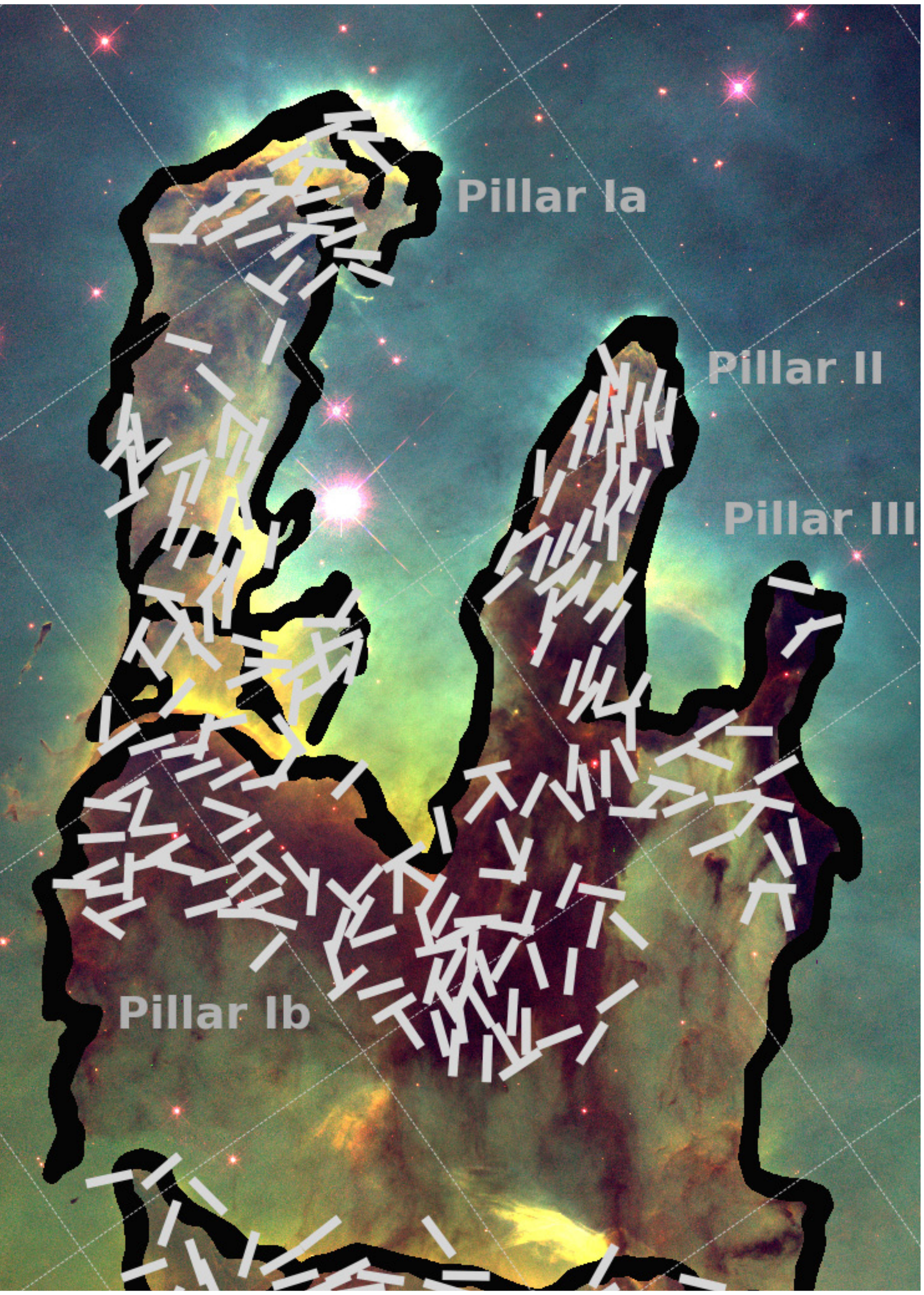
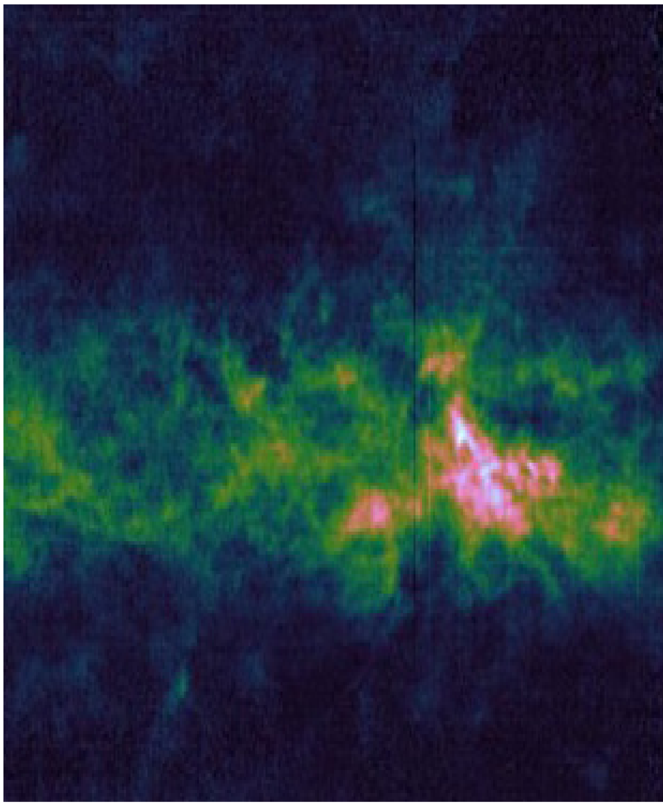
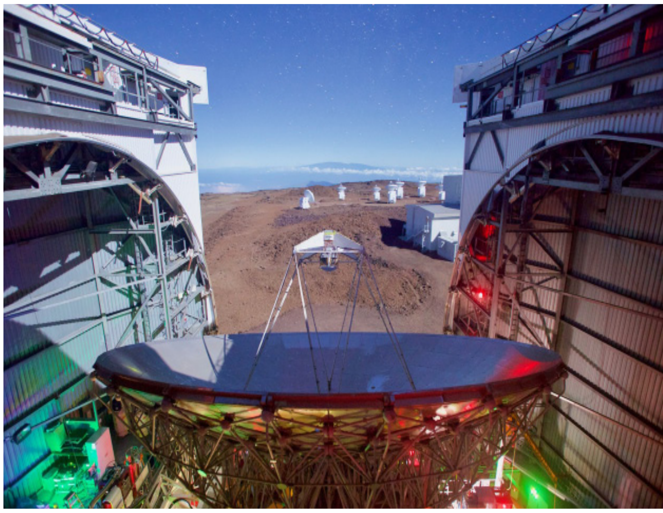
East Asian Observatory News







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Issue #4, September 2018

East Asian Observatory News

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In this Issue:

East Asian Observatory

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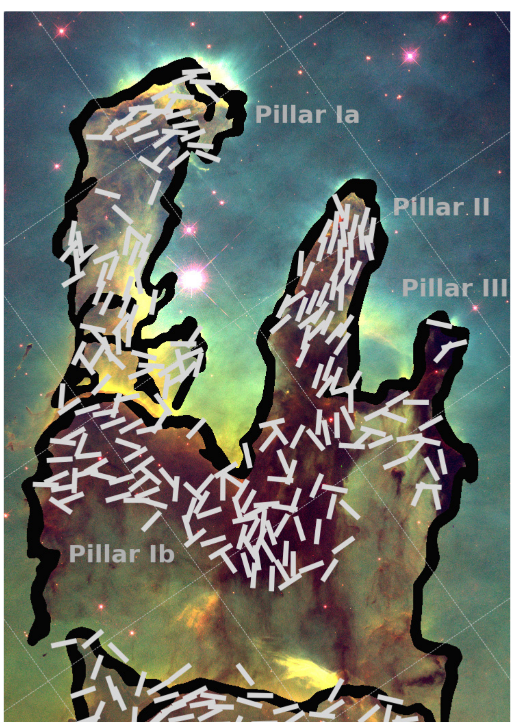

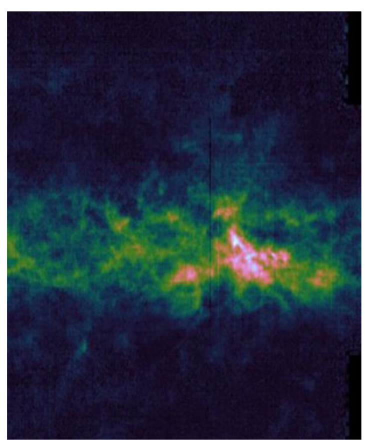

From the front cover.

Left: An illustrative figure of the BISTRO magnetic field vectors observed in the Pillars of Creation, overlaid on a composite 502 nm, 657 nm and 673 nm HST image from Hester et al. (1996, AJ 111, 2349) (Story on Page 9).

Top Right: ^{13}CO integrated intensity in the CMZ from the CHIMPS2 survey (Story on Page 8).

Bottom Right: JCMT without it's iconic GoreTex membrane facing north towards the SMA with Maui in the distance. The membrane had been removed for commissioning in December 2018. Photo by William Montgomerie.

Director's Corner

Paul Ho, Director General of EAO

The EAO is now in her fourth year of operations of the JCMT. The Observatory continues to perform extremely well, and we are delivering great scientific results. The publication rate at 117 papers for 2017, is the highest annual count in JCMT history. Many exciting results from POL-2 were published, as well as the first results from the Large Programs. The JCMT participated successfully in the first two Event Horizon Telescope experiments with ALMA, during April 2017 and 2018. Very exciting images of the supermassive black holes in SgrA* and M87 were obtained. We have had 8 calls for PI proposals, and 2 calls for Large Programs. Proposal pressure remains high, with an oversubscription rate of ~3-5 across the partner regions.

During September and October 2017, the JCMT hosted the Greenland Telescope (GLT) receiver system, for integration tests and VLBI tests. These successful tests greatly facilitated the deployment of the receivers to the GLT in Thule, and resulted in the GLT successfully participating in the EHT experiment in April 2018. A copy of the GLT receivers is now under construction and will be deployed to JCMT as the replacement of our 230 GHz instrument, RxA3m, which was retired in June.

In December 2017, we removed the wind screen in front of the telescope in order to measure its transmission properties. The instrumental polarization introduced by the wind screen was accurately evaluated, allowing us to reliably calibrate POL-2 for 450μm and 850μm operations.

In 2017, the EAO completed the mid-term review of operations and scientific results while the JCMT partners in UK and Canada succeeded in raising new funds for their continued participation. As a result, in April 2018, the EAO Board approved the extension of JCMT operations for another five years. The EAO and UH are currently working on the extension of JCMT to 2025. With this extension, we will proceed to develop the replacement of HARP and SCUBA-2. We aim to improve the speed of these receiver systems by a factor of 10. We are currently evaluating new detector arrays to replace SCUBA-2, and we are making new mixers for HARP.

In other EAO news, during this past year, EAO regional scientists have raised funds to access UKIRT, and an agreement has been reached for EAO astronomers to access Subaru. We happily welcome Thailand and Vietnam as observer status in EAO, which allows astronomers in those regions to access EAO facilities. Malaysia is working on their observer status in EAO, and may soon be on board. These are our latest developments, and we look forward to our next update.

Figure 1. Clockwise from left. Group photo on the first day of VLBI (Very Long Baseline Interferometry) observations in April. Top right: The GLT receiver installed at JCMT. Bottom right: "We've got fringes!" JCMT, GLT (Greenland Telescope), and SMA staff work to get ready for VLBI observations as part of the Event Horizon Telescope.

Interested in keeping up with the latest information from JCMT? Then join our mailing list! Simply email: jcmt_users+subscribe@eaobservatory.org to join.

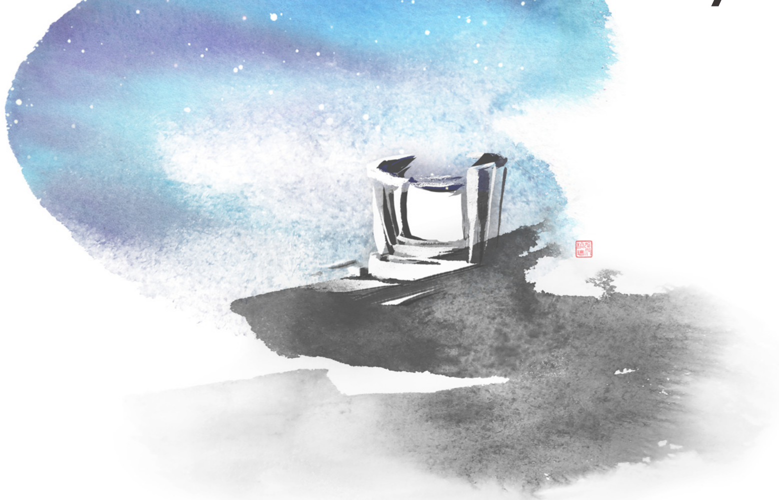

Figure 2. Top: JCMT EAO all staff photo in June. Middle: A painting of JCMT by EAO Resident Artist Jung Shan Chang. Bottom: The JCMT 2018 User Meeting held in Seoul, South Korea at the end of January/beginning of February was a success with 39 science talks spread over two days.

Rain, Rain, Go Away

Jessica Dempsey, Deputy Director

Winter arrived late but with a vengeance this year, with extended periods of ever worsening summit conditions - these issues plagued all facilities, with reports of the worst winter on record for all observatories. A series of cold fronts materialized over the Big Island, almost weekly, from mid-February through to April, with thundery conditions in Hilo and socked-in fog, rain and snow showers across the Maunakea summit. For JCMT, it meant a record amount of time closed, or with an atmosphere too water-logged for any useful observing.

In an average winter, we collect roughly 350 hours of observing a month, but in February through to April, we collected less than half of that, with an average of 160 hours lost to weather each month - over four times the average. Additionally, the weather has stayed moist even when we could open: no Grade 1 weather (Tau < 0.05) has been recorded in any month since February through to and including July, except March, which managed a whole single night of it!

We are always grateful for our positive, eager user community - and we want to assure you that we want to get your project time just as much as you do. We have been very frustrated that the conditions have continued to work against us. My weather experts are suggesting a lingering La Nina was mostly to blame for the wet winter, and likewise this current moist summer is a result of shifting to neutral conditions. The good news? They suggest to me that El Nino is on its way, hopefully in time for a sparklingly dry and clear winter of 2018-2019. Thanks for your patience with us and we hope to see drier skies and project completion totals ramping up very soon.

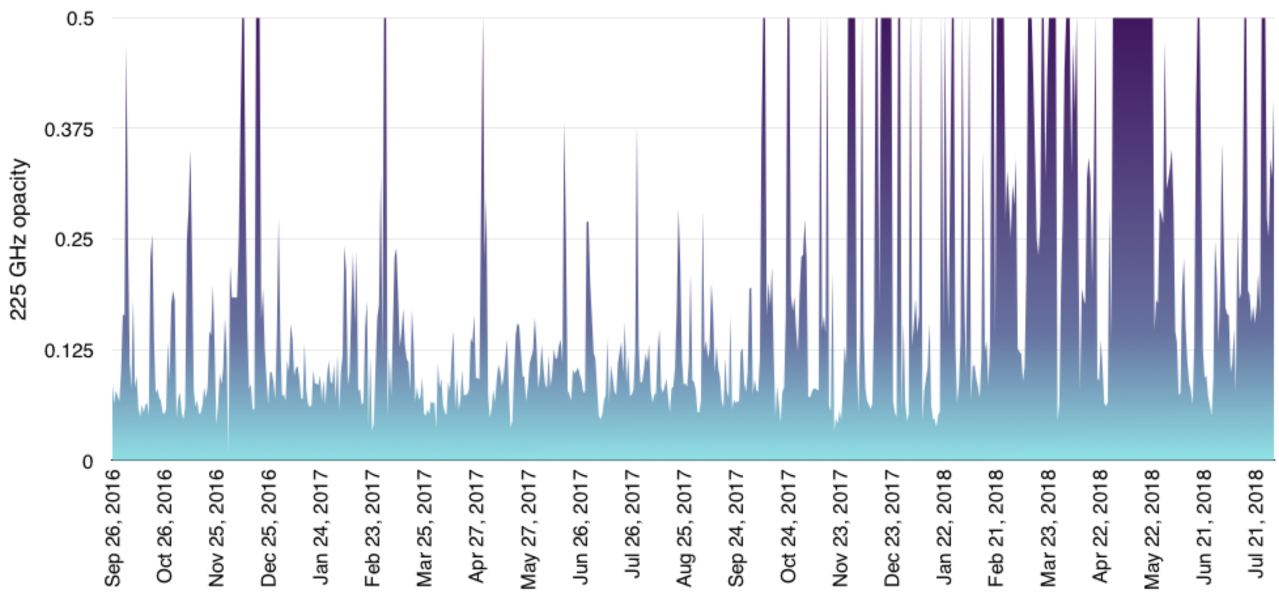

Figure 3. Measured opacity (225 GHz) via the WVM since September 2016.

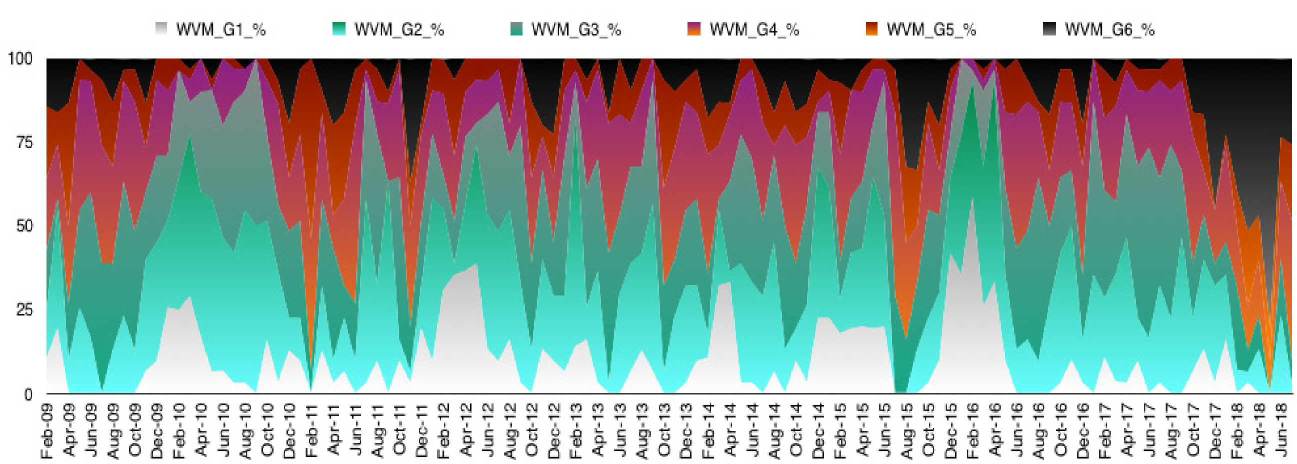

Figure 4. Percentage of time spent per weather grade as measured from the JCMT Water Vapor Monitor since 2009.

NESS: The Nearby Evolved Stars Survey

Peter Scicluna, Postdoctoral Fellow at Academia Sinica Institute of Astronomy and Astrophysics

When stars approach the end of their lives, they go through periods of enhanced mass loss. During these periods, "evolved" stars eject between 10 to 80 percent of their initial mass. Through these processes, the new elements produced in the stars' cores during their lifetimes are ejected to the interstellar medium, and will eventually go on to form new generations of stars.

The Nearby Evolved Stars Survey (Scicluna et al., in prep; http://evolvedstars.space) is an ambitious attempt to study this mass loss in detail for a large, volume-limited sample of stars relatively close to the Sun. With the JCMT, we are using 515 hours of telescope time to observe a sample of nearly 300 stars over three years in both molecular lines and continuum. Additional data will be collected by other telescopes from around the world, including a southern sample observed with APEX (see Fig. 5), observations at longer wavelengths with the Nobeyama 45m telescope and several hundred hours of archival data. From these observations we will determine the mass-loss rate for all sources, their dust-to-gas ratios, and for at least a subset of sources the $^{12}C/^{13}C$ ratio. In addition, a subset of sources is being mapped in detail, to allow us to determine the mass-loss rate and dust-to-gas ratio over the recent history of the mass loss.

By adding up the mass-loss rates of all the sources, we will determine the total rate of mass injection to the solar neighbourhood. We will also be able to compare the mass-loss rates to the other properties of the stars in the sample. For example, by studying the evolution of mass-loss rate and outflow velocity with T_{eff}, L, and the pulsation period, we can study the physics underlying the mass-loss process, and how the outflow is initiated. By exploring the

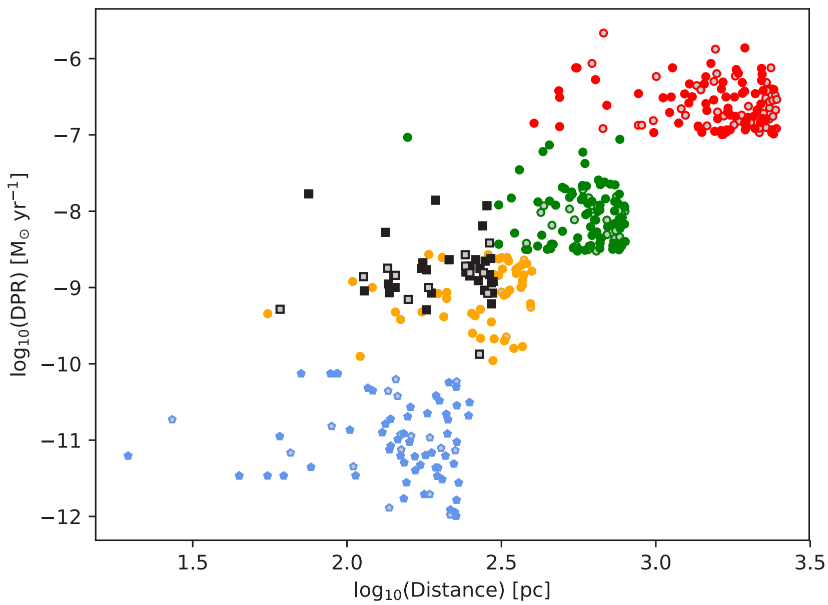

Figure 5. The NESS sample of galactic evolved stars showing the estimated dust production rate as a function of distance. The coloured symbols are sources selected for observations toward the central star, while the black squares are a subset of sources selected for detailed mapping on scales of at least 2' x 2'. Filled symbols are the nearly 300 sources being observed from the JCMT, while the outline sources the are ~100 sources being observed by APEX.

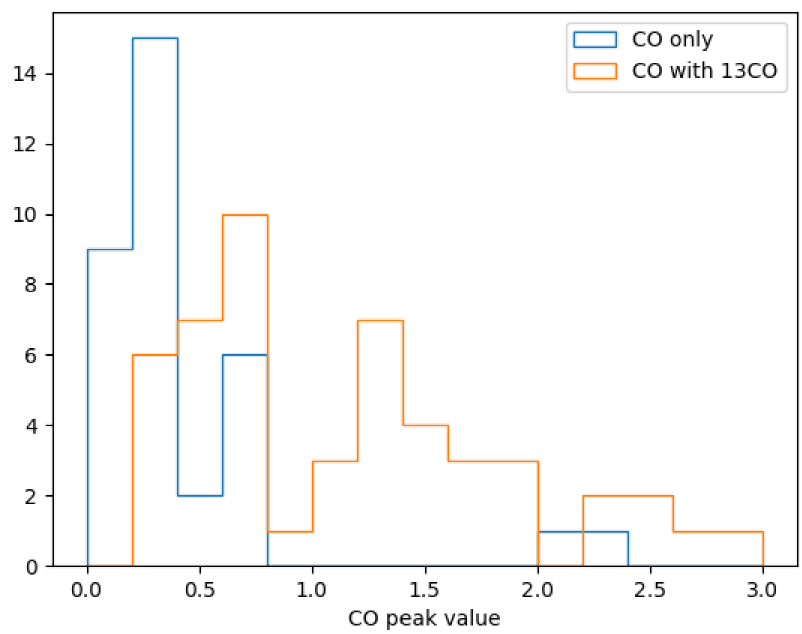

Figure 6. Histogram of $^{13}CO(2\text{-}1)$ detections as a function of observed $^{12}CO(2\text{-}1)$ brightness for a subsample of NESS sources (Wallstrom et al., in prep).

evolution of dust composition in the mid-infrared and comparing this with the mass-loss rate, the physics of dust nucleation and growth can be revealed. Finally, we expect to develop a number of in-depth studies of individual objects based on NESS observations.

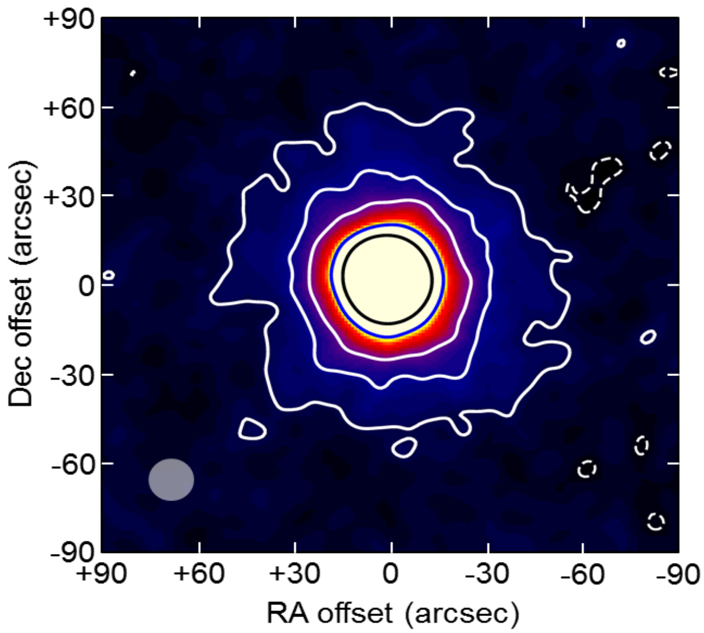

Figure 7. SCUBA-2 850 μm image of CIT6 (Holland et al., in prep).

NESS is 42% complete in terms of observing time after just one year. Our data so far covers all observing modes, using SCUBA-2, HARP and RxA3m. We have developed a preliminary python pipeline for heterodyne data which reduces and extracts the spectra, then fits the parameters of the spectral line observed. This pipeline will be released to the astronomical community when complete and is designed to be adaptable for other science cases. We are beginning to analyse the preliminary data, including examining the $^{12}CO/^{13}CO$ ratio for all sources with observations of both molecules (see Fig. 8 and Wallstrom et al., in prep).

SCUBA-2 observations remain more difficult to interpret. We are searching for extended emission close to very bright compact sources, which requires very high dynamic range. This pushes the data reduction software to its limits, as it struggles to disentangle the extended emission from astronomical background. Our initial methods reveal substantial extended emission (see Fig. 8 and Dharmawardena et al., subm.) but further improvements are expected as we continue to work on the pipeline (Holland et al., in prep).

Although our data reduction and analysis methods are still undergoing development, we are pushing to explore the results in the data. Our initial results include a detection of the peculiar dust shell of U Ant with SCUBA-2, an analysis of which is ongoing. We are also seeing an unusually low detection rate of CO lines toward stars expected to have very low dust-production rates. A small fraction of these sources have strong CO lines, but the majority are too weak to detect. This supports existing suggestions that there may be a sudden transition to strong mass loss, but the threshold remains undetermined.

As part of NESS, we are developing a number of codes, all of which will be made available to the community via github.com, licensed so that they can be used and built upon in future. In the interests of reproducibility, this extends to all the scripts developed as part of the core papers, so that all the data and plots will be verifiable. A public database of all the NESS raw, reduced and advanced data products will be released; the NESS database is poised to become the authoritative source for evolved-star studies in the next decade.

NESS is a collaboration of roughly 70 scientists in Taiwan, China, South Korea, Japan, Canada, the United Kingdom, Vietnam and EAO. For further information about NESS, or details of how to get involved, please contact the authors or visit the team website (http://evolved-stars.space).

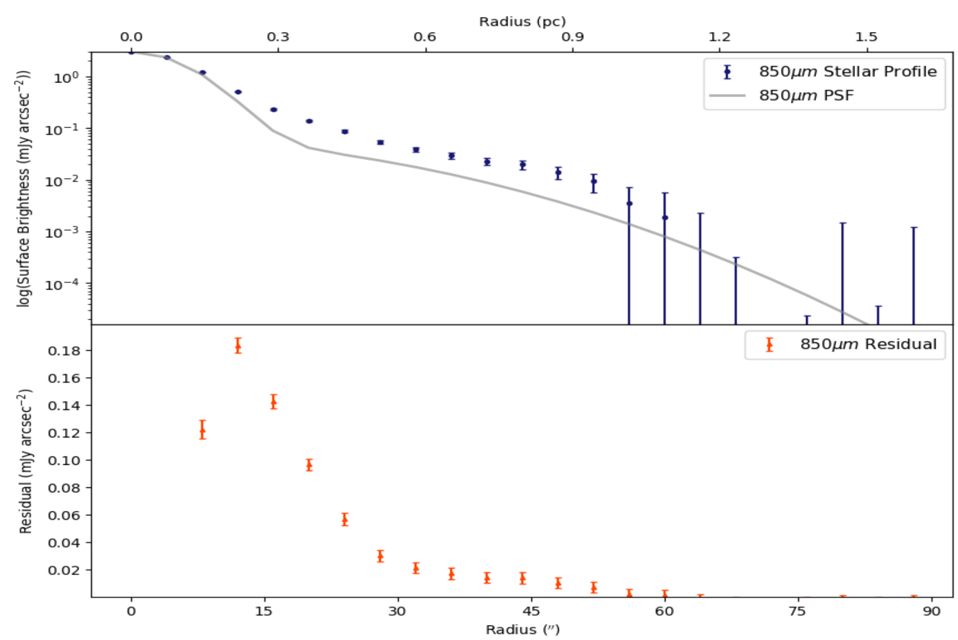

Figure 8. Azimuthally-averaged radial profile of CIT6 from the SCUBA-2 850 μm image (Dharmawardena et al., subm). The lower panel shows the residual after subtracting the SCUBA-2 PSF, to emphasise the extended dust emission, which is seen up to 45" from the star.

CHIMPS2: The CO (J=3-2) Heterodyne Inner Milky Way Plane Survey 2

David Eden, Post Doctoral Research Associate at the Astrophysics Research Institute, Liverpool John Moores University

CHIMPS2 was awarded 404 hours in the second JCMT Large Program proposal call to observe large portions of the Galactic Plane in ^{12}CO, ^{13}CO, and $C^{18}O$ J=3-2 emission. This project is an extension of the CHIMPS (Rigby et al., 2016; Fig 9) and COHRS (Dempsey et al., 2013) surveys, extending them into the Outer Galaxy, Central Molecular Zone (CMZ), and further into the Inner Plane.

When combined with the complementary ^{12}CO/^{13}CO/$C^{18}O$ J=1-0 survey at the Nobeyama 45m telescope (FUGIN; Umemoto et al., 2017) at matching 15" resolution and sensitivity, and other current CO surveys, the results will provide a complete set of high-resolution transition data with which to calculate accurate column densities, gas temperatures and turbulent Mach numbers, which otherwise depend on approximations and assumptions. This will be invaluable physical information, enabling molecular cloud properties to be compared across a range of Galactic environments; the star-formation efficiency and dense-gas mass fraction to be mapped across the Plane; the Galactic structure to be determined, as traced by molecular gas and star formation; cloud formation models to be constrained; the role of filaments in star formation to be determined; to test current models of the gas kinematics and stability in the Galactic-centre region and the flow of gas from the disc. All of these results will be key pieces in the jigsaw puzzle of producing an empirical recipe for star formation. It will also provide an invaluable legacy data set for JCMT that will not be superseded for some time.

CHIMPS2 has around 100 members from all EAO affiliated regions, with all levels of the career ladder represented.

Current Progress

CHIMPS2 observations began at the start of semester 17B, in July 2017, and the survey is currently 30% complete, with extensive coverage of the Outer Galaxy and CMZ, as can be seen in Fig. 9.

Our Data Reduction Working Group has made significant progress in adapting the reduction processes from the CHIMPS and COHRS projects to the new data from CHIMPS2, utilising the Starlink ORAC-DR data reduction pipeline. These pipelines are to be adapted to better suit the different Galactic environments, to accentuate the more complex CMZ and the sparser Outer Galaxy regions.

Internal releases of the current data have occurred through the CHIMPS2 VO Space (http://apps.canfar.net/storage/list/CHIMPS2), as well as the current ORAC-DR pipeline hosted on the project wiki.

With a significant amount of data now obtained and the inclusion of CHIMPS and COHRS, initial data analysis has begun, with exciting results to be outlined in upcoming peer-reviewed publications. Currently, a survey description paper is in preparation, with publication expected in the next few months. In June 2018, we held our first face-to-face CHIMPS2 team meeting in Liverpool, UK, on the eve of two international star-formation conferences.

In summary, CHIMPS2 is progressing well, with multiple Working Groups identified, excellent data acquisition rates, and publications in preparation.

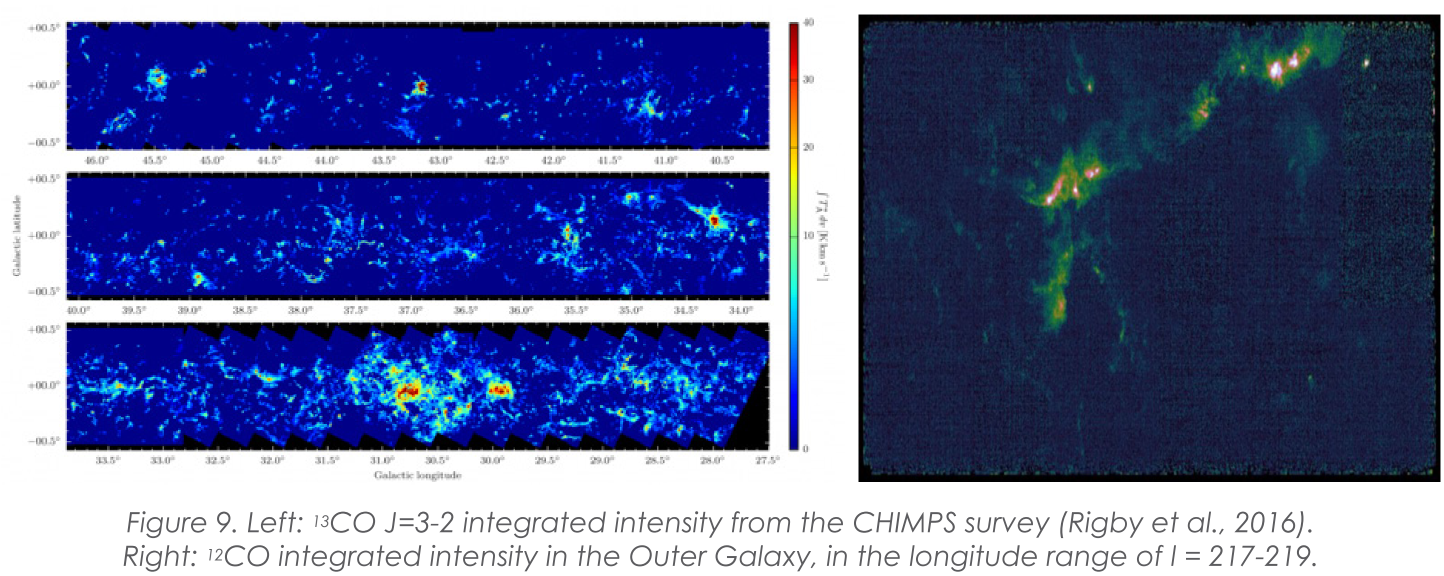

Figure 9. Left: ^{13}CO J=3-2 integrated intensity from the CHIMPS survey (Rigby et al., 2016). Right: ^{12}CO integrated intensity in the Outer Galaxy, in the longitude range of l = 217-219.

First Observations of the Magnetic Field Inside the Pillars of Creation: Results from the BISTRO Survey

Kate Pattle, Derek Ward-Thompson, Tetsuo Hasegawa, Pierre Bastien, Woojin Kwon, Shih-Ping Lai, Keping Qiu, Ray Furuya, David Berry and the JCMT BISTRO Survey Team

The BISTRO (B-Fields in Star-Forming Region Observations) Survey has for the first time mapped the magnetic field in the dense gas of the `Pillars of Creation', using instruments on the JCMT. The Pillars of Creation, in the Messier 16 star-forming region, which is also known as the Eagle Nebula, were the subject of one of the most iconic images taken by the Hubble Space Telescope (HST). The Pillars are a set of columns of cold, dense gas protruding into a region of hot, ionized plasma. The Pillars have nurseries of new stars forming at their tips, and are a particularly dramatic example of a feature found in many regions of interstellar space in which high-mass stars are forming.

We present the first high-resolution observations of the Pillars in polarized light at submillimeter wavelengths -- submillimeter light being on the cusp between infrared and radio waves, where the cold, dense dust and gas which will form the next generation of stars emits most of its light. Light emitted from these dusty regions is polarized perpendicular to the direction of its local magnetic field, and so we can

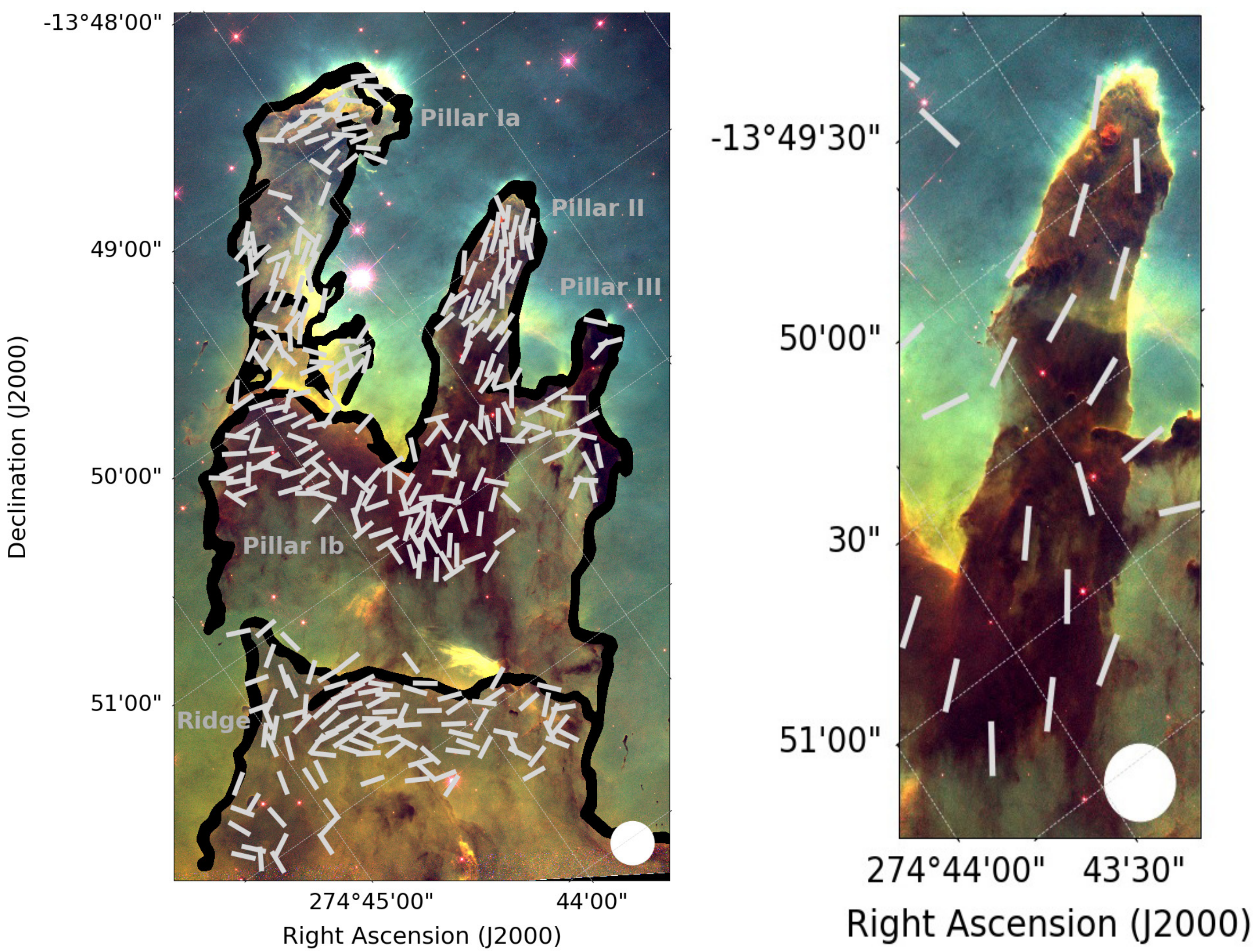

Figure 10. Left: An illustrative figure of the BISTRO magnetic field vectors observed in the Pillars of Creation (Left) and a zoom in of Pillar II (right). The magnetic filed vectors are over- laid on a composite 502 nm, 657 nm and 673 nm HST image from Hester et al. (1996, AJ 111, 2349). The magnetic field runs roughly parallel to the Pillar's axis. No polarization is detected at the Pillar's tip -- this depolarization is consistent with a horseshoe-shaped magnetic field morphology on scales smaller than the beam. Left image is shown on the cover of this Newsletter.

use our observations to directly probe the magnetic field morphology within the dense gas of the Pillars of Creation. Our observations were taken at a wavelength of 0.85 mm as part of the BISTRO Survey, using the POL-2 polarimeter on the SCUBA-2 submillimeter camera at the JCMT. They show that the magnetic field runs along the length of the pillars, at a significantly different angle to the field in the surrounding ionized plasma, and has an estimated strength of approximately 170 – 320 microGauss (1.7 – 3.2 × 10^{-8} Tesla), an intermediate magnetic field strength for a region of space which is forming stars.

Young hot stars, with masses more than eight times that of the Sun, produce large numbers of high-energy photons. These high-energy photons ionize a volume of the region within which they form, splitting hydrogen atoms into pairs of protons and electrons. As the shock front between the material ionized by the young stars and the untouched neutral material advances, complex structures form in the dense gas at the interface. Particularly, pillars of dense, neutral gas like those in M16 are found protruding into the ionized region, apparently left behind by the advancing shock front. The formation and evolution of these pillars is not well-understood -- debate continues as to whether these pillars form behind obstructions to the shock front, or whether they can form from turbulent instabilities in the shock front itself. The role of the magnetic field in the formation of the Pillars is particularly uncertain, since the strength of the magnetic field in the dense parts of the Pillars has not been measured until now.

Our observations of the magnetic field running along the length of the Pillars are consistent with the Pillars being formed by compression of gas with an initially weak magnetic field: the magnetic field has not had the strength to resist being dragged into its current configuration by the motions of the gas. However, the magnetic field strength appears to have been increased by being compressed in the forming pillars. The magnetic field strength that we estimate is large enough to magnetically support the sides of Pillars against collapsing radially under pressure from the surrounding hot plasma, and to prevent the Pillars collapsing under their own gravity. It is important to note though that the Pillars are still being destroyed by the same shock interaction that created them: the magnetic field that we measure is not strong enough to prevent the Pillars being gradually eroded from their tips by the effects of the young stars in the region. Our results suggest that the evolution and lifetime of the Pillars may thus be strongly influenced by the strength and orientation of their magnetic field: the Pillars' longevity results from magnetic support.

The James Clerk Maxwell Telescope, located on Maunakea in Hawai'i, is operated by the East Asian Observatory. The BISTRO Survey is a large team of scientists working to understand the role of magnetic fields in the formation of stars, with members from across the partner regions of the East Asian Observatory: China, Japan, South Korea, Taiwan and Vietnam, and from participating universities in the United Kingdom and Canada.

This research has been accepted for publication by The Astrophysical Journal Letters. A pre-print is available at http://arxiv.org/abs/1805.11554.

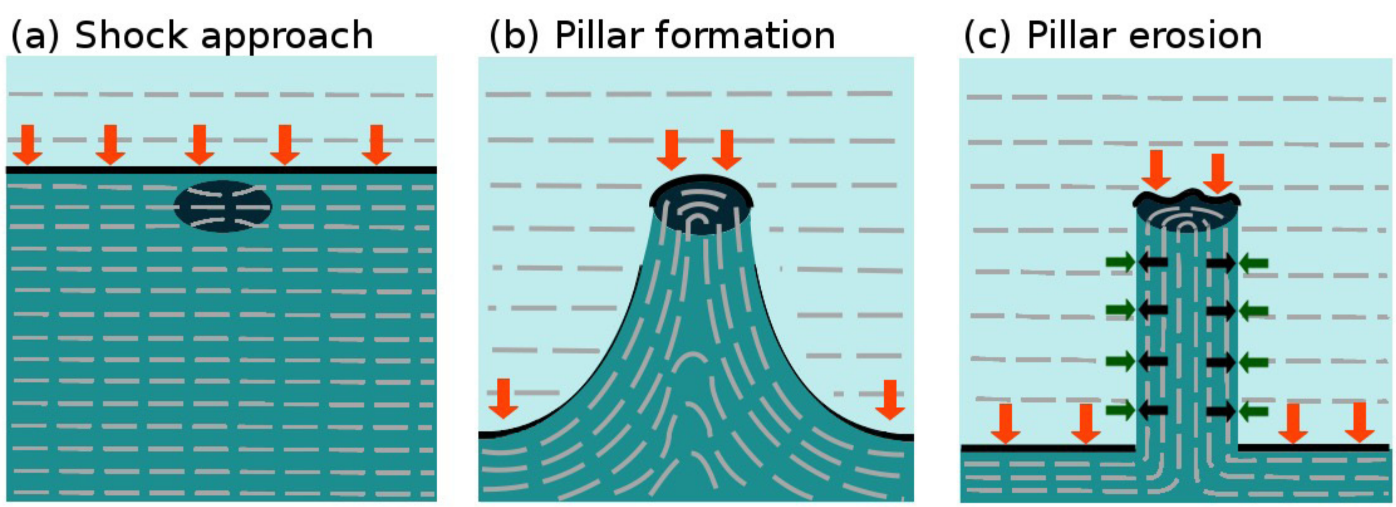

Figure 11. Our proposed evolutionary scenario: (a) an ionization front moving perpendicular to the ambient magnetic field approaches an existing over-density in the molecular gas. (b) The ionization front is slowed by the over-density. The flux-frozen magnetic field 'bows' into the forming pillar. (c) The compressed magnetic field supports the pillar against further gas-pressure- and gravity-driven radial collapse, but cannot support against longitudinal erosion of the over-density by ionizing photons. Throughout, dark blue shading represents molecular gas and light blue shading represents ionized material. The ionization front is shown as a black line. Grey dashed lines indicate the local magnetic field direction. Red arrows represent photon flux, black arrows represent magnetic pressure, and green arrows represent thermal gas pressure.

HASHTAG: The HARP and SCUBA-2 High- Resolution Terahertz Andromeda Galaxy Survey

Matthew Smith, Research Associate at Cardiff University, UK

The HARP And SCUBA-2 High-Resolution Terahertz Andromeda Galaxy Survey (HASHTAG) is a new JCMT large program to observe the entire dust disk of Andromeda at 450 and 850μm with SCUBA-2, and selected regions in CO(J=3-2) with HARP. Our team comprises of 82 members spread over all JCMT partner countries. HASHTAG will observe M31 with SCUBA-2 getting deep dust maps with a sensitivity of at least 3.0 mJy/beam at 850μm and 47.8 mJy/beam at 450μm. The figure shows the example of our pilot observations, where we target the region observed by the Hubble telescope (PHAT survey). The significant improvement in resolution over what is possible at SPIRE 500μm is clearly evident. The proximity of Andromeda makes it an ideal laboratory for studies of star formation, the interstellar medium (ISM), and the properties of dust, as we obtain excellent spatial resolution (~20 pc) and it has been intensely studied at all wavelengths. Andromeda also provides a useful contrast to the Milky Way, as it has a much larger bulge and less obvious spiral arms with most star formation occurring in a ring.

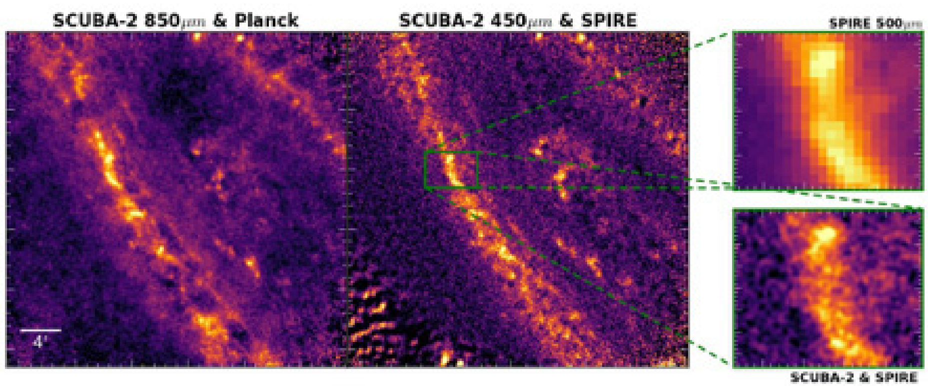

Figure 12. The 850μm (left) and 450μm (middle) images from our pilot program which observed a 30' region of M31. For both bands, we use data from either Planck or SPIRE to add in large-scale structures. The improvement in resolution from 36'' for SPIRE 500μm to 7'' for SCUBA-2 at 450μm is clearly apparent in the zoomed plot. To aid visualisation we have convolved the SCUBA-2 maps with a Gaussian with the same FWHM as the PSF. The full sensitivity is only achieved in the central part of the image.

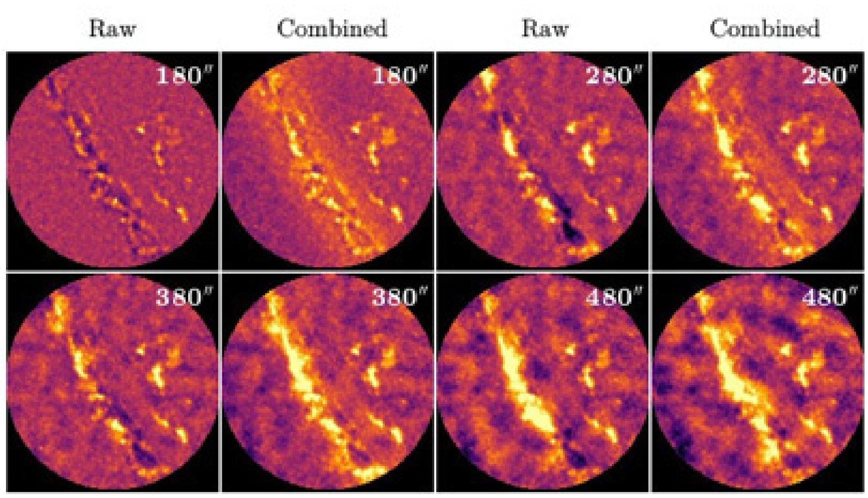

Figure 13. Our simulation of injected the SPIRE 250μm into the raw-data SCUBA-2 data of the CLS field. The 'raw' columns show the SCUBA-2 map generated by Skyloop and the 'combined' column shows when we perform the matching with our equivalent to Planck map (actually a smoothed version of the Herschel map). When the filter scale is set too harsh we lose extended emission, while if the filter settings is set too light large-scale noise dominates.

In addition to our SCUBA-2 measurements we also observe 60 square arcminutes with HARP. This is primarily so we can calibrate a method to accurately subtract contamination from the CO(J=3-2) using other tracers, but our observations target regions with in-depth spectroscopy with other instruments, and so we can understand the molecular ISM.

The science goals for HASHTAG include:

The Physics of Dust – The dust in M31 is a challenge for dust models with radial variations in the dust-emissivity index, and significant differences between models of dust absorption and emission. By combining our high-resolution dust maps with the results from the Panchromatic Hubble Andromeda Treasury (PHAT), and maps of the atomic and molecular gas, we will investigate the properties of dust. For example whether the variation in dust properties is primarily driven by the temperature, composition or age of the dust.

The Interstellar Medium – We will be able to determine the variation of the CO X-factor and gas-to-dust ratio across the galaxy, and how the gas, dust and metallicity are related.

Star Formation – We will use this map to produce a catalogue of approximately 2000 clouds with masses. The cloud catalogue will for the first time allow us to move from studying the relation between star formation and gas on large scales (the Kennicutt-

Schmidt relation) to investigating the physical relation between the clouds and the stars forming within them. For example we will use the catalogue to investigate whether there is a single evolutionary history for a cloud or whether the history of a cloud depends on its location within a galaxy.

Our Current Status

With our first observing season complete we now have completed our CO observations, and our SCUBA-2 observations are 19% complete. The analysis of the CO data is already underway, and while we are eagerly awaiting more SCUBA-2 data, we are using this period to optimise our SCUBA-2 pipelines so we can create the best map possible. Andromeda presents a difficult challenge; not only do we have to deal with the filtering effects needed to remove atmospheric and instrumental effects, but having such a large dataset for a single field brings its own processing challenges. As part of this development we have modified the Skyloop script (possibly a bit of an ugly hack), which for our data/system runs approximately twice as fast. We've delivered our version of Skyloop to the observatory, to hopefully be released for the whole community.

One of our biggest challenges is the high-pass filtering that is required in the pipeline to remove the effect of the atmosphere, which has the unfortunate by-product of removing the large-scale emission of the galaxy. To overcome this problem, which is the reason why, after 30 years of submillimetre astronomy, there are no high-quality submillimetre images of galaxies in the Local Group, we use the Planck and SPIRE maps to replace the large-scale emission missed by SCUBA-2. We are developing a public tool that will take any SCUBA-2 maps and combine them, in Fourier space, with either the Planck or Herschel maps to provide high-fidelity images on all spatial scales (see Figures).

To optimise this technique, we are currently running a campaign of simulations in which we inject a Herschel 250μm image of Andromeda scaled to 850 μm into a SCUBA-2 dataset from the Cosmology Legacy Survey. We then vary the parameters in the data reduction pipeline, to see which ones allow us to best recover the emission we put in. The figure shows a subset of our simulations in which we vary possibly the most important parameter – the filter scale. Work is continuing to look at other parameters such as the mask, tolerance, etc.

We have our fingers crossed for a good observing season this year so we can start working on the exciting science.

Magnetized Inflow Accretion - An Important Force to Transport Gas to the Supermassive Black Hole Sagittarius A* at the Center of the Milky Way

Pei-Ying Hsieh, Patrick M. Koch, Woong-Tae Kim, Paul T. P. Ho, Ya-Wen Tang, and Hsiang-Hsu Wang

SgrA* - the Closest Laboratory to Study Black Hole Feeding

Sagittarius A* (SgrA*) is the closest Super Massive Black Hole (SMBH) in our home, the Milky Way Galaxy. This SMBH been targeted by many scientists to understand the nature of gas accretion in past decades. Observing the gas accretion onto a SMBH is critical to helping us understand how such objects can release tremendous amounts of energy.

Surrounding SgrA* is a circumnuclear disk (CND), a molecular torus rotating with respect to SgrA*. Within this CND are ionized gas streamers called mini-spiral (also called SgrA West) which fills the molecular cavity. The mini-spiral is hypothesized to originate from the inner edge of the CND. The CND is the closest "food reservoir" for SgrA*, and is therefore critical for understanding the feeding mechanism of SgrA*. Despite their importance, looking for the physical evidence to connect the mini-spirals and the CND has puzzled astronomers since they were discovered a few decades ago.

Intensive measurements of dynamical orbital movements around SgrA* have been done in the past decades, but another important force – the magnetic field - is rarely probed. This is solely because the weak polarized signal generated by the magnetic field from dust emission is difficult to measure. However, the magnetic field is expected to be important for material orbiting within and around the CND. The magnetic stress acting on the rotating disk can exert a torque to extract angular momentum from rotating gas, and thus drive gas inflows. In addition, the magnetic tension force can draw the gas back from the gravitational pull. Taking advantage of excellent atmospheric conditions on the Maunakea summit at 4000 meters and large aperture size of the JCMT, the submillimeter polarization experiments were successfully obtained toward the Galactic Center to understand the role of the magnetic field.

Tracing Magnetized Accreting Inflow

We utilized the dust polarization data obtained by the JCMT-SCU-

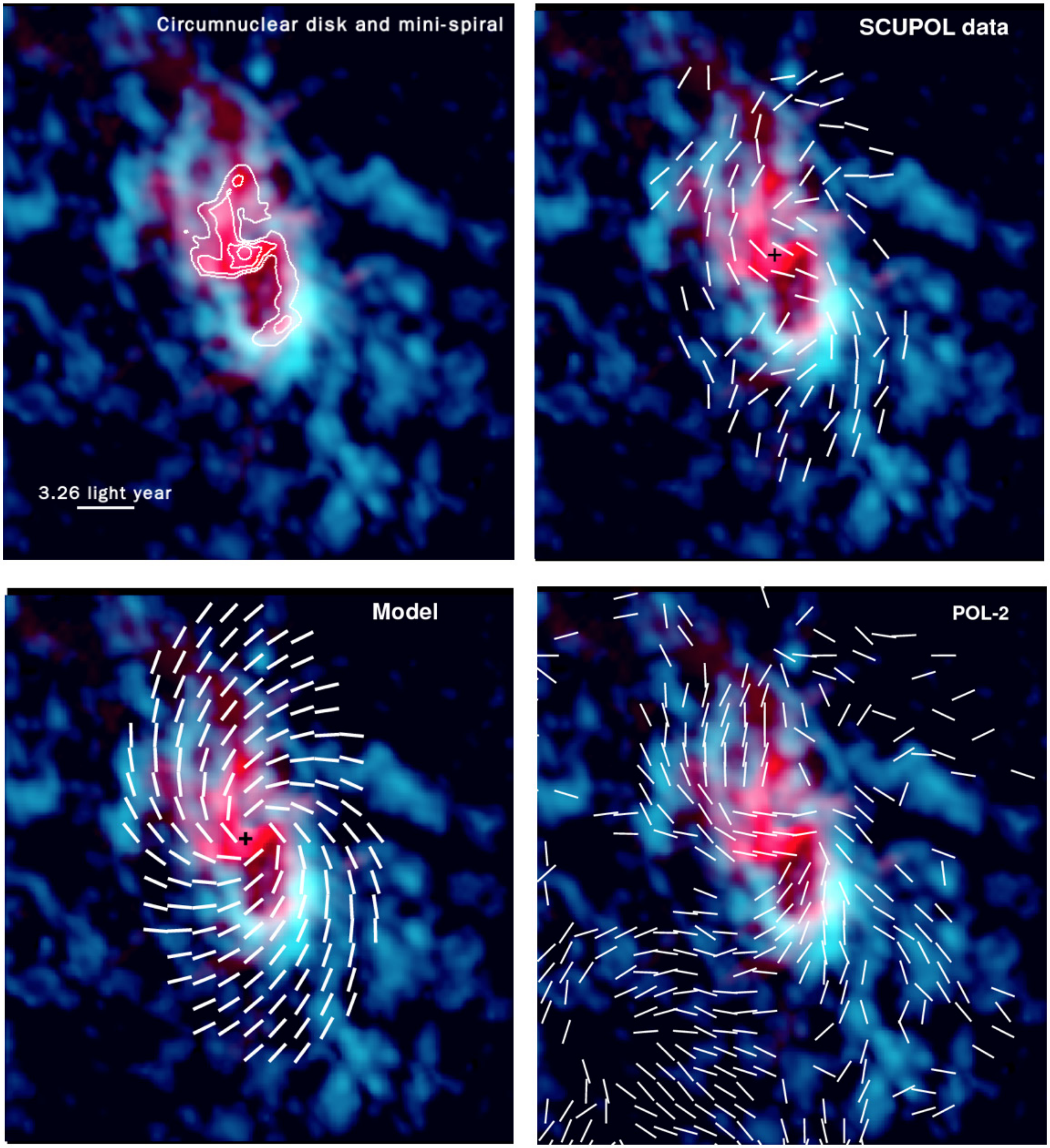

Figure 14. Color-composite images of the molecular gas of the CND (blue; newly reprocessed from the SMA archive) and the Very Large Array (image from the VLA archive) 6 cm map tracing the ionized mini-spiral (red). The radius of the CND is around 2-5 parsec. The magnetic field of the JCMT-SCUPOL data and the model are overlaid with the white segments in the upper right and low left panel, respectively. The location of SgrA is labeled with the black cross. The CND is a molecular torus rotating with respect to the supermassive black hole SgrA*. The mini-spiral is hypothesized to be originated from the inner edge of the CND. The alignment of the magnetic field line along with the CND and the mini-spiral tells us that they are linked with a coherent magnetic field. We found the magnetic field is able to guide the ionized particles from the CND to the mini-spiral, which depicts the footprint of inflow near SgrA*. In the lower right panel, the latest dust polarization data taken in 2017 measured with POL-2 is shown. The magnetic field is shown with the white segments. An improved spatial coverage and sensitivity clearly reveal the connection between the CND and the mini-spiral at even higher spatial sampling than the JCMT-SCUPOL data, which confirm the picture we proposed.*

POL instrument to image the orientation of the magnetic field (top right Fig.14). A detailed comparison with higher-resolution interferometric map newly reprocessed from the Submillimeter Array (SMA) archive reveals that the magnetic field aligns with the CND (the blue image component in Fig. 14). Moreover, the innermost observed magnetic field lines appear to trace and align with the mini-spiral coherently. This is the first attempt to reveal the footprint of inflow linking the CND and the mini-spiral; tracing the inflow from a few parsec to sub-parsec scales. The comparison of the model and data reinforces the key idea that the CND and the mini-spiral can be treated as a coherent inflow-system.

From our work we find a β_{Plasma} (ratio between the thermal and magnetic pressure) of ≤ 1. The β_{Plasma} value was estimated by modeling the global magnetic field morphology (resulting in a constraint on the azimuthal-to-vertical field strength ratio of ~40, and an inflow-to-rotational velocity ratio of ~0.25). This result indicates that the magnetic field appears dynamically significant toward the CND and also onwards to the inner mini-spiral.

This finding tells us that the magnetic field is able to guide the motion of the ionized particles that originated in the CND. Curiously, we also found the rotation is about 10 times faster than the Alfvén velocity, suggesting that the CND is still a rotation-dominated disk and the magnetic field is less important in affecting the disk rotation. The Galactic Center is the closest galactic nucleus that can be studied with an unprecedented spatial resolution and sensitivity. Our finding may help to understand and model the inflow picture in Milky Way-like galaxies hosting black hole similar to SgrA*.

This research has been accepted for publication in the Astrophysical Journal. An open access article is available at http://iopscience.iop.org/article/10.3847/1538-4357/

Automated Detective Work: Hunting for Submillimetre Variability in Young Protostars

Steve Mairs, Graham Bell, Doug Johnstone, Sarah Graves

Low mass stars form via gravitational collapse in the coldest and densest regions of molecular clouds. The rate and consistency of how this infalling mass is accreted by the protostar, however, is largely dependant on the circumstellar disc which forms early in a protostar's lifetime (Jørgensen et al. 2008, ApJ, 683:822; Armitage et al. 2015, arXiv:1509.06382). Simulations predict that these non-smooth discs contain gravitational (Vorobyov & Basu 2005, ApJL, 633:L137), magnetorotational (Armitage et al. 2001, MNRAS, 324:705), and spiral wave (Bae et al. 2016, ApJ 833:126) instabilities that cause material to build up, compress the magnetosphere of the central source and lead to gas rapidly flowing through directed funnels onto the forming star (see the review by Hartmann et al 2016, ARA&A, 54:135).

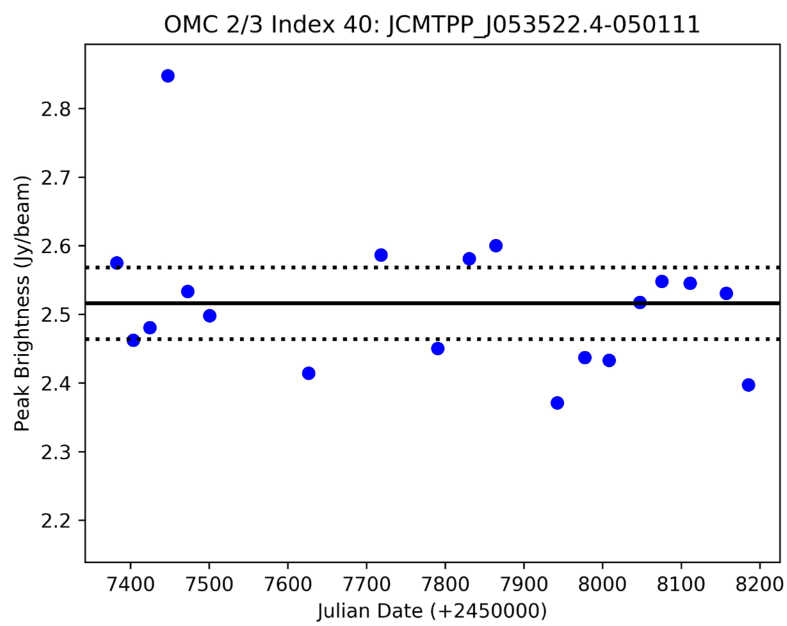

Figure 15. Stochastic Variables. Type 1 example light curve. The dotted lines show the expected standard deviation of the light curve. Note the obvious outlier in the fourth epoch.

In this scenario, the protostars may undergo long, relatively quiescent periods interspersed with strong bursts of rapid growth. The amplitudes of these accretion bursts are constrained on thousand year and longer timescales and are usually assumed to be driven by gravitational instability in the outer disk. Short timescale, high cadence monitoring campaigns are taking place at shorter wavelengths (e.g. 430-840 nm; Cody et al. 2017, ApJ 836:41), but the amplitudes and timescales of accretion bursts in the earliest stages of star formation are largely unconstrained by observations due to thick dust obscuration.

These early stages are significant as they provide insight into the chemical evolution of the natal envelope (Harsono et al. 2015, A&A, 582:A41; Frimann et al. 2017, A&A, 602:A120) and the contraction rate of the star (Baraffe et al. 2017, A&A, 597:A19).

The James Clerk Maxwell Telescope (JCMT) Transient Survey (Herczeg et al. 2017, ApJ, 849:43) is an observational program designed to measure the continuum variability in young deeply embedded protostars and gain insight into disc evolution for sources detected in eight fields within the Gould Belt: OMC 2/3, NGC 2024, NGC 2071, NGC 1333, IC348, Ophiuchus, Serpens Main, and Serpens South. SCUBA-2 observations (450 and 850 μm) of each of these regions have been taken monthly since December, 2015, and will continue until 2019, yielding a dataset for variability studies and, in the end, the deepest sub-millimetre observations of each of these regions to date. Many confirmed and candidate ~year long timescale variables have already been discovered by the team (Mairs et al. 2017, ApJ, 849:107; Yoo et al. 2017, ApJ, 849:69; Johnstone et al. 2018, ApJ, 854:31). These detections have relied on correcting for the telescope pointing uncertainty to better than 1" and, in addition, deriving relative flux calibration factors between each image accurate to ~2.5% (a factor of 3 - 5 improvement over the absolute flux calibration; see Mairs et al. 2017, ApJ, 843:55).
Now, EAO staff who are also members of the Transient Survey have constructed a variability detection pipeline that runs automatically after an observation is performed. The pipeline employs three methods of detecting variable signals associated with compact (pointlike) dust features which are described in full by Johnstone et al. (2017, ApJ, 854:31). Briefly, they are:

1. Tracking the peak brightnesses of all the bright, compact dust structures over time in order to identify individual observations wherein a given source looks significantly brighter or fainter than average (Stochastic Variables – Type 1).

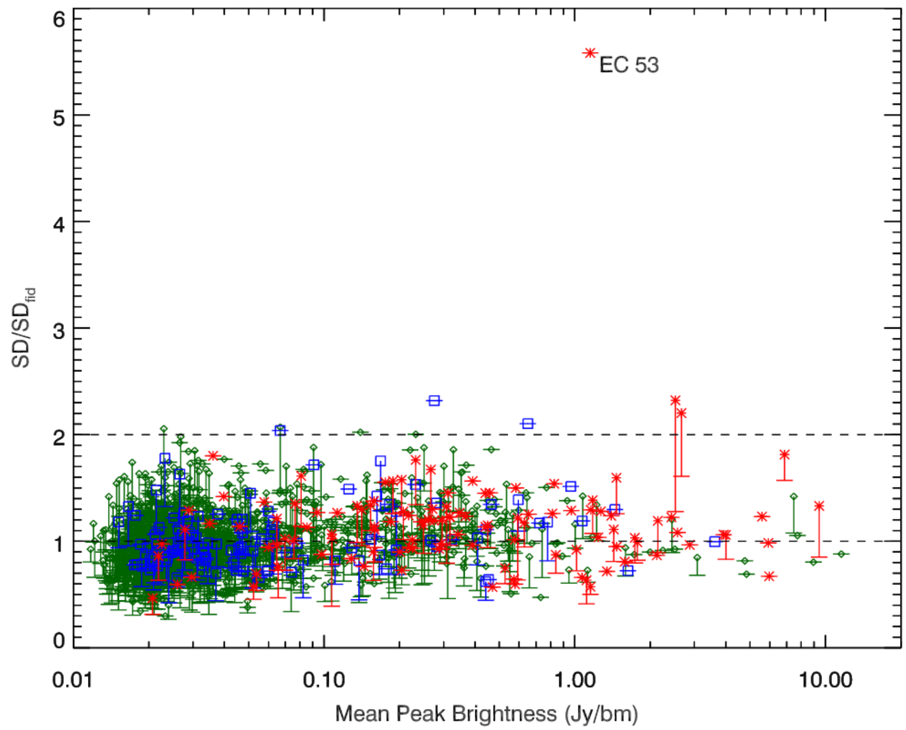

Figure 16. Type 2 example detection (taken from Johnstone et al. 2017, ApJ, 854:31). The Y-axis compares the measured and expected standard deviation of the source light curves for more than 1600 sources. EC 53, a known periodic variable, is the only obvious outlier.

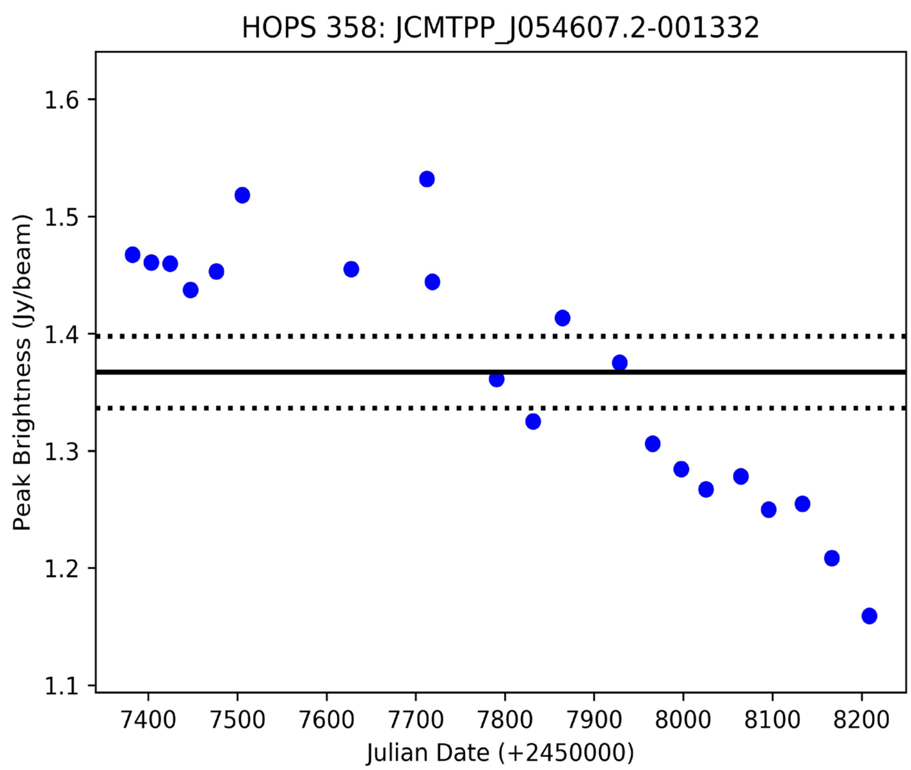

Figure 17. Secular Variables. Linear fits are performed for light curves and the significance of their slopes are tested by team members. HOPS 358 was the subject of a recent ATel released by the Transient Team (see text).

2. Deriving a model for the expected variance of the light curves of bright, compact sources over time and flagging sources which have a significantly larger variance than predicted (Stochastic Variables – Type 2).

3. Fitting a linear slope to the light curves of sources over time, and testing the significance of any non-zero slope (Secular Variables).

Peak fluxes of 1665 known sources are consistently measured and rigorously analysed for both stochastic and secular signs of variability. Light curves are generated for sources which are flagged as stochastic candidate variables and automatic email messages are sent to survey members, informing them of the detection and providing additional information about specifics such as the position of the source, the flux calibration uncertainties of the images, and whether or not there is a known young stellar object nearby. Linear fits are generated for all sources over time and catalogues of the secular variable information are available to all team members to perform their own analysis.

The pipeline was installed in April and it has detected 23 potential sources of interest that have required follow-up investigation. Among these is the dramatic dimming of the dust envelope surrounding HOPS 358 (Furlan et al. 2016, ApJS, 224:5; see Figure 17). The embedded Class 0 protostar shows no evidence of variability for the first 9 months before its flux begins to steeply decline over the next year. An Astronomer's Telegram (ATel) was issued for the source on April 27th (http://www.astronomerstelegram.org/?read=11583); the first telegram to include the keywords "Sub-Millimeter" and "Young Stellar Object". Shortly after the first ATel, the Transient team issued a second for the brightening of the periodic variable, EC 53 (Hodapp et al. 2012, ApJ, 744:56; Yoo et al. 2017, ApJ, 849:69; http://www.astronomerstelegram.org/?read=11614). Further investigation is underway for the remaining candidates.

As the JCMT Transient Survey continues, these statistical tests will only become more robust. The team expects to discover ever fainter signs of variability, offering deeper insights into the physics of a protostar's inner disc while paving the way for multi-wavelength studies of how stars gain their mass.

SMU Refurbishment Report

Craig Walther and William Stahm, EAO

The secondary mirror electro/mechanical system (SMU) consists of three major items: the mirror itself, a system to move the mirror along three axes for the purposes of alignment and focus, and a high speed chopper for chopping and jittering. This entire system is mounted about 4.5 meters above the surface of the main dish. During the month of May 2018, the engineering group at EAO removed this system from the telescope and bolted it to the floor just outside the control room. The SMU has to be removed from the telescope using the overhead crane, in order to do this, the Gore-Tex wind blind membrane had to be rolled up and kept out of the way. All of the support electronics for the SMU were brought down from the right mezzanine just below the Nasmyth platform where HARP is situated and hooked up to the SMU with test cables. After doing this the SMU was fully functional while bolted to the floor.

Figure 18. Neal Oliveira and Simeon Johnson preparing to remove the SMU.

The SMU electronics had never been disassembled using the overhead crane before, as during the last refurbishment in 2007, SCUBA-2 was not yet installed. With SCUBA-2 installed the antenna cannot be rotated with respect to the carousel far enough to use the star lift. Near the top of the building, there is a "man basket" installed. This device resembles the basket of a hot air balloon, but it moves along a track, allowing a staff member to reach the SMU while suspended above the telescope. A good method for accessing the SMU using the man basket was discovered during re-installation but on disassembly the wires were just disconnected by leaning out of the crane control box. Since that was not a very controlled process, some of the 11 year old+ labels simply broke off the cables which lead later to a long assembly process sorting out the cables.

The plan was to measure the chopper performance before the SMU was removed from the telescope, then repeat the measurements while it was mounted on the floor before it was disassembled, then repeat the measurements after it was reassembled, then repeat the measurements after it was remounted on the telescope. This plan was executed, but unfortunately a ground loop in a test cable lead to the first measurements of chopper performance while bolted to the floor to be extremely noisy and not of much use.

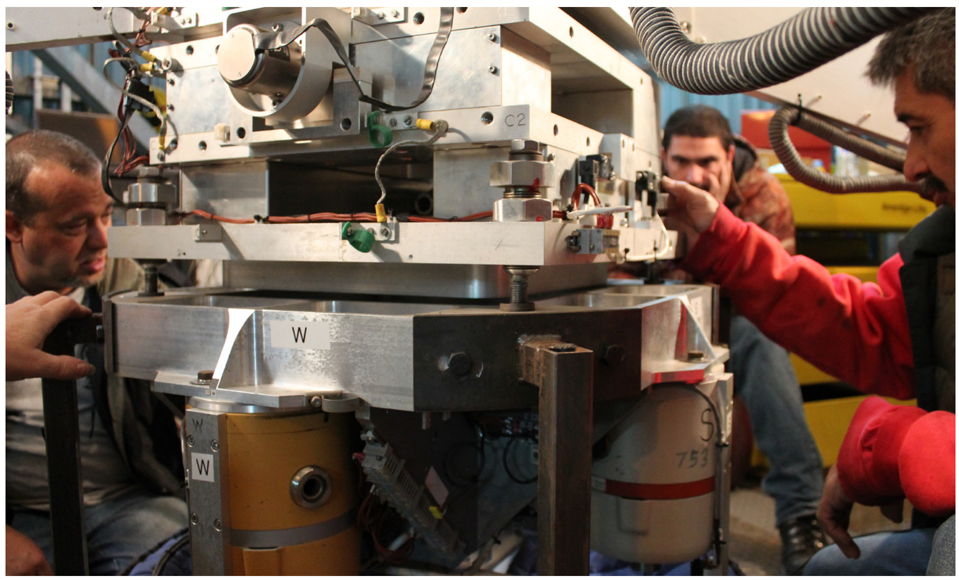

Figure 19. Neal Oliveira, Simeon Johnson, and Vernon DeMattos reattaching the chopper unit to the tables of the SMU. Photo by Kevin Silva

While on the floor, the system to move the secondary mirror in all three axes was operated to verify the functionality and their associated limit switches. Also the chopper limit switches were verified to be working. Using a strip chart recorder, the natural (un-driven) step response of the chopper was measured.

Each of the three axes were disassembled and their linear bearings cleaned and lubricated. The drive motor assemblies for each axes were totally disassembled and inspected, both mechanically and electrically. Several bearings as well as the flywheel shaft were replaced and all other bearings in the system were cleaned and repacked with grease. All three of the tachometers (tachos; devices that measure the working speed of the motors) were found to be bad and were replaced. The jitter seen in the Y axis in 2007 (and all the years since) was due to its tacho missing some windings, so replacing its tacho fixed this problem. Therefore, it was decided to put the X-axis motor assembly back into it original position, since it is engraved as being the X-axis motor drive assembly. The three harmonic drives were disassembled, cleaned, lubricated and reassembled. One axis brake pad was found to be loose, the "spare" brake pad was found to have too small of through hole, so the loose pad had to be put back on. The three drive belts were replaced. One motor was found to require about twice the drive current as the other motors, again the "spare" motor's shaft where it was supposed to attach to the tacho was too large. The motor test unit was disassembled and its motor was put in place of the one with the high current.

Once the system to move the secondary mirror was reinstalled in the SMU chassis it was discovered that X-axis now moved in the opposite direction as before and the limit switches stopped the wrong direction of motion. Further inspection revealed that much of wiring was inconsistent between the axes and on one axis the brake switch was turning off the return line of the motor instead of turning off the drive line. It was decided to rewire these systems to make everything between the axes consistent and correct. This lead to a fair number of wires needing to be relabeled and lots of testing. In addition, the x-axis software had to be modified to control the axis correctly. A repeatable method for measuring the "zero" points (bore-sight) of each axes was developed and the software to calculate the new zero points was properly documented. When the encoder units were being reinstalled it was discovered that two of the steel ribbons (a thousandth of an inch thick) that are wrapped around the encoder shafts to drive them were torn, so they were replaced. It is thought that these ribbons might have torn due to metal fatigue.

The (Ling brand) chopper vibrators were removed from the mirror unit and disassembled and inspected. All of their electronic properties were measured using a laboratory strain gauge. Their phenolic springs were inspected for cracks. One vibrator was determined to be too dirty so its magnet was disassembled and cleaned. New dust covers were glued into the vibrators that needed them. One vibrator had reduced magnetic power, and the only spares also had reduced magnetic power, so two magnets, each with reduced power, were put into the North-South axis so that they would match. The four flex pivots were removed and replaced. The LVDTs were removed, cleaned, and realigned. The secondary mirror itself was cleaned with a fine dusting brush. The entire chopper unit was reassembled, tested and relabeled.

Things were actually much worse than expected in almost all areas. Also this refurbishment might have been more thorough than ones in the past. Many “spare” pieces that were in the SMU cabinet were discovered to not really be spares due to all of these parts being obsolete and the new items that people have purchased before have some small dimension that makes it unusable in the system. Discovering all of these wrong dimensions was time consuming - especially at 14,000 feet.

The fully refurbished SMU chassis was then lifted back onto the telescope and reinstalled. The electronic cables were relabled and reattached and the control electronics were lifted up on the right mezzanine platform and relabled and reattached. The functionality of the entire system was tested. After the basic functionality was verified, the wind blind was rolled back down in from the telescope. During the refurbishment all of the right side skirts that attached the wind blind’s track to the carousel were also replaced.

We performed a full “functional checkout” the same night the SMU was reinstalled, with a TSS in control. It was determined that the calculated correction, for the change in the dish shape, to the secondary mirror’s X-axis had the wrong sign. Since the secondary mirror software automatically sends pointing information to the telescope control software when it moves the X-axis, that information also had the wrong sign. This lead to large errors in pointing calibrations. The signs of the sonstants that affect these corrections were changed and the SMU began to operate as normal. An all-sky pointing run determined that the refurbishment was successful.

CADC as a Tool for JCMT Astronomers

JJ Kavelaars, Astronomer and Head of the Canadian Astronomy Data Centre

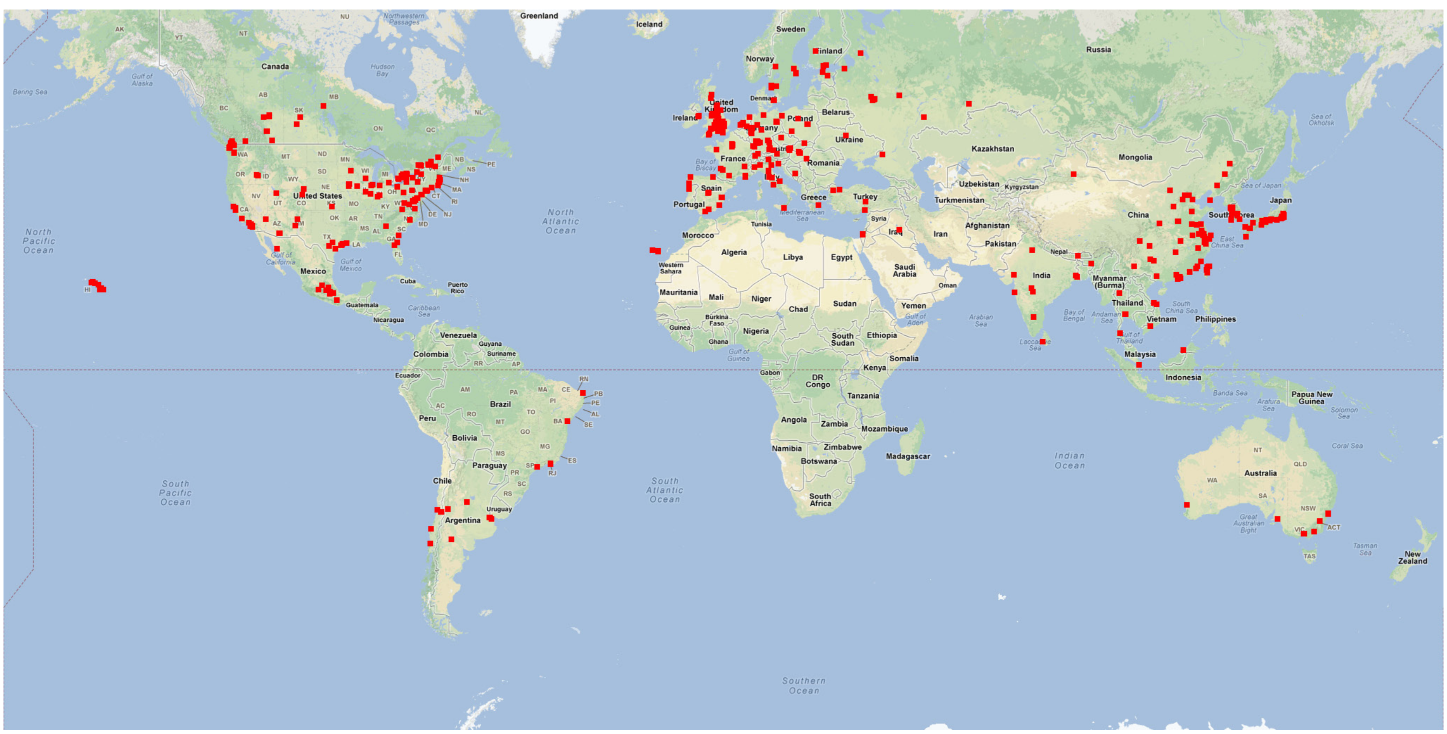

Figure 20. Locations around the globe that CADC delivered JCMT data to in 2017.

For more than two decades the Canadian Astronomy Data Centre (CADC) has provided science data storage and observation archiving to the JCMT facility and the JCMT user community. Canada’s participation as an archive partner is part of our ongoing contribution to the JCMT, to ensure continued stability of operations of the facility and maximize the science return from observations.

An effective JCMT Science Archive (JSA) is a key component to maintaining, and growing, the scientific impact of the JCMT. The size of the data archive itself grows constantly as does the user base. Protecting data integrity and privileged access while enabling the desired archive data to be found, efficiently delivered and, now, processed are the key activities of CADC in our support of the JSA. Through these activities we are part of keeping the science impact high.

With the advent of SCUBA-2 and development of Legacy Surveys, the size (both in data volume and number of files) and complexity of JCMT datasets grew substantially. For example, the CADC currently contains over 4000 calibrated SCUBA-2 datasets taken as part of the JCMT-GBS. During the Gould Belt Survey the CADC worked with Compute Canada to provide specialized computing and storage infrastructure tuned to the needs of the survey under the CANFAR collaboration. In 2017 the GBS (Gould Belt Survey) project used 4+ core years of processing.

CANFAR was originally created to support CFHT (The Canada France Hawaii Telescope on Maunakea) survey teams and supporting JCMT was a natural extension of this capacity. The CANFAR system provides direct access to the JCMT data archive collection within the same data centre as the computing nodes needed to process this data. This 'co-location' greatly reduces the network delays often associated with large data processing projects, provides queue scheduled computing resources to allow large quantities of observations to be processed to science ready data products, and provides a network accessible storage system for accessing and distributing those advanced data products (either to private teams or publicly).
The work of providing this infrastructure to GBS was new to both the CADC and Compute Canada (CC) and plans did not come off without a hitch, but the general outcome has been that CANFAR provided the majority of processing for the GBS.

www.canfar.net provides: access to cloud computing resources via interactive and batch processing systems; access to long-duration user storage via 'VOSpace'; protected data access and data/computing sharing using a group management system; and, storage connected to DOIs to provide data preservation for science publications.

Given the reasonable success of GBS and the stability of the platform CANFAR cloud computing platform, CANFAR is making this computing infrastructure more generally available to the JCMT User. The base level resources are 16 core VMs with 256 G Bytes of RAM and a few 100 G-Byte VOSpace allocation. Using these resources JCMT users can quickly 'spin up' an ORAC-DR capable Virtual Machine on CANFAR to quickly retrieve and pre-process their science observations. The goal of this system is to provide users with an avenue to easily modify the generic pre-processing provided by the EAO staff, in order to provide a more customized reduced dataset.

I attended the most recent data reduction workshop, held at the JCMT User Meeting in Seoul and provided a brief tutorial on making use of the CANFAR computing platform for JCMT. The presentations from that tutorial can be found on the User Meeting web pages: www.eaobservatory.org/jcmt/science/seoul-2018/ Following those instructions allows a JCMT user to get a CANFAR account and be given a processing and storage allocation. There is a specific tutorial on the CANFAR web site (www.canfar.net) that walk users through setting up their first JCMT processing machine inside CANFAR. We look forward to more users taking advantage of these resources.

For assistance with getting started and using CANFAR please contact CADC helpdesk: cadc@nrc.ca

Scientific Computing and Starlink Updates

Sarah Graves, Graham Bell, David Berry, EAO

Starlink
The latest Starlink release (2018A) went live in July. You can see the full details of the changes at http://starlink.eao.hawaii.starlink/2018A, and you can download the release from http://starlink.eao.hawaii.starlink/2018ADownload.

As well as the usual list of software and documentation updates, this is the first release to support our new HDF5-based file format for .sdf files. This format will change the structure of NDF files on disk. The 2018A release can read the new format, but by default will still write the old format files. You can optionally try out writing the new format by setting the environmental variable to HDS_VERSION=5.

For details of this format you should please see Tim Jenness's 2015 Astronomy & Computing paper "Re-implementing the Hierarchical Data System using HDF5". Our intention is that the next Starlink release will default to writing files in the new format. You will not be able to read the new format .sdf files with any version of Starlink older than 2018A.

We have also released a python package designed to allow easier scripting of Starlink and ORAC-DR routines from Python – this is the starlink-pywrapper package, installable with pip, and its documentation is available at:

https://starlink-pywrapper.readthedocs.io/en/latest/

We ran a tutorial on this package at the Korea JCMT Users' Meeting in February. You can see all of our tutorials at:

www.eaobservatory.org/jcmt/science/reductionanalysis-tutorials/

POL-2 improvements

Dr David Berry has been continuing his work improving the POL-2 data reduction processes. The pol2map script now supports a skyloop mode. He has also added an experimental 450um data reduction mode, using a new 450um instrument polarization model. However, due to the difficulty of detecting any polarization at these wavelengths we recommend talking to your EAO support scientist directly.

EAO and its plans for Starlink in the future

East Asian Observatory does not anticipate moving away from NDF and Starlink for its data format and astronomy software. We have therefore been working to ensure Starlink will still be fit-for-purpose over the next years as we upgrade the instrumentation at the JCMT. The current work has focused on:

- Moving to HDS version 5, using the standard HDF5 file format. This allows the larger array sizes necessary with large-format heterodyne instruments.

- Porting critical libraries and applications from F77 to C, to remove single-thread bottlenecks and allow for long-term maintainability. ARY has been finished in the 2018A release, and NDF is currently being converted.

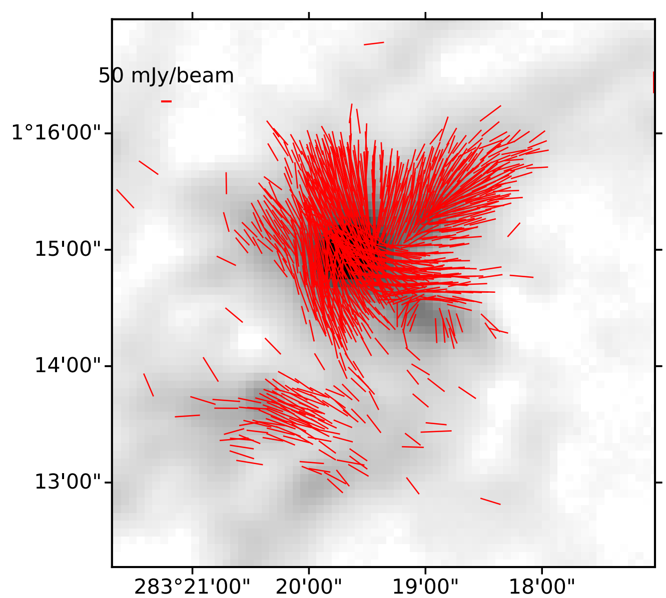

Figure 21. An example of a skyloop-based reduction of 12 POL-2 observations of G34.3. The plot shows the detected polarized intensity vectors on 4" pixels, clipping out all vectors with a polarized intensity SNR of less than 5.

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Target Availability

Output

Availability by Date

The following table shows how many targets are available as a function of date and (UT) time.

Targets are considered to be available if they are above an elevation of 30.0 degrees.

Date (UT)	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
2018-01-01	3	3	6	6	6	6	6	6	3	2	0	0	0
2018-01-29	6	6	6	6	6	6	3	3	0	0	0	0	1
2018-02-26	6	6	6	6	4	3	0	0	0	0	1	3	3
2018-03-26	6	6	6	3	0	0	0	0	1	3	3	3	3
2018-04-23	6	3	0	0	0	0	1	3	3	3	3	3	2
2018-05-21	1	0	0	0	0	1	3	3	3	3	2	2	2
2018-06-18	0	0	0	1	3	3	3	3	2	2	2	0	3
2018-07-16	0	1	3	3	3	3	2	2	2	2	2	3	3
2018-08-13	3	3	3	3	3	2	2	2	2	3	3	6	6
2018-09-10	3	3	3	2	2	2	0	3	3	6	6	6	6
2018-10-08	3	2	2	2	0	3	3	3	6	6	6	6	6
2018-11-05	2	2	0	3	3	3	6	6	6	6	6	6	3
2018-12-03	0	3	3	3	6	6	6	6	6	6	3	2	0
2018-12-31	3	3	6	6	6	6	6	6	3	3	0	0	0

Figure 22. The new target availability tool, showing when during the year th targets of the JCMT Transient Search large program are available. This tool is integrated into our Hedwig proposal handling system and can be used to quickly check whether your targets are suitable for the current semester.

We would also like to acknowledge the continuing help and support provided by the wider Starlink developer and user communities, and reiterate our continued support of Starlink as an open source project.

We recognize that currently the most popular scripting language among our users is Python, and we are continuing to look at the best ways to allow easy use of NDF and Starlink from Python, and improving interoperability with the wider astronomical python community. Currently, there are existing HDS and NDF python interfaces, the PyAst package, and the starlink-pywrapper package to enable easy calling of Starlink routines from Python.

Observing Tool
In May we had an update to our JCMT Observing Tool. Perhaps the most important note for users is that you must use this release for all current science programs. If you are using webstart then the OT should automatically update, but you can always download the current release by typing:

javaws http://ftp.eao.hawaii.edu/ot/jac-ot.jnlp

into a terminal.

There were various miscellaneous updates included in this release, including some useful fixes to the redshift handling. Please see https://www.eaobservatory.org/jcmt/observing/software-installation

Contact us
The Scientific Computing group consists of Dr David Berry, Dr Graham Bell and Dr Sarah Graves. As well as numerous internal-only and UKIRT-only processes and software, we are also responsible for a large set of the user-facing systems and software. We develop and support Starlink and ORAC-DR, the JCMT OT, the QT, the OMP, the JCMT Science Archive and its products (with CADC) and the Hedwig Proposal System. Together with the support scientists we also write and maintain documentation for all of these projects, and support any scientists who are using our software.

If you have any feature requests, bug reports or general thoughts on our software we would love to hear them! As well as emailing any of us directly, you can email all of us at scicom@eao.hawaii.edu, or you can email helpdesk@eaobservatory.org for more general discussion.

A Brief Note on Akamai Observing

Mark Rawlings, EAO

When it comes to requesting observing time being akamai (smart) is a must for all astronomers. At the JCMT Users meeting in 2016 and then again in 2018 Ciska Kemper presented a talk entitled "Writing a good proposal". In that talk Ciska outlined that typically when proposing for time an observer should be aiming for a publication for every 10-15 hours of time requested, although this greatly changes as a factor of frequency and weather band.

The position of science targets can often help (or hinder) project completion. Certain fields (e.g. the Galactic Center) are much more heavily oversubscribed than others, so any projects that are able to make use of science targets at less-popular RAs can often benefit from that in terms of completion.

Another way in which observers can be smart is to account for weather band pressures. In Figure 23 we see the time requested (and over subscription factors) as a function of weather band. If you have an akamai idea that could work in Band 4 and Band 5 time then submit it!

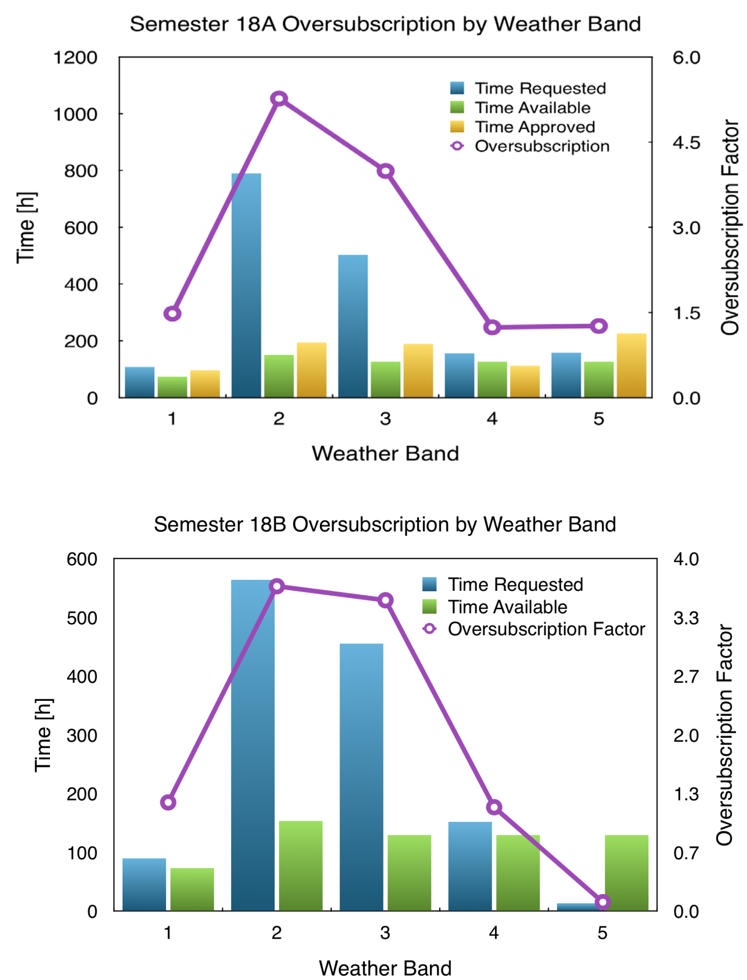

Figure 23. Top: Semester 18A Oversubscription by Weather Band. Bottom: Semester 18B Oversubscription by Weather Band.

2018 Huliau - A Time of Change

Callie Matulonis, EAO

Every new year brings it's own set of challenges and triumphs, expected and unexpected outcomes. Since our last newsletter, the EAO and Hawai'i continue to survey a universe unfolding as we observe it. Much like the lava flows that have transformed the Big Island this year, we have had changes that will shape the way we work for years to come. To many, 2018 has been a great "huliau". In the Hawaiian language, huliau means a "turning point or time of change". With the onslaught of poor weather on the summit, and the hope of new instruments on their way - there are many good things to look forward to as we adapt to our new surroundings.

Figure 24. Former TSS William Montgomerie stands proudly in front of the telescope he now operates onboard SOFIA.

This 2018 huliau has seen a number of changes to our EAO 'ohana (family).

In August, we were sad to say goodbye to longtime Radio Frequency/ Microwave Field Engineer, Ken Brown, as he pursues retirement. Ken started at JAC in August 2000. He was assigned the oversight of the heterodyne instrumentation at JCMT. He participated in the HARP, RxH3, and ACSIS commissionings, several upgrades to RxA, and many repairs of the other RF equipment.

We sent our best wishes to Telescope System Specialist, William Montgomerie, in April as he left EAO to embark on a new career with SOFIA, the Stratospheric Observatory for Infrared Astronomy, an aircraft based out of California that carries on it a 2.7 meter reflective telescope. William grew up on the Big Island, and interviewed for the TSS position at JCMT one week after graduating from the University of Hawai'i at Hilo. He was with the JCMT for nearly seven years, and made a lasting impression on us all.

We also bid farewell to Electronic Instrumentation Technician, Mark Ayap. Mark started in August of 2011. He has performed a wide variety of technical tasks including fixing torn roof cables, replacing the old Crown amplifiers, building PC boards for the UKIRT ISU2 upgrade and many more. Mark is planning on moving to Oahu to attend the University of Hawai'i at Mānoa to pursue an electrical engineering degree.

We were happy to welcome back returning ETIS (Engineering Technology, Information Systems and Software) intern Mailani Neal this summer. Mailani is from Kona, Hawai'i and graduated high school from the Hawai'i Preparatory Academy in Kamuela, Hawai'i. She is entering her last year of undergraduate studies at Rensselaer Polytechnic Institute in Troy, New York where she will earn her Bachelor of Science Degree in Applied Physics with a concentration in Astronomical Instrumentation. While at EAO, Mailani has been analyzing and processing data to create temperature maps from sensors on the telescope dish.

Figure 25. Radio Frequency/ Microwave Field Engineer, Ken Brown, says goodbye to JCMT after 18 years of hard work and dedication.

Figure 26. Electronic Instrumentation Technician, Mark Ayap, heads to UH Manoa to pursue an electrical engineering degree.

You may recognize Shao-Liang Li from his time spent as an "East Asian Observatory Visiting Student" in 2016. Li, formerly of the Purple Mountain Observatory in China, comes back to join us now as an Instrument Scientist where he works on optimizing SCUBA-2 performance and possibly a restart of the long-delayed commissioning of FTS-2. His beloved wife Enlan accompanies him in Hilo where they are enjoying their time and settling into their new home.

Bill Stahm was enlisted as our staff Electronics Engineer and has had his hands full with nearly all of the projects to maintain and enhance the operation of the telescope. He brings to us a wealth of experience coming from the University of Wyoming's Atmospheric Science Division where he worked in many exciting research programs that took him all around the world. He will be very focused in the coming months with the new receiver for VLBI that will be installed and operational in 2019.

Izumi Mizuno received her Ph.D. while in Japan at the Nobeyama Radio Astronomical Observatory. We are delighted to have Izumi on board at the JCMT as an Instrumentation Scientist. She has been studiously learning all about the JCMT systems and verifying that systems are working properly. For a short time, she even trained for Extended Operations and was able to gain an invaluable understanding on how to operate the telesope.

Extended Operations has been a bit of a challenge this year with all of the poor weather, but our newest Extended Operator, Alyssa Clark, stands by eagerly waiting opportunities to get on sky for those few precious hours in the morning when conditions permit. Alyssa splits her time between JCMT and being a night attendant at the NASA Infrared Telescope at the summit of Maunakea.

Many good things on the horizon at EAO! Stay tuned for another exciting year ahead, and mahalo for supporting EAO. Cheers!

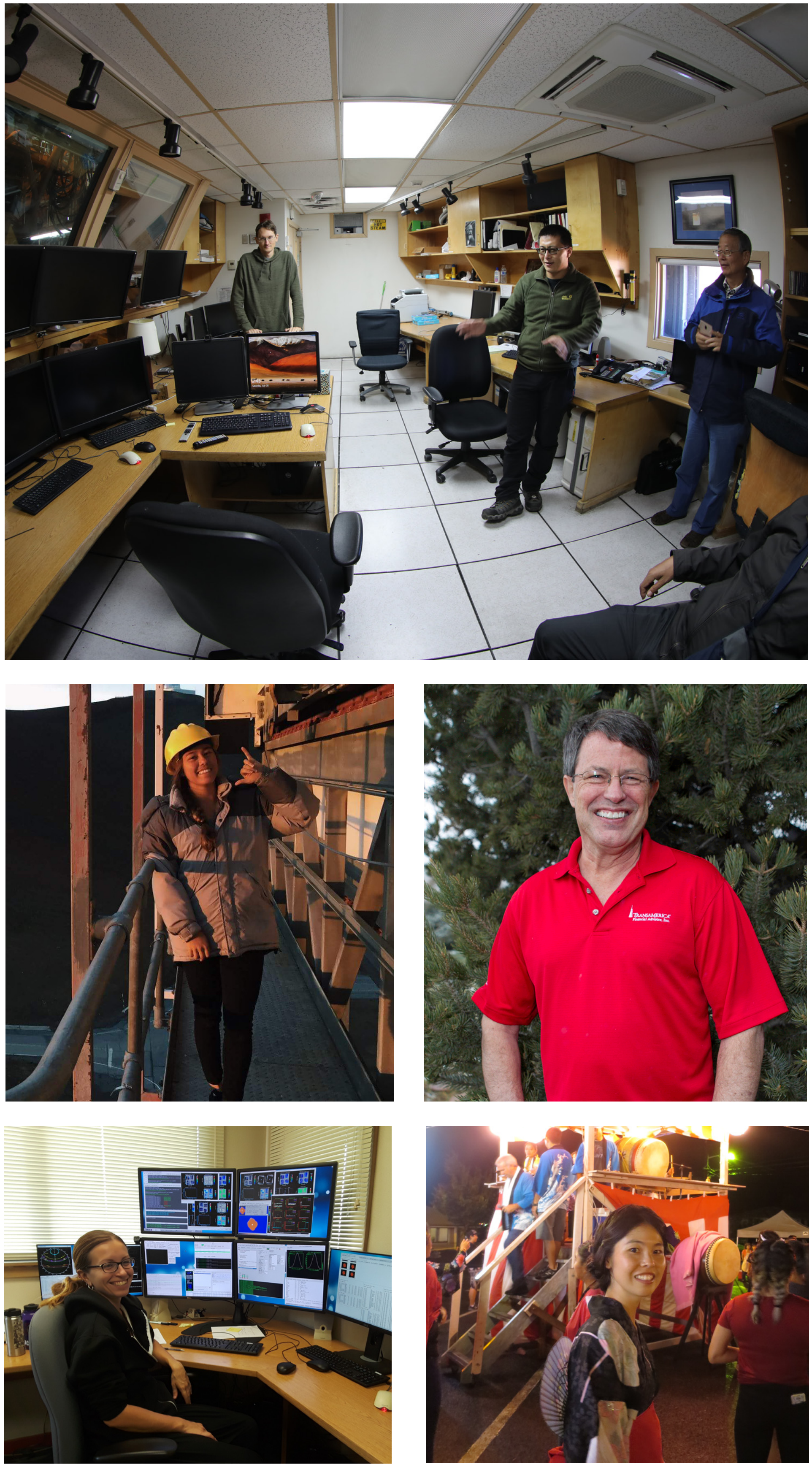

Figure 27. Top: Shaoliang Li hosts a tour of JCMT. Middle left: Mailani Neal gives a shaka on top of the JCMT roof catwalk. Middle right: Electronics Engineer, Bill Stahm. Bottom left: Alyssa Clark during extended operations from JROC (JCMT Remote Operations Center). Bottom right: Izumi Mizuno wearing traditional Japanese wear, named yukata, at a bon dance in Hilo.

James Clerk Maxwell Telescope
East Asian Observatory