dense and field environments are consistent with each other. Second, between $1.25 < z < 2.25$, star formation in both environment bins decline beneath the level necessary to sustain the observed mass growth rate, and therefore gas-rich and -poor mergers become necessary. Finally, at $z < 1.25$, star formation in both environments falls off to a point that requires gas-poor mergers to become the likely primary driver of mass growth. Also at this time, galaxies in dense environments experience a more rapid decline in star formation with redshift than their counterparts in field environments. Overall these results support the case in which environmental dependencies manifest most strongly at low redshift and are not detected above z ~ 1.

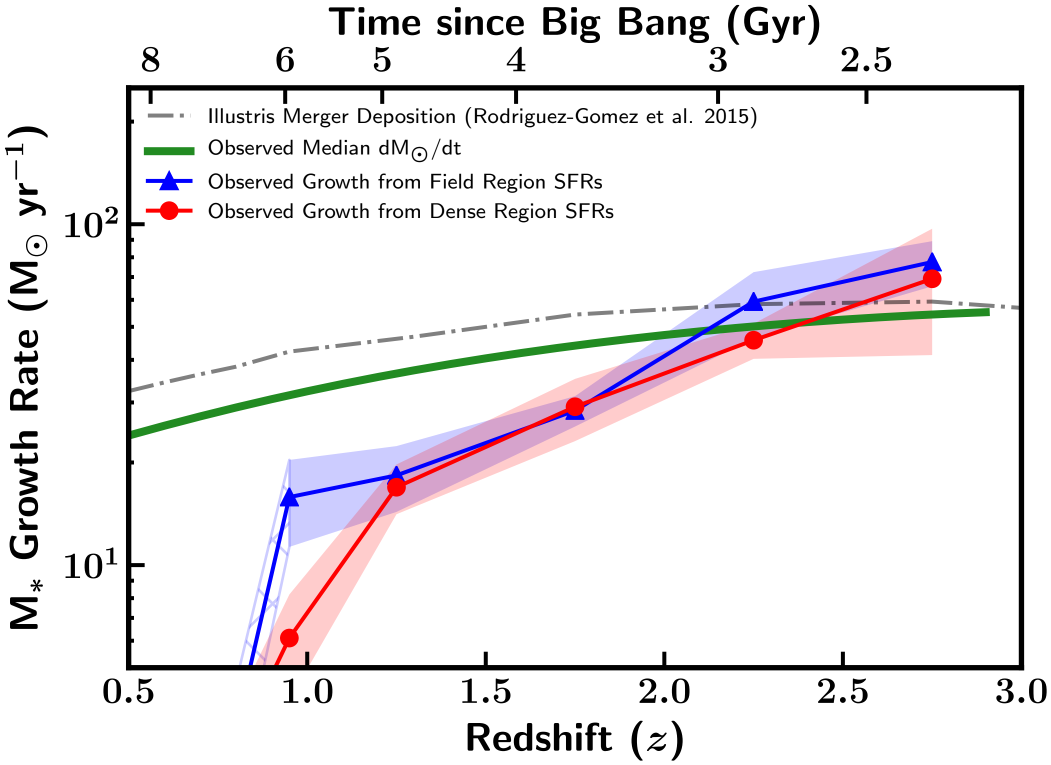


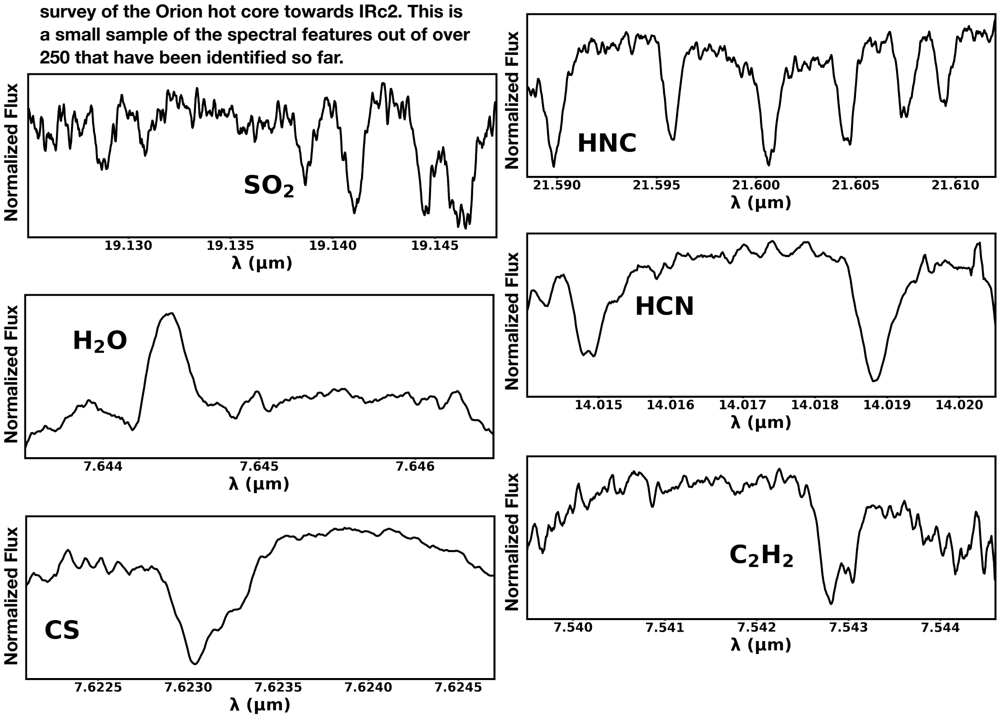
Figure 1: The image shows the stellar mass growth only due to star formation of galaxies in the field in blue and dense environments in red. We compare this to the total observed growth rate in green. The growing discrepancy between total growth rate and growth due to star formation at low redshift is indicative of another mechanism needed to add to the total growth rate, e.g. mergers.

Hot Core Molecular Chemistry with SOFIA

Written by: Sarah Nickerson (NASA Ames Research Center)

Rich molecular chemistry surrounds hot cores. These warm, dense regions around protostars are a key evolutionary stage in the formation of complex and prebiotic molecules that will later be the building blocks of planetary systems, such as our own Solar System. Critical to understanding this chemistry are rovibrational transitions and symmetric molecules with no permanent dipole moment, phenomena exclusive to the mid infrared (MIR, 5 to 30 microns). The airborne observatory SOFIA is a unique tool for studying the IR, particularly the MIR where large swaths are inaccessible to ground-based telescopes due to water vapour in the Earth's atmosphere. The spectrometer EXES aboard SOFIA has the highest resolution of any MIR instrument past and present, enough so that we can identify individual molecular transitions. No other telescope provides this opportunity to study the chemistry of hot cores.

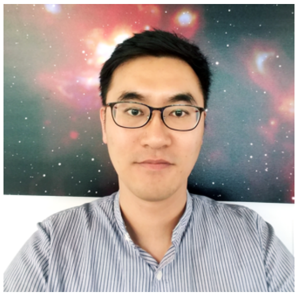
I recently joined NASA Ames as a postdoc with Naseem Rangwala to build the molecular inventory for hot cores as part of the first blind, MIR line survey at high resolution (R~60,000). I am currently analyzing spectra of the Orion hot core IRc2 from 7.5 to 25 micron, taken with EXES. Orion is the nearest massive star-forming region and it is indeed proving to be rich in molecules that once characterized will illustrate IRc2's kinematics and physical conditions. In order to gain a larger picture of hot core chemistry, I will compare IRc2's spectra to other hot cores from the SOFIA science archives. This has inspired me to work on methods of processing the spectra quickly without sacrificing accuracy and to efficiently identify molecules. The SOFIA archives alone are rich in unstudied data. The sheer volume of data telescopes produce is an ongoing problem facing modern astronomy. When even larger telescopes go online we must be ready for the wealth of information that they will bring.



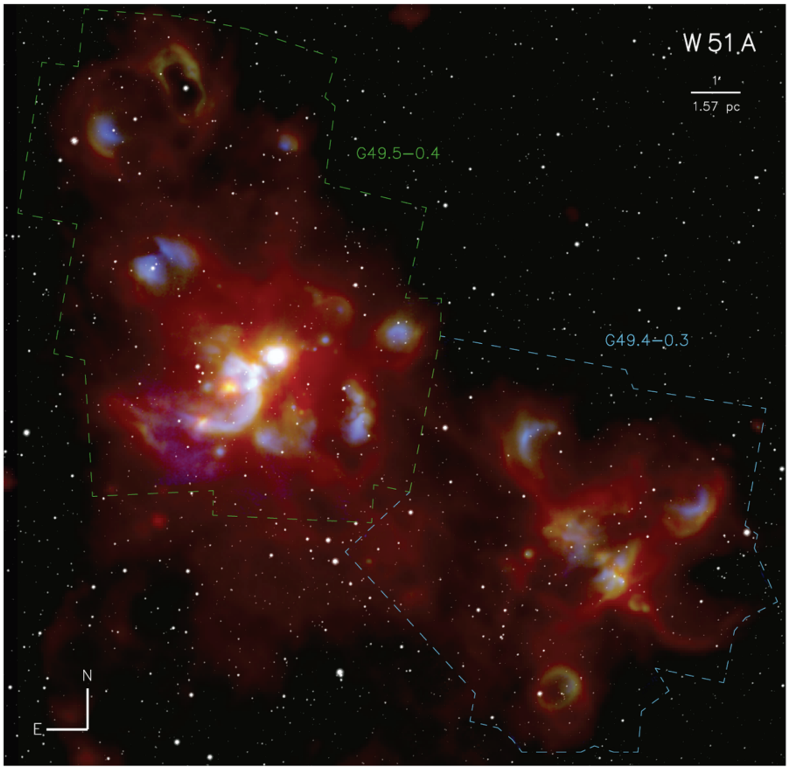
Preliminary results from our blind, mid infrared survey of the Orion hot core towards IRc2. This is a small sample of the spectral features out of over 250 that have been identified so far.

Massive Star Formation in W51A

Written by: Wanggi Lim (SOFIA-USRA, NASA Ames Research Center)



We present the first result of our SOFIA-FORCAST 20 and 37µm imaging survey toward Galactic Giant HII regions. Massive stars play key roles to shape and maintain the Galactic ecology due to their energetic feedback along their life time and abilities as major sources of heavy elements to the natal interstellar medium. Despite of the importance, we barely understand their formation mechanisms due to the far distances (several kpc in general) and high extinction at their early stages. The Giant HII regions are well known as active high-mass star forming regions. We select W51A as the first target to investigate its detail properties and evolutionary history since it is one of the brightest and most massive Galactic Giant HII regions. We use the SOFIA photometry combined with Spitzer-IRAC and Herschel-PACS photometry data to construct spectral energy distributions (SEDs) of sub-components and point sources detected in the SOFIA images. We fit those SEDs with young stellar object models, and find 41 sources that are likely to be massive young stellar objects, many of which are identified as such in this work for the first time. Close to half of the massive young stellar objects do not have detectable radio continuum emission at cm wavelengths, implying a very young state of formation. One of the young stellar objects is surprisingly bright across all wavelengths. Modeling of these data indicates that it may be exceptionally large, with the equivalent mass of 100 Suns. If future observations confirm that it is indeed a single, colossal star, rather than multiple stellar siblings clustered together, it would be one of the most massive forming stars in our galaxy. We derive luminosity-to-mass ratio and virial parameters of the extended radio sub-regions of W51A to attempt to estimate their relative ages. We are able to confirm analytically what previous authors have determined qualitatively concerning the relative ages of these sub-regions.



Long Wavelength HgCdTe Detector Development

Written by: Judith Pipher (University of Rochester)

Back when Dan Goldin was the NASA Administrator (1992-2001) his mantra in a period of lower budgets was “faster, better, cheaper”. The University of Rochester IR group began a quest to develop sensitive long wave HgCdTe detector arrays that could be passively cooled for space astronomy missions, as a better and cheaper option than cryogenically cooling as had been used for other IR missions. The cutoff wavelength of $Hg_{1-x}Cd_xTe$ material can be modified by varying the mole fraction x of Cd. The softer long wave material is prone to defects. We worked first with Rockwell Scientific (later they became Teledyne Imaging Sensors), piggy-backing on other better-funded projects. It took some time, with limited grants, to achieve even partial success – until in 2005 Amy Mainzer, then at JPL, approached us to work on developing 10 μm arrays for a proposed mission she called NEOCam, which would survey to find 90% of Near-Earth Objects 140m in size and larger in 5 years. Her project eventually received technology funding and with APRA funding from NASA to Rochester, we began to make remarkable progress in this very difficult task in collaboration with Teledyne. We knew that we had to make use of the Astronomy multiplexer readouts in the HxRG class that Teledyne had developed for the near and mid-IR HgCdTe arrays because they expended very low power as needed for space missions, and because they were low noise. This requirement meant some innovative developments at Teledyne to bond the HxRG to the long wave material, because that material posed a peculiar set of problems.

By 2013, we had demonstrated 1k x 1k format 10 μm arrays that would meet NEOCam specifications. These devices operated at a focal plane temperature of 40K, easily achievable in space by a thermally well-designed spacecraft – for example, *Spitzer*, when it ran out of cryogens in 2009, equilibrated with its space environment at a focal plane temperature of ~26K. After showing that these arrays worked well under high energy proton bombardment, we began the task of moving to larger format 2k x 2k arrays. Although 5 μm arrays had been developed for JWST, the softer long wave material proved a more challenging development, particularly when it came to removing the CdZnTe substrate on which the detector material was grown. Ultimately, we left a thin layer of substrate intact, and showed that proton irradiation did not adversely affect performance.

Excellent performance of the 2k x 2k 10 μm arrays was then demonstrated. In the intervening years, we also began working on 13 μm and then 15 μm cutoff arrays, utilizing lessons learned at the shorter wavelengths, and employing lower temperature operation (28-30K). Most recently we have begun working on 11 μm arrays for NEOCam (now the telescope is named NEO Surveyor). Pertinent performance descriptions can be found in the references below and the references therein to intermediate publications and earlier work:

McMurtry et al. (2013) Opt. Eng., 52, 091804
Dorn et al. (2016) JATIS, 2c6002D
Dorn et al. (2018) Proc. SPIE, 10709, id. 1070907
Cabrera et al. (2019) JATIS, **5**(3), 036005
Cabrera et al. (2020) JATIS, 6(1), 011004

Individuals involved in technical aspects of this project at Rochester include Profs. J. Pipher and W. Forrest; engineers C. McMurtry, J. Wu (single pixel studies); past graduate students C. Bacon, M. Dorn, M. Cabrera; current graduate students G. Zengilowski, N. Reilly. At JPL and now University of Arizona, A. Mainzer; A. Wong. At Teledyne, D. Lee.

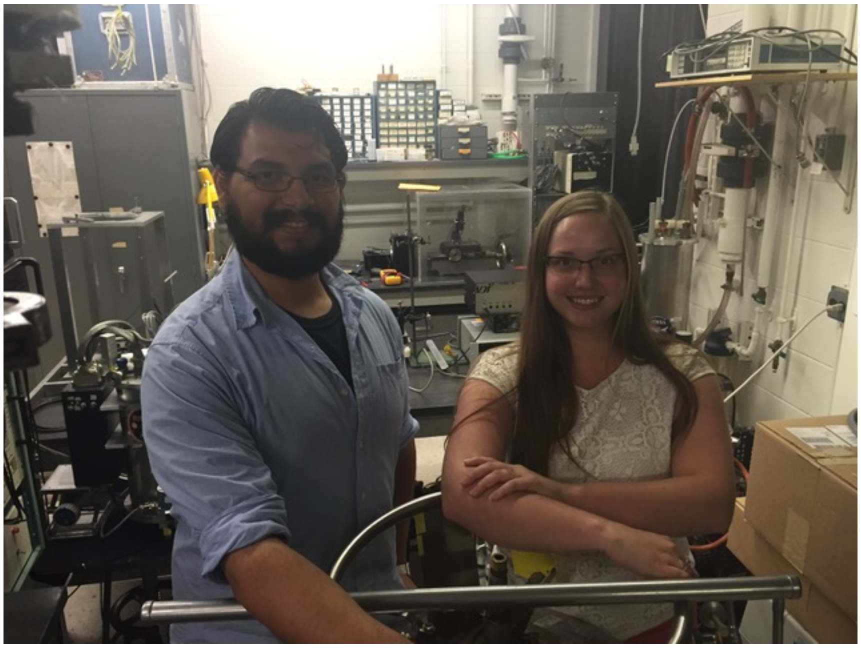


Figure 1: Past PhD students at University of Rochester Mario Cabrera (now at Conceptual Analytics) and Meghan Dorn (now at Teledyne).

The EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM)

Written by: Eric R. Switzer (NASA Goddard)

For more information: https://arxiv.org/abs/1912.07118

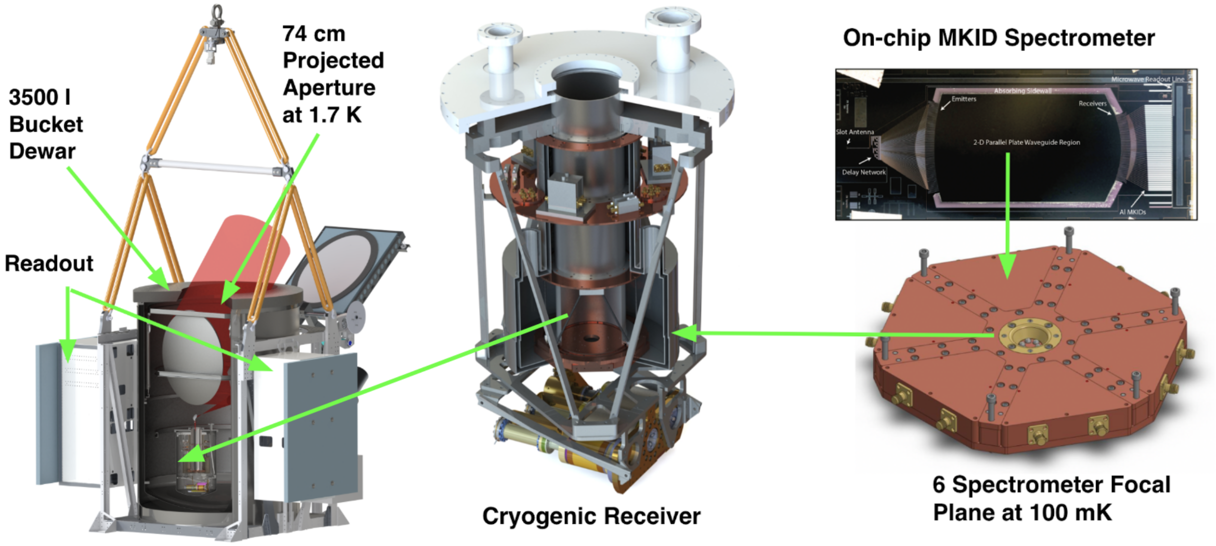
Overview: EXCLAIM, the EXperiment for Cryogenic Large-Aperture Intensity Mapping, started in April 2019 under NASA APRA funding. EXCLAIM is a cryogenic balloon-borne instrument that will survey galaxy and star formation history over cosmological time scales. Rather than identifying individual objects, EXCLAIM is a pathfinder to demonstrate an intensity mapping approach, which measures the cumulative redshifted line emission. It will operate at 420-540 GHz with a spectral resolution R=512 to measure the integrated CO and [CII] in redshift windows spanning $0 < z < 3.5$. CO and [CII] line emissions are key tracers of the gas phases in the interstellar medium involved in star-formation processes. EXCLAIM will shed light on questions such as why the star formation rate declines at $z < 2$, despite continued clustering of the dark matter. The instrument will employ an array of six superconducting integrated grating-analog spectrometers (µ-Spec) coupled to microwave kinetic inductance detectors (MKIDs).

Science: EXCLAIM's specific goals are to 1) make a definitive detection of redshifted [CII] in correlation with Baryon Oscillation Spectroscopic Survey (BOSS) quasars at redshifts $2.5 < z < 3.5$; 2) detect two adjacent ladder lines of CO in cross-correlation with each of the BOSS samples (MAIN, LOWZ, CMASS); and 3) constrain both CO J=4-3 and [CI] (492 GHz) in the Milky Way. [CI] emission can track molecular gas in regions where CO is photo-dissociated, providing insight into the relation between CO and molecular gas.

Instead of detecting individual galaxies, EXCLAIM will pursue intensity mapping (IM) to measure the statistics of brightness fluctuations of redshifted, cumulative line emission. IM is a measurement of integrated surface brightness rather than source flux, which relaxes requirements on the EXCLAIM telescope aperture size. IM is sensitive to the integral of the luminosity function in cosmologically large volumes, and to tracers of several environments in the interstellar medium (ISM). EXCLAIM's primary extragalactic science is done by cross-correlation in the BOSS S82 region, to facilitate unambiguous detection of redshifted emission in the presence of foregrounds.

Approach: EXCLAIM will use an all-cryogenic telescope that provides high sensitivity in a one-day conventional balloon flight from North America. This conventional flight also offers excellent access to the BOSS regions and easy logistics and reuse. EXCLAIM's telescope and receiver will be housed in a liquid-helium Dewar, with an inner diameter of 150 cm, and identical in design to the Absolute Radiometer for Cosmology, Astrophysics, and Diffuse Emission (ARCADE II) and the Primordial Inflation Polarization ExploreR (PIPER) instruments. At float altitude, positive pressure from boil-off gas keeps the cryogenic optics dry and clean, eliminating the need for any optics or windows at ambient temperature. The Dewar supports a 90 cm cryogenic primary aperture (74 cm projected).

Key technologies: EXCLAIM will use µ-Spec integrated spectrometers, which implement all of the elements of a diffraction-grating spectrometer on a silicon chip. A lenslet couples light from the telescope onto a slot antenna. On the chip, the diffraction-grating is synthesized by a Nb microstrip line delay network, which launches signals into a Nb 2D parallel-plate waveguide region with emitting and receiving feeds arranged in a Rowland configuration. The 355 receiving feeds are coupled to half-wave Al-Nb microstrip transmission line MKIDs. Unique aspects of the µ-Spec chip technology are: 1) high immunity to stray radiation on chip, 2) potential for spectral resolving power in the thousands, ultimately limited by intrinsic millimeter-wave loss of crystalline silicon, 3) ultrasensitive MKIDs down to single-photon detection level by using SOI technology to reduce detector frequency noise and active inductor volume.

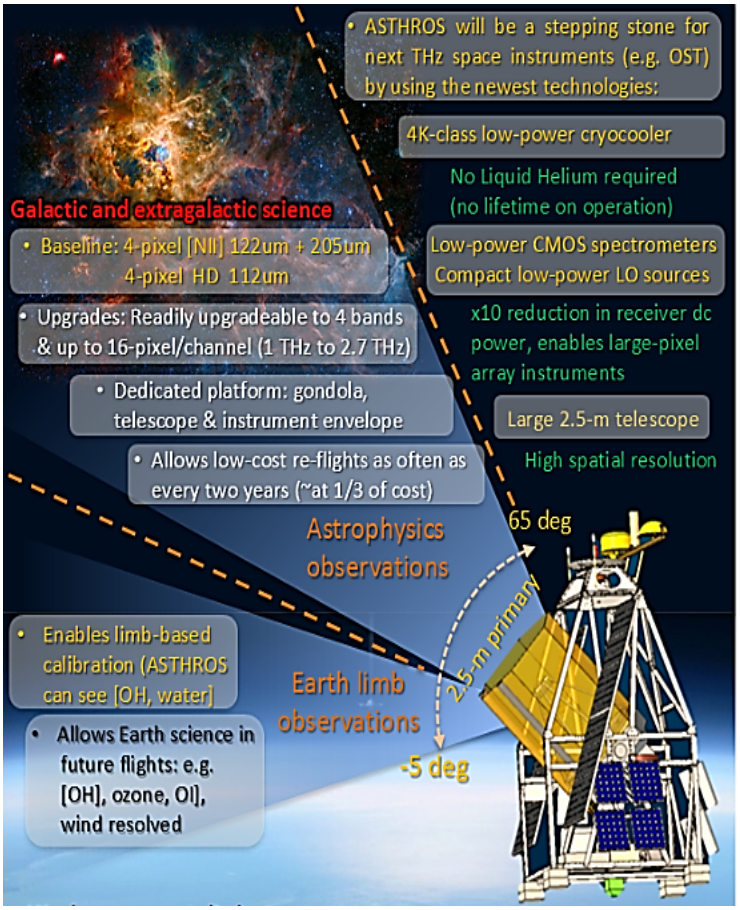


The ASTHROS balloon-borne stratospheric telescope selected by NASA to fly from Antarctica in 2023

Written by: Jorge Pineda (326), ASTHROS Principal Investigator and Jose V. Siles (386), ASTHROS Project Manager & Technical Lead

The Astrophysics Stratospheric Telescope for High Spectral Resolution Observations at Submillimeter-wavelengths, ASTHROS, is a 2.5-m (SOFIA-like size) balloon-borne observatory that will make the first detailed spectrally resolved high spatial resolution 3D map of ionized gas in Galactic and extra-galactic star forming regions via simultaneous observations of the 122μm (2.459 THz) & 205μm (1.461 THz) fine structure lines of ionized nitrogen.

ASTHROS builds on the success of the Stratospheric THz Observatory (STO-2), providing a low-risk low-cost stepping stone for future heterodyne missions. A 21-day Antarctic flight in 2023 will focus on mapping two template Galactic star forming regions and the entire disk of the M83 barred spiral galaxy at high angular resolution, complementing existing datasets from SOFIA, WISE, Herschel, Spitzer and HST. ASTHROS will be capable of tuning to nearby spectral lines (OH, HDO, HF, HD, CO) for Target of Opportunity observations. One compelling target is the HD 112μm (2.674 THz) line that traces the gas mass distribution in protoplanetary disks. ASTHROS' resolution corresponds to 0.2 pc and 0.35 pc at 122μm and 205μm, respectively, for a source 4 kpc from the Sun. This high angular resolution will enable us to resolve structures ~750 times smaller than the typical size of star forming regions (~150 pc). Combined with large-scale mapping, we will begin to understand how different stellar feedback mechanisms affect ionized gas over a wide range of spatial scales in the Milky Way and the M83 galaxy.



ASTHROS payload will consists of a 4-pixel dual band cryogenic superconducting heterodyne array camera for high-spectral resolution imaging at 1.4-1.5 THz and 2.4-2.7 THz. The instrument design features a straightforward receiver architecture, simple optical layout, and subsystems that have high degree of flight heritage, pedigree, and proven performance through suborbital and space missions such as

Herschel HIFI and STO-2. ASTHROS will fly for the first time a 4-K class low-power cryocooler and thus will not require liquid helium. A cryocooler will enable extended lifetime missions, and its use will serve as a pathfinder for Origins Space Telescope (OST), future NASA Probe-class missions, or Small Satellite missions.

ASTHROS will be the first long duration balloon mission led and managed by JPL. JPL will also responsible for building the payload. ASTHROS partners include John Hopkins University – Applied Physics Laboratory, Arizona State University and University of Miami.

The SPICA: Mission Update and Potential US Contributions

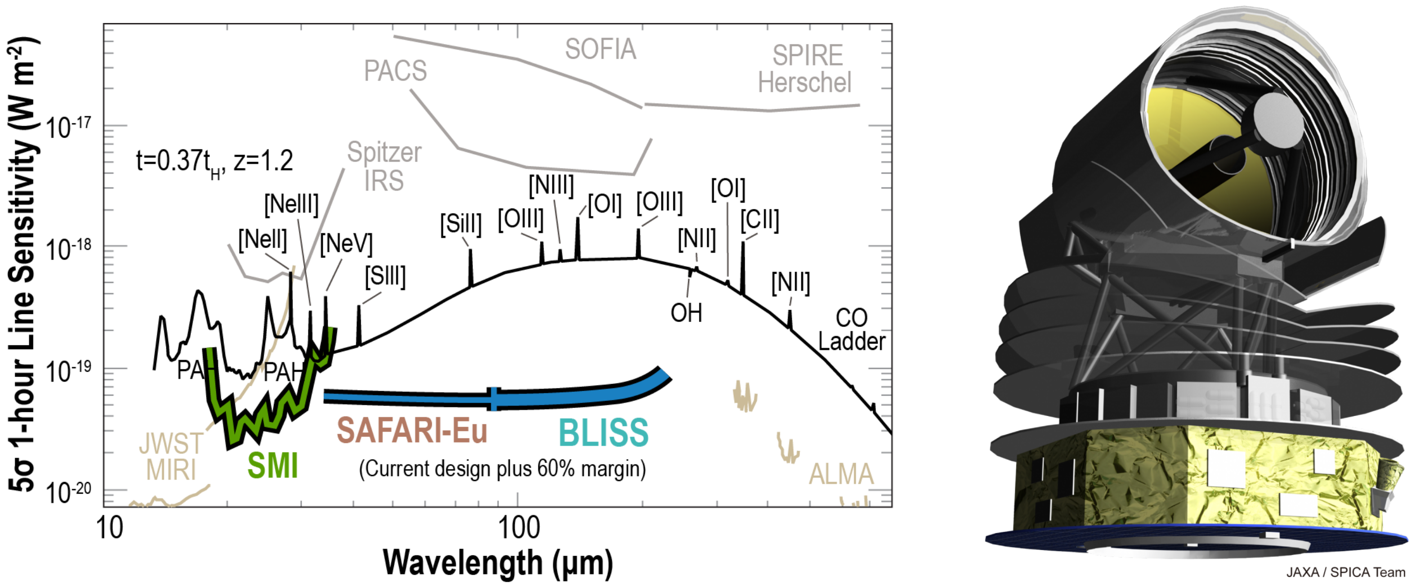
Written by: Charles M. Bradford (JPL, Caltech)

Mission Overview: A joint European-Japanese team is proposing to implement the SPace Infrared telescope for Cosmology and Astrophysics, SPICA. SPICA targets mid- and far-infrared wavelengths, and is designed to achieve true background limited performance with a 2.5-meter primary mirror cooled to below 8 K. ESA has selected SPICA as one of the 3 candidates for the Cosmic Visions M5 mission, and JAXA has indicated commitment to their portion of the collaboration. The two agencies have invested in a joint concurrent study, and a collaboration framework has gelled. ESA will provide the silicon-carbide telescope, science instrument assembly, satellite integration and testing, and the spacecraft bus. JAXA will provide the passive and active cooling system (supporting the T<8K telescope), cryogenic payload integration, and launch vehicle. The ESA phase-A study is underway now; the downselect among the three candidates will occur in 2021, and the expected launch is around 2031.

Science: How does the Universe work? How did we get here? These fundamental questions guide much of modern astrophysics. Answering these questions requires understanding the inner workings of galaxies throughout cosmic history: how and when their stars and black holes formed, when their heavy elements came to be, and how interstellar material transformed into planets capable of bearing life. Dust is ubiquitous in the Universe, and studying the interiors of galaxies and forming planetary systems requires techniques that overcome its obscuration. Far-IR spectral line emission is uniquely powerful for this—it free-streams through even deeply obscured regions, and provides a detailed view of the processes and contents within. With its cold telescope and sensitive instrumentation, SPICA offers a revolutionary capability for far-IR spectroscopy with observing speed more than 10,000 times greater than the current state of the art (see Figure). While SPICA will offer a diverse panoply of breakthrough scientific investigations, our small US team is particularly focused on three themes: a) heavy element abundances through cosmic time, b) feedback and atomic gas cooling in galaxy outskirts, and c) a census of mass in planet-forming disks of all ages.

Instruments: SPICA will have 3 instruments. JAXA's SPICA mid-infrared instrument (SMI) will offer imaging and spectroscopy from 12 to 38 microns (see Figure). It is designed to complement JWST MIRI with wide-field mapping (broad-band and spectroscopic), R~30,000 spectroscopy with an immersion grating, and an extension to 38 microns with antimony-doped silicon detector arrays. A far-IR polarimeter from a French-led consortium will provide dual-polarization imaging in 3 far-IR bands. And finally, a sensitive far-IR spectrometer SAFARI will be provided by a broad SRON-led consortium. It will provide full-band instantaneous coverage over the full 35-230 micron band (longer wavelength extension is under study) using four R=300 grating modules. A Fourier-transform module which can be engaged in front of the grating modules will offer a boost to the resolving power, up to R=30,000 at 100 microns.

Proposed US contributions: Our JPL-led team has proposed a Mission of Opportunity (MoO) under the name BLISS to the last Explorer call in August 2019. We aim to contribute the two long-wavelength spectrometer modules with integrated detector arrays for SAFARI. This hardware contribution builds on our long-standing detector development program, important because the instrument requires superconducting bolometer array with per-pixel sensitivity ~30 times lower (more sensitive) than previously used. We have been working closely with the European instrument team to develop the SAFARI concept and design over the past several years. The proposed SAFARI contribution, and a very modest science team fits into a MoO budget. Additionally, a larger group of US scientists has also submitted a program paper to Astro2020, outlining opportunities for a more substantial NASA contribution to SPICA (https://ui.adsabs.harvard.edu/abs/2019BAAS...51g..87C/abstract). A strategic NASA contribution could enhance the scientific return of SPICA in a number of ways: increasing instrument capabilities of both SAFARI and SMI with enhanced contributions e.g. of detectors systems and telescope cooling, extending the mission lifetime, and supporting US scientists to use SPICA. This kind of strategic contribution leveraging US expertise, while modest in the scope of NASA astrophysics missions, was very productive for both the US community and the international partners in ESA'S Herschel and Planck missions.



JAXA / SPICA Team

Figure 1: Spectroscopic sensitivity with SPICA. With the actively-cooled telescope, the SMI and SAFARI spectrometers approach the fundamental limits of shot noise from the astrophysical backgrounds. SMI is a JAXA-led instrument using, the plotted curve is for medium resolution spectroscopy. SAFARI is a workhorse far-IR spectrometer build by a large consortium led by SRON with substantial US participation (proposed). The curve shows the sensitivity in the base R=300 mode; this full band is covered simultaneously. Observing speed scales as the square of this sensitivity.

UPCOMING EVENTS

4-8 Jan 2020 – **AAS 235**
***IR SIG splinter session on Tuesday, January 7th!**
Honolulu, Hawaii
https://aas.org/meetings/aas235

20-22 Jan 2020 – **Star Formation Across the Universe**
University of Hertfordhsire, Hatfield, Hertfordshire, UK
http://star.herts.ac.uk/incubator/

2-5 Feb 2020 – **Science with the Atacama Pathfinder Experiment (APEX2020)**
Ringberg Castle, Germany
https://events.mpifr-bonn.mpg.de/indico/event/134/

11-13 Feb 2020 – **Celebrating the Legacy of the Spitzer Space Telescope**
Caltech, Pasadena, CA
https://conference.ipac.caltech.edu/legacyofspitzer/

2-6 Mar 2020 – **Ground and space observatories: a joint venture to planetary sciences**
Santiago, Chile
https://conference.almaobservatory.org/planets2020/

23-27 Mar 2020 – **IAU Symposium 360: New Era of Multi-Wavelength Polarimetry**
Hiroshima, Japan
https://astropol2020-iau.jp/

30 Mar - 3 Apr 2020 – Ground-based thermal infrared astronomy - past, present and future
ESO Garching, Munich, Germany
http://www.eso.org/sci/meetings/2020/IR2020.html

30 Mar - 1 Apr 2020 – Multi-line Diagnostics of the Interstellar Medium in Galaxies
Nice, France
https://iram2020nice.sciencesconf.org/

30 Mar - 2 Apr 2020 – Science with the Hubble and James Webb Space Telescopes VI
Stockholm, Sweden
http://www.stsci.edu/contents/events/stsci/2020/march/science-with-the-hubble-and-james-webb-space-telescopes-vi

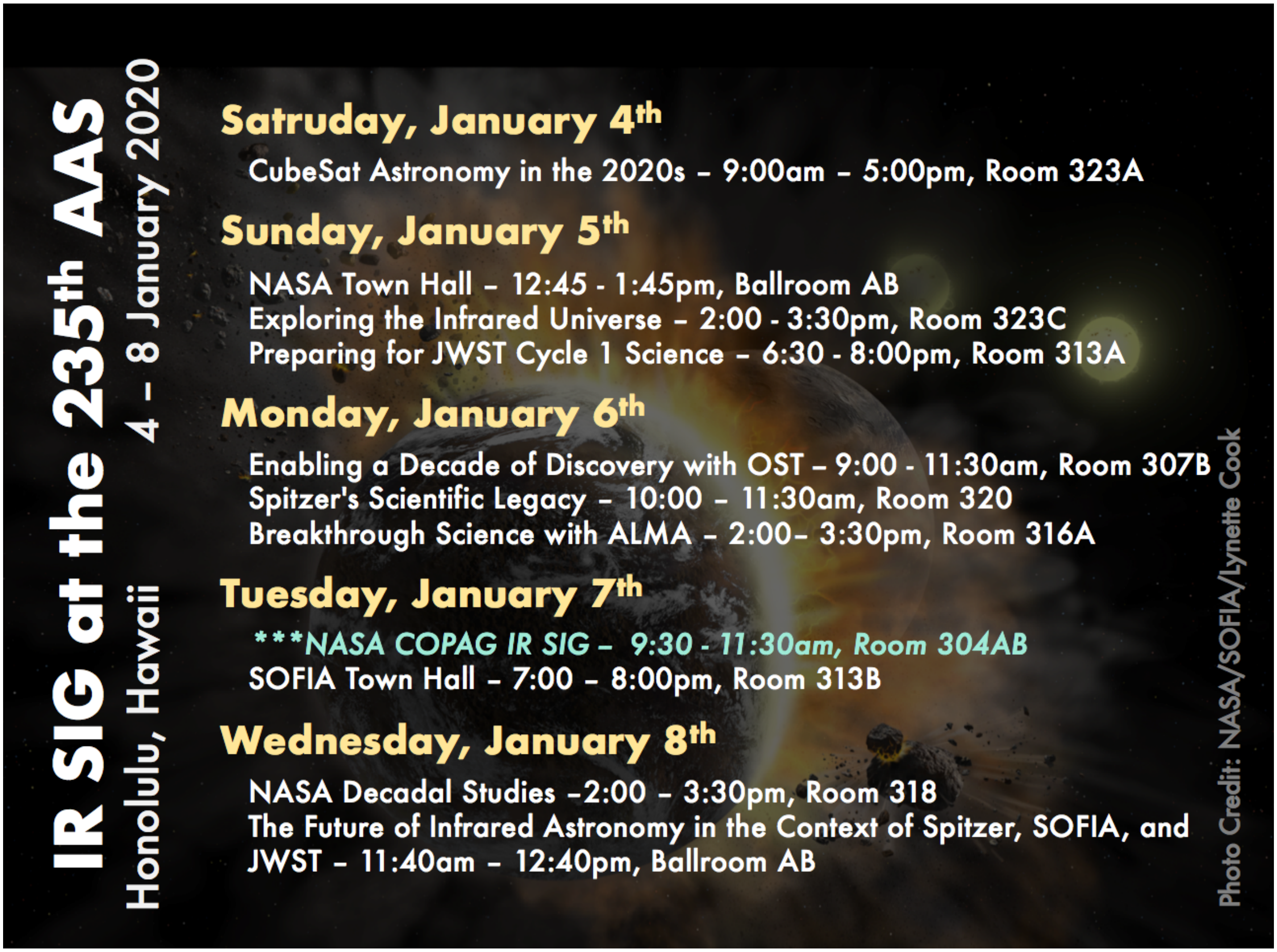
13-20 May 2020 – **17th NRAO Synthesis Imaging Workshop**
Socorro, NM
http://www.cvent.com/events/17th-synthesis-imaging-workshop/event-summary-0d59eb6cd1474978bce811194b2ff961.aspx

UPCOMING EVENTS

31 May - Jun 4 2020 – AAS 236
Madison, WI
https://aas.org/meetings/aas236

14-19 Jun 2020 – SPIE Astronomical Telescopes+ Instrumentations 2020
Pacifico Yokohama, Yokohama, Japan
http://spie.org/SPIE_Astronomical_Telescopes_Conference

21-26 Jun 2020 – Cool Stars 21
Toulouse, France
https://coolstars21.github.io/



IR SIG at the 235th AAS
Honolulu, Hawaii 4 - 8 January 2020

Satruday, January 4th
CubeSat Astronomy in the 2020s – 9:00am – 5:00pm, Room 323A

Sunday, January 5th
NASA Town Hall – 12:45 - 1:45pm, Ballroom AB
Exploring the Infrared Universe – 2:00 - 3:30pm, Room 323C
Preparing for JWST Cycle 1 Science – 6:30 - 8:00pm, Room 313A

Monday, January 6th
Enabling a Decade of Discovery with OST – 9:00 - 11:30am, Room 307B
Spitzer's Scientific Legacy – 10:00 – 11:30am, Room 320
Breakthrough Science with ALMA – 2:00– 3:30pm, Room 316A

Tuesday, January 7th
****NASA COPAG IR SIG – 9:30 - 11:30am, Room 304AB*
SOFIA Town Hall – 7:00 – 8:00pm, Room 313B

Wednesday, January 8th
NASA Decadal Studies –2:00 – 3:30pm, Room 318
The Future of Infrared Astronomy in the Context of Spitzer, SOFIA, and JWST – 11:40am – 12:40pm, Ballroom AB

Photo Credit: NASA/SOFIA/Lynette Cook

IR SIG Leadership Council

The current members of the IR Science Interest Group (SIG) Leadership Council are:

Duncan Farrah	**University of Hawaii**
Jeyhan Kartaltepe	**Rochester Institute of Technology**
Tiffany Kataria	**Jet Propulsion Laboratory**
Jens Kauffmann	**Massachusetts Institute of Technology**
Lisa Locke	**JPL**
Enrique Lopez Rodriguez	**SOFIA Science Center**
Meredith MacGregor (Co-Chair 2020)	**University of Colorado Boulder**
Elisabeth Mills	**Brandeis University**
Eric Murphy (current Co-Chair)	**National Radio Astronomy Observatory**
Omid Noroozian	**National Radio Astronomy Observatory**
Naseem Rangwala (current Co-Chair)	**SOFIA Science Center**
Dave Sanders	**University of Hawaii**
JD Smith	**University of Toledo**
Johannes Staguhn	**Johns Hopkins University, NASA GSFC**
Mike Zemcov (Co-Chair 2020)	**Rochester Institute of Technology**

Additional information about the IR SIG can be found at our website: **https://fir-sig.ipac.caltech.edu/**

To contact the IR SIG LC directly, email: **irsiglc@gmail.com**.

We are recruiting new members!

The Infrared Science Interest Group Leadership Council (IR SIG LC) invites applications to fill up to three council vacancies, to commence spring 2020. Membership terms are flexible: 1, 2, or 3 years depending on availability. Applications are due by **February 28, 2020 at 5pm Pacific time**.

The IR SIG LC is interested in applications from individuals working in areas relevant to the infrared astronomy community, including any area of science, and any instrument development domain. We are especially interested in applications from people who are dedicated to growing and developing community activities, and representing the needs of the community to NASA.

Applications, consisting of a cover letter plus two-page CV, should be sent by email to the IR SIG LC co-chairs: Naseem Rangwala (naseem.rangwala@nasa.gov) and Eric Murphy (emurphy@nrao.edu).