SMA Newsletter

Submillimeter Array Newsletter | Number 17 | January 2014

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FROM THE DIRECTOR

Dear SMA Newsletter readers,

Ten years have passed since the dedication of the SMA in November 2003. I would like to draw your attention to the conference announcement on page 13 that outlines plans to celebrate **The Submillimeter Array: First Decade of Discovery**.

I would also like to draw your attention to the article on page 8 that summarizes the current status of upgrades to the receivers at the SMA. In particular, I am happy to report that the SMA Receiver Group has completed upgrades to the bandwidth of the 300 GHz receivers. This brings them in line with the wideband 200 GHz receiver upgrade completed in August 2012. In other words, the SMA front-ends are now capable of providing 16 GHz of bandwidth, and the only missing piece required to enable wideband observing is the successful completion and implementation of the additional correlator capacity. While tests using the new SWARM correlator, under development in the Cambridge Labs, are encouraging, more work is needed before it can be offered for production science. We will offer shared risk observing across the full 8 GHz IF bandwidth in the upcoming call for proposals, which has a submission deadline of 13 February (see page 13).

Ray Blundell

RESOLVING THE NATAL MOLECULAR CLOUD OF A FORMING YOUNG MASSIVE CLUSTER

Hauyu Baobab Liu, Roberto Galván-Madrid, and Qizhou Zhang

Young massive clusters (YMCs) (stellar masses $M_{cl} > 10^4\ M_\odot$, size scales of a few parsecs, and crossing times a few × 100 Myr) probably represent the young end of the so called super star clusters. Some may be young analogs of globular clusters, provided that they remain gravitationally bound for timescales comparable to a Hubble time. The deeply embedded, very luminous ($L_{bol} > 10^7\ L_\odot$) star formation regions stand out as the obvious candidates to be active YMC formation sites. These objects are rare in our Milky Way. The evolution of their natal molecular clouds are governed by the interplay of the gravity, turbulence, (proto-) stellar feedback, and potentially magnetic field. The detailed studies of these molecular clouds are not only intriguing in themselves, but also uniquely provide the spatially resolved templates for understanding the origin of YMCs in star forming galaxies elsewhere. The questions are: What are the properties and physical conditions of the molecular clouds that give birth to YMCs? What are the effects of YMC feedback upon its own parental cloud?

W49A at Galactic coordinates $l = 43.1$, $b = 0.0$ is the most luminous star formation region in the Milky Way ($L \sim 107.2\ L_\odot$). This GMC has an extent of $l > 100$ pc, but all the prominent star formation resides in the central ~ 20 pc. Its inner region contains the well-known massive star formation regions W49 north (W49N), W49 south (W49S), and W49 southwest (W49SW). The most prominent by far is W49N, hosting an intriguing ring of hypercompact (HC) and ultracompact (UC) HII regions within a radius of a few parsecs. Part of the stellar population in W49N is already visible in the near infrared and its mass has been estimated to be $M_{cl} \sim 4 \times 10^4\ M_\odot$, whereas the part associated with the most compact HII regions is not even visible in the mid-infrared.

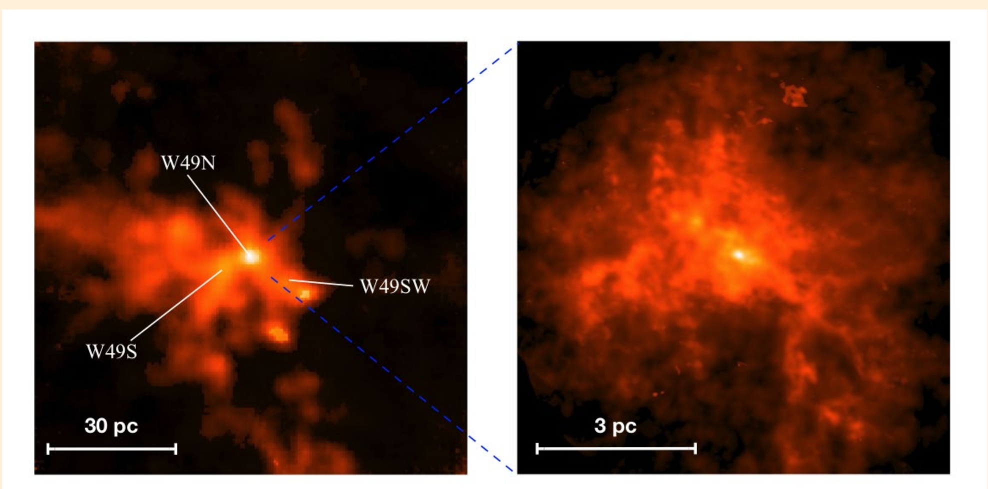

Figure 1: (Figure 9 of Galván-Madrid, R. et al. 2013): Mass surface density (Σ) maps obtained from CO-isotopologue line ratios. The left panel shows the zoomed-out Σ measurement from the PMO-14m telescope CO and ^{13}CO 1–0 maps (HPBW = 58″). The right panel shows the zoomed-in Σ measurement from the SMA mosaics combined with IRAM-30 m telescope maps of ^{13}CO and C^{18}O 2–1. The well-known embedded OB cluster-forming regions W49N, W49S, and W49SW are labeled in the left panel.

We have performed extensive mapping observations of molecular lines toward the W49A, using the Submillimeter Array (SMA), the Purple Mountain Observatory 14m Telescope (PMO-14m), and the IRAM-30m Telescope. Our observations aim to provide a comprehensive picture of gas structures and kinematics on multiple spatial scales. The molecular line observations provide the unique value over dust continuum emission since they trace the gas motion, thus, avoid the confusion from the independent molecular clouds in the line of sight. The derived molecular gas column density from our observations presents a strikingly ordered hierarchical network of filaments that is forming a YMC or a system of YMCs *(Figure 1)*.

The PMO-14m images with ~3 pc resolution resolved several 10-30 pc scale radially converging gas filaments *(Figure 1 left)*. The most active cluster-forming region W49N coincides with the convergence of these filaments. The two less prominent neighbors W49S and W49SW appear to be formed in the two densest gas filaments connecting to the southeast and southwest of W49N. The larger-scale filaments are clumpy and could be forming stars at a rate lower than that of the central clusters.

The combined IRAM-30m + SMA images with ~ 0.1 pc resolution further trace a triple, centrally condensed filamentary structure that peaks toward the central parsec scale ring of HC HII regions in W49N, which is known to host dozens of deeply embedded (maybe still accreting) O-type stars (Figure 1 right). In addition, localized UC HII regions are also found in individual filaments. Our finding suggests that the W49A starburst most likely formed from global gravitational contraction with localized collapse in a "hub–filament" geometry.

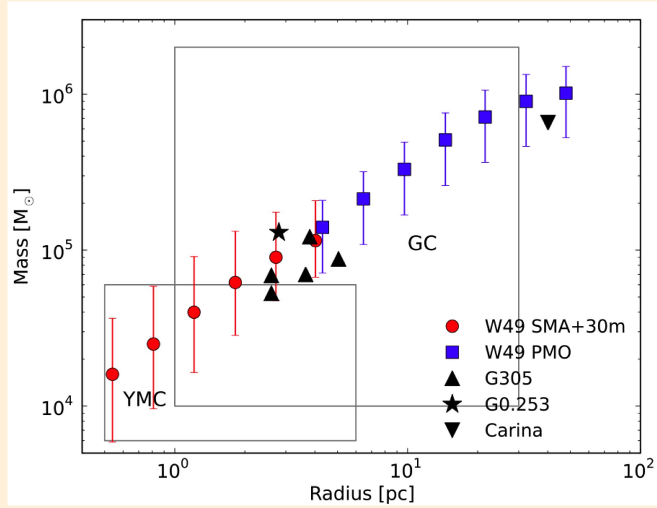

Figure 2: (Figure 10 of Galván-Madrid, R. *et al*. 2013): Mass versus radius for Galactic molecular clouds that may form or are indeed forming massive clusters ($M_\star > 10^4\ M_\odot$ in stellar mass). The filled red circles and blue squares show the total mass in the W49 giant molecular cloud as a function of radius. The black symbols are measurements compiled from the literature. The typical regimes of stellar mass and radius for Galactic young massive clusters and globular clusters are marked with boxes (Portegies Zwart et al. 2010).

From multi-scale observations of CO isotopologues, we derived a total neutral mass M_{gas}~$1.1\times10^6\ M_\odot$ within a radius of 60 pc, and M_{gas}~$2\times10^5\ M_\odot$ within the central 6 pc radius. In other words, ~20% of gas mass is concentrated in ~0.1% of the volume. The W49 GMC has enough mass to form a YMC as massive as a globular cluster *(Figure 2)*. The current ionization fraction in the central region is only ~1%, which indicates that the feedback from the central YMCs is still insufficient to disrupt the GMC. There is also no evidence on global scales for significant disruption from photoionization. Likely, the resulting stellar content will remain as a gravitationally bound massive star cluster or a small system of bound star clusters.

The W49A observations have been published in Galván-Madrid *et al.* (2013). Our molecular line mapping survey with PMO-14m, IRAM-30m, and SMA toward several L ~ $10^6\ L_\odot$ OB cluster forming regions have revealed similar configurations (Liu 2012; see also Galván-Madrid et al. 2009, Liu et al. 2012a, 2012b). The detailed gas kinematics in these OB cluster-forming regions will be addressed in upcoming papers.

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GRAVITATIONAL LENS MODELS BASED ON SUBMILLIMETER ARRAY IMAGING OF HERSCHEL-SELECTED STRONGLY LENSED SUBMILLIMETER GALAXIES AT Z > 1.5

Shane Bussmann

Wide-field surveys at submm wavelengths are fantastic tools for discovering galaxies that are gravitationally lensed by an intervening galaxy or group of galaxies along the line of sight. These systems are extremely useful probes of galaxy evolution because they act as cosmic telescopes that magnify the background source (facilitating follow-up observations) and because they provide a unique measurement of the mass of the foreground lens(es).

The Herschel Space Observatory has surveyed nearly 1000 square degrees that are now being used to discover large numbers of lensed submillimeter galaxies (SMGs). The SMA is now playing a critical role in following up these objects. Observations from the SMA totaling nearly 200 hours of on-source integration time have been used by our team to provide critically important spatially resolved measurements of the thermal dust emission at observed-frame 870μm from a sample of 30 of these lensed SMGs. The data were used to develop lens models and thereby determine the far-infrared luminosities and sizes of lensed SMGs discovered by Herschel, after accounting for the effects of lensing (Bussmann et al. 2013).

Using a custom analysis technique applied in the visibility plane, as is appropriate for interferometers like the SMA, our team was able to extract the maximum amount of information available in the SMA data. For the most highly magnified sources, this allowed us to probe down to spatial resolutions of FWHM~0.1" – roughly a factor of 5 better than what can be accomplished by the SMA without the effect of lensing. This spatial resolution is comparable to the best that was offered by the Atacama Large Millimeter Array (ALMA) during its early science Cycle 2 call for proposals (i.e., baseline lengths of ~1.5 km, providing a synthesized beam of FWHM~0.1″ at 870μm).

The lensed SMGs show over a decade range in sizes (median circularized half-light radii of 1.6 kpc) and intrinsic (i.e., unlensed) FIR luminosity (median L_{FIR} of $7.9\times10^{12}\ L_{\odot}$). These sizes and L_{FIR} values combine to result in a nearly two-decade range in SFR surface density (median $\Sigma_{SFR} = 200$ $M_{\odot}\ yr^{-1}\ kpc^{-2}$). A handful of lensed SMGs lie near or above the theoretical limit of $\Sigma_{SFR} = 1000\ M_{\odot}\ yr^{-1}\ kpc^{-2}$ for an optically thick disk, but there are also several objects with Σ_{SFR} values over an order of magnitude below this limit, implying that multiple modes of star-formation may be required to explain SMGs at z ~ 1.5.

The magnification factors measured for the lensed SMGs were found to be significantly lower than predicted from models based on number counts of unlensed SMGs. This may be an indication that the bright end of the SMG luminosity function or the intrinsic sizes of SMGs are currently poorly understood, highlighting a clear path for future research.

The lens models also provide measurements needed to determine the masses of the foreground lenses. One of the key features of our study is its multi-wavelength nature. In addition to the SMA submm imaging, we use optical spectroscopy to determine precise distances to the lenses. Some of these were obtained using the Red Channel Spectrograph on the MMT. We found that the lenses are at higher redshifts and have lower masses than lenses found in surveys based on Sloan Digital Sky Survey (SDSS) optical spectroscopy, in agreement with expectations for a source-selected (rather than lens-selected) survey for lenses.

Looking toward the future, the number of lenses that will be found from wide-field (sub)mm surveys (Gonzalez-Nuevo et al. 2012) promises to be comparable to that from SDSS-based searches, but the former provide access to a population of lenses with fundamentally different properties. For this reason, lenses found by Herschel are highly complementary to those found by SDSS and will remain so for the foreseeable future.

A similarly sized sample of bright, lensed sources discovered by Herschel will be incredibly useful for studying the nature of star-formation in SMGs in the distant Universe on size-scales that are inaccessible without lensing. The sample will also be the starting point for searches for molecular emission thanks to the amplification effect of lensing. The prospects for studies of these objects in the future are very bright.

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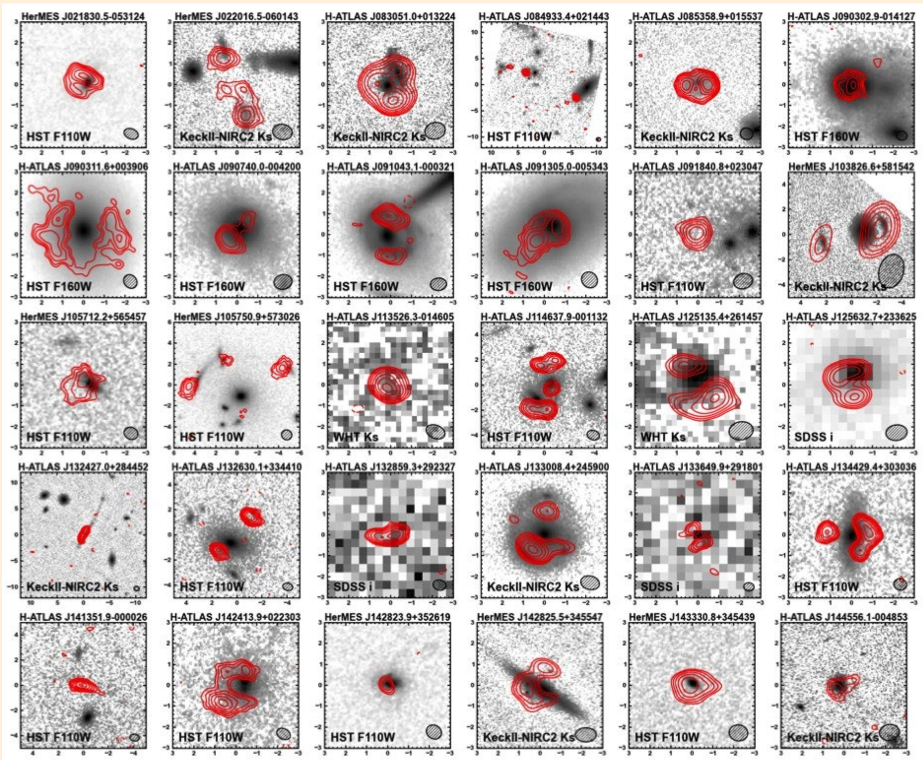

Figure 1: Postage stamp images of 30 Herschel-selected strongly lensed SMGs. Red contours show SMA observations of the 880μm thermal dust emission. Greyscale images show the best available optical or near-IR imaging. The lenses are not detected in the submm images and the sources are generally not detected in the optical or near-IR images.

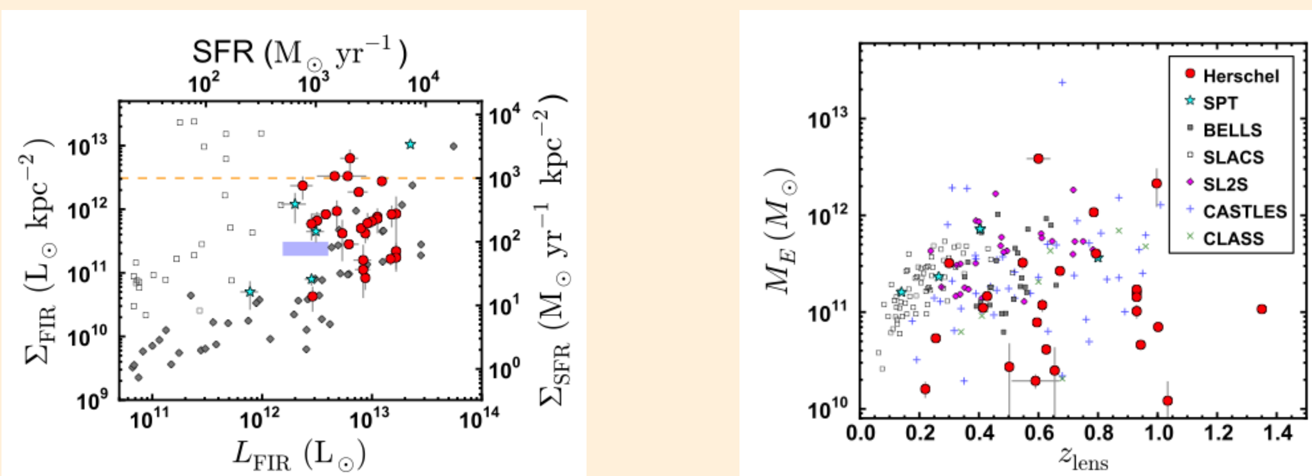

Figure 2 Left: Far-IR luminosity surface density as a function of FIR luminosity. The orange dashed line traces the theoretical limit of Σ_{SFR} for an optically thick disk (Thompson et al. 2005). The SMA subsample spans nearly one decade in L_{FIR} and two decades in Σ_{FIR}. A handful of sources approach or exceed the highest values observed in local LIRGs and ULIRGs ($\Sigma_{FIR} = 10^{13}$ $L_\odot$ kpc^{-2}).

Right: Mass enclosed within Einstein radius as a function of lens redshift. Herschel has identified lenses that are lower in mass or higher in redshift than any of the optically-based searches (SLACS, BELLS, and SL2S). The range in parameter space occupied by the Herschel data points is comparable to that of CASTLES, CLASS, and SQLS, but Herschel promises to provide a sample size that is over an order of magnitude larger.

SUBMILLIMETER POLARIZATION AND MAGNETIC FIELD PROPERTIES IN THE ENVELOPES OF PROTO-PLANETARY NEBULAE CRL 618 AND OH 231.8+4.2

L. Sabin, Q. Zhang, A.A. Zijlstra, N.A. Patel, R. Vázquez, B.A. Zauderer, M.E. Contreras, and P.F. Guillén

One of the main issues in the study of the late evolution of low and intermediate mass stars (0.8 and 8 M_{sun} on the Main Sequence), is their drastic change in morphology. Indeed while they spend most of their time generally displaying a spherical geometry, the majority of the end-products after the Asymptotic Giant Branch phase i.e. Proto-Planetary Nebulae (PPNe) and Planetary Nebulae (PNe), are characterized by aspherical (e.g. bipolar, multipolar) morphologies. The role of magnetic fields as a viable and efficient shaping mechanism, via the collimation and launch of outflows and winds, has widely been discussed, but poorly studied observationally.

A primary method to trace magnetic fields is through the analysis of dust continuum linear polarization where we rely on the principle of alignment of non-spherical spinning dust grains with their long axis perpendicular to the field (Lazarian 2003). Following earlier single dish investigations of the thermal continuum emission with SCUBA on the JCMT (Sabin et al. 2007); we selected two PPNe: CRL 618 and OH 231.8+4.2, for detailed interferometric study with the SMA in polarimetric mode (Sabin et al. 2013). The observations were conducted in compact configuration at ~345 GHz, with an angular resolution of ~2".

CRL 618 is a well-studied carbon-rich quadrupolar nebula (two pairs of shocked and expanding lobes), located at 0.9 kpc (Fig.1-Top). The SMA observations at 0.8mm revealed an East-West elongated continuum over a ~5.4"x4.6" area with a peak intensity of 3.4 Jy/beam and a mean of 1.2 Jy/beam over the whole continuum. We successfully detected linear polarization above the 3σ threshold (peak of 9.6 mJy/beam); however we note a low peak fractional polarization (P%) of 0.7%, which is likely linked to the generally small size of carbonaceous grains. The polarization vectors are well aligned and found to be roughly perpendicular to the direction of the ionized outflows. We can therefore infer that the magnetic field in CRL 618 is globally aligned with these outflows (mean PA ~96 degrees) and can then be described as a well-organized polar magnetic field (Fig. 1- Bottom).

OH 231.8+4.2 (D~1.54 kpc) is also a well known PPN, but with an oxygen-rich chemistry, which displays two asymmetrical elongated lobes (Fig.2-Top). The submillimeter wavelength continuum data indicated a north-south elongated distribution extending over an area of ~7.3"x5.7". The measured peak intensity is 0.78 Jy/beam with a mean of 0.31 Jy/beam over the whole area. Similarly to CRL 618, linear polarization was detected above the 3σ level; however, OH 231.8+4.2 presents totally different and interesting polarization characteristics. First, the polarized area is fragmented into four unequal parts, the largest one showing a peak ~16 mJy/beam. The polarization vectors in each of those "blobs" have a dominant and overall complementary position angles, which form a ring-like structure coincident with previous maser observations (Etoka et al. 2009). This dusty ring translates into an X-shaped magnetic structure, once the vectors are rotated by 90 degrees, which would then associate the field in OH 231.8+4.2 with a dipole configuration or at the very least a polar configuration. A small set of vectors may be linked to a hint of a toroidal field, but this would still need to be confirmed (Fig.2-Bottom).

With the SMA we detected and described for the first time the configuration of the magnetic field in two PNe, CRL 618 and OH 231.8+4.2, at the smallest scale. In combination with our previous investigation, we were able to identify a pattern in the link between P% and chemistry (oxygen- rich nebulae with larger grains tend to have higher P%) as well as to the evolution of the field's configuration while the nebulae evolve (from polar/dipolar to to-

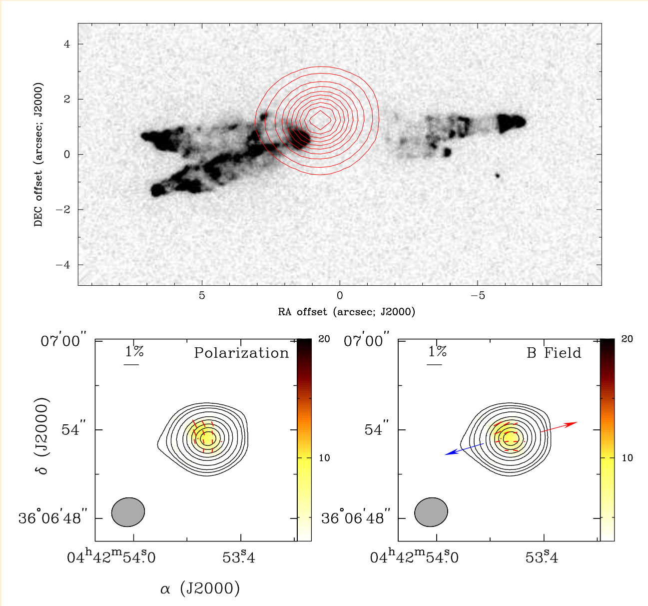

Figure 1: HST image of CRL 618 (top) with its 0.8mm dust continuum emission (red contours in steps of ~3σ×[0.5,1,2,3,4,5,6,7,8,9]) from the SMA observations superimposed. **Bottom:** Polarization map (left) and magnetic field map derived by rotating the polarization vectors by 90 degrees. The red and blue indicate the red- and blue-shifted CO outflow. In both cases, the black contours which indicate the total dust emission are drawn in steps of 0.02 Jy × (3,6,10,20,40,60,90,120,150). The color image indicates the polarized intensity with its associated scale bar in Jy/Beam on the right. Finally the polarization vectors are drawn as red segments and the scale is set to 1%. In all maps the polarization segments were slightly over-sampled. North is up and East is left in all frames.

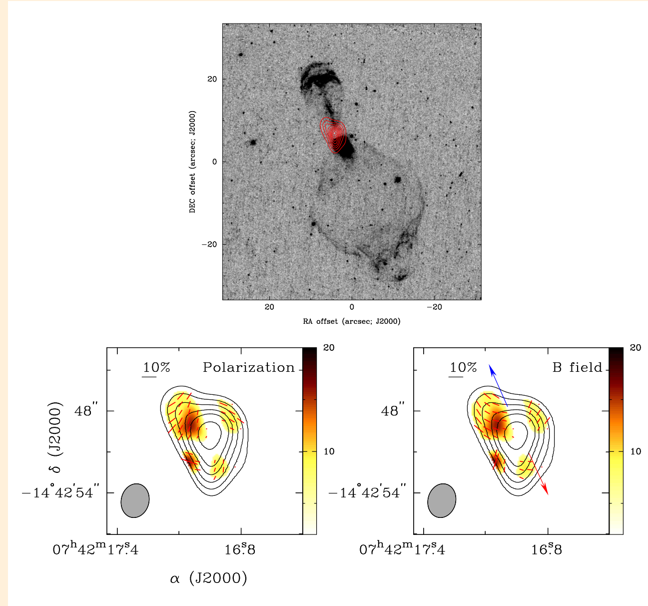

Figure 2: Same as CRL618 (Fig. 1) but for OH 231.8+4.2, showing the HST and SMA 0.8mm dust continuum emission and at the bottom the polarization and magnetic field maps. The continuum contours are drawn in steps of 0.02Jy ×(3,6,10,15,20,30,40,50,60). The polarization vectors are drawn as red segments and the scale is set to 10%.

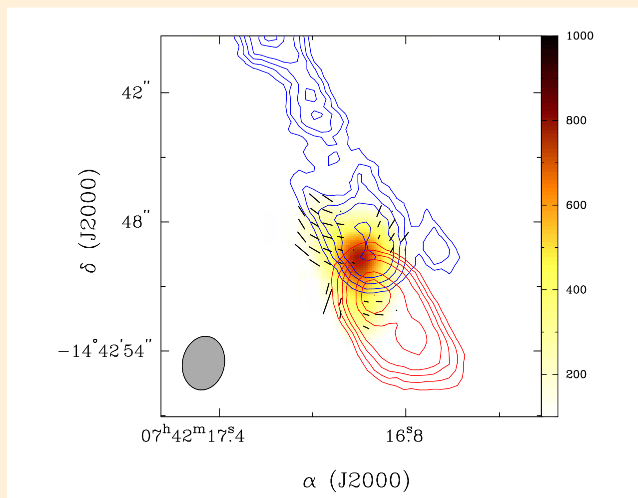

Figure 3: Distribution of the ^{12}CO(3-2) outflow vs the magnetic field in OH231.8+4.2 (right). The vectors are generally well aligned with the blue,red-shifted flows and may underline the action of a magnetic launching mechanism.

roidal). But the most intriguing and interesting result emerged when we compared the magnetic field distribution to that of the powerful (100 km/s) CO(3-2) molecular outflows. In both cases we observed a neat alignment between both structures (Fig. 3). This is particularly well-seen in the case of OH 231.8+4.2 where the magnetic vectors perfectly follow the "walls" of the CO emission. This would probe a dynamically important field at "small" scale and could also be the signature of a magnetic launching mechanism (such as magneto centrifugal launch, Frank & Blackman 2004) as described by Blackman et al. (2001). This therefore opens the door to deeper and more sensitive observations to explore this mechanism.

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NEW WIDE-BAND 300 GHz RECEIVERS FOR THE SMA

Edward Tong and Ken Young

Following the rollout of the new upgraded 200 GHz band receivers capable of delivering a much wider IF bandwidth (see SMA newsletter August 2012), the front-end team of the SMA has recently completed the wideband upgrade of the 300 GHz receivers. These new receivers offer increased flexibility for spectral line observation within the 300 GHz band.

Like the wideband 200 GHz receivers, the new 300 GHz receivers are based on a distributed superconducting tunnel junction array comprising 3 SIS junctions connected in series. A photo of the central part of the mixer chip is shown in Fig.1. The inset shows the junction array in more detail. The mixer chip was fabricated by the SIS fabrication facility at ASIAA. Each of the 3 junctions measures 1.4 μm in diameter and has a critical current density of 7 kA/cm^2. Although the 3 junctions appear to be closely packed together, the high frequency of operation means that the short length of transmission lines connecting them are actually electrically long enough to act as tuning elements to tune out the junction capacitance in a distributed way. The layout of the mixer chip was modeled carefully to allow the mixer to operate over the entire SMA 300 GHz band.

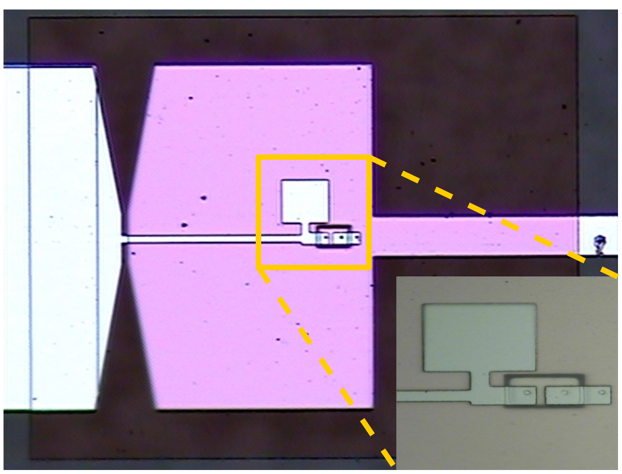

Figure 1: Photo of the new 300 GHz mixer chip showing the waveguide coupling structure and the on-chip tuning circuit of the SIS mixer. The inset shows the 3-junction series array in more detail. The first two junctions are located on an island. The junctions are connected to the waveguide feed point by an input quarter-wave transmission line and a shunting low impedance section. (Photo courtesy of Ming-jye Wang and Wei-chun Lu, ASIAA).

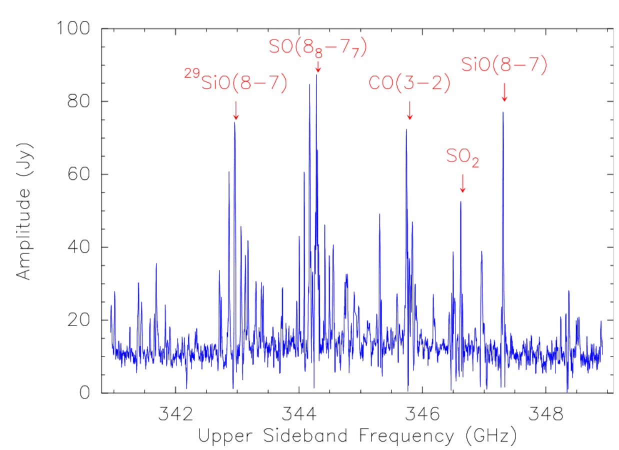

Figure 2: Upper sideband spectrum of Orion BN/KL for a single baseline. With a local oscillator frequency of 337 GHz, the 4-12 GHz portion of the receiver IF is stepped in frequency, 2 GHz at one time for processing by the SMA correlator. The four spectra are merged to produce this figure. During this observation, the weather was quite poor (~4 mm PWV) and the source was not very high in the sky. Integration time per 2 GHz spectrum is about 20 minutes).

The new 300 GHz receivers offer several desirable features. The useful IF bandwidth is even wider than that of the upgraded 200 GHz receivers. Receiver sensitivity stays quite flat up to 12 GHz and on-sky testing confirmed that the usable bandwidth extends to 13.8 GHz. In addition, the response to magnetic field in an SIS series array turns out to be smoother, and Josephson effects are more easily suppressed. Finally, these receivers also provide better system noise temperature at the low end of the frequency band below 300 GHz, while maintaining competitive performance around the popular CO(3-2) line at around 345 GHz. Observers interested in observing below 300 GHz can benefit from these new receivers given the atmospheric transmission is generally better in that part of the receiver band.

Although the full capability of these new 300 GHz receivers will not be available until full operation of the additional SMA Wideband Astronomical ROACH2 Machine (SWARM) correlator, SMA users can now access the higher IF using the Bandwidth Doubler feature of the SMA. Fig. 2 shows a 10 GHz wide spectrum obtained with the new receivers. In this observation, the Local Oscillator of the receiver was fixed at 337 GHz. The Bandwidth Doubler mode was used to map a 2 GHz wide spectrum from the 4-12 GHz IF to the SMA correlator in a sequential manner. Since both sidebands are recovered in the SMA correlator, one can use the new receivers to observe a pair of spectral lines that are separated by up to 27 GHz in the 300 GHz band. We believe that the new receivers will open up new possibilities for the SMA community.

UPGRADE OF OPTICAL POINTING GUIDESCOPES FOR THE SMA

Nimesh A. Patel, Steve Leiker, John Cheng, Rob Christensen, and Hiroaki Nishioka

Figure 1: (Left) SBIG ST-i guidescope mounted on the carbon fiber central hub of the backup structure of SMA antenna-1. (Middle) Rob Christensen comparing the sizes of the old and new guidescope tubes! (Right): STI-i guidescope with the mounting bracket.

Following every reconfiguration of the SMA, we need to calibrate the pointing correction terms in the mount model. The largest changes in pointing are typically due to azimuth encoder DC offset (azimuthal error in the setting of an antenna on the new pad), and the tilt of the azimuth axis (deviation of the azimuth axis from the local vertical). We observe about 200 bright stars all over the sky, with an optical guidescope that is mounted in the back-up structure of each of the SMA antennas. The *Electrim* EDC-1000 CCD camera that is used in these guidescopes is getting old and is now completely obsolete. We need to replace it with a newer and more sensitive camera.

We chose the Santa Barbara Instrumentation Group's ST-i guiding camera (http://www.sbig.com) which has nearly the same pixel count as the *Electrim* EDC-1000 (648x486) and similar pixel size (7.4 microns) but the sensitivity is at least ten-fold greater. The ST-i camera is also much lighter and smaller compared to the *Electrim*; the entire guidescope assembly including the 100 mm focal length lens is only about 20 cm long (Figure 1) The small size and cylindrical shape of the camera allows it to be mounted rigidly on the telescope's central hub. We use the same mounting point as the older guidescope tubes, but added a custom built aluminum bracket to locate the ST-i camera/guidescope behind the hole in the panel.

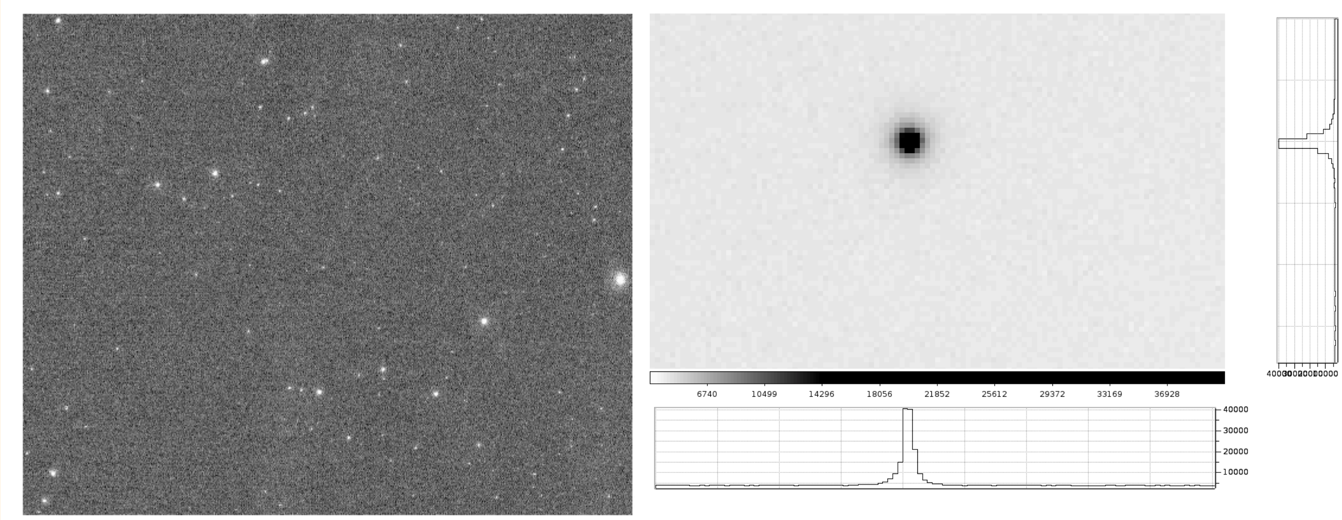

Figure 2: (Left) A one second exposure of a 2.7 degree wide field taken during a science track, showing a number of stars detected. Several of these stars have sufficient S/N and spreading of light across pixels to allow centroiding for offset measurements. (Right): An 800 ms exposure on Polaris with a cut across the horizontal and vertical directions through the center to show the intensity profiles.

The ST-i camera has a USB 2.0 interface (also used for power) and has a 16-bit ADC. SBIG provides Linux driver for the camera and we use a C program to set the exposure time and acquire an image in FITS format. The camera control software runs on an Intel processor *Mini-Box* PC and accepts commands from the central computer via Remote Procedure Call client-server software. FITS images are written on a cross-mounted directory accessible on the observing console linux PC (obscon) for display and analysis. A sample one second exposure image is shown in Figure 2 (left). The ST-i camera automatically acquires dark frames using its built-in shutter and each image is already dark-frame subtracted. The antenna was observing a science target during the acquisition of this image, and no specific optically bright star was commanded to be at the center of this frame. Several stars are detected with sufficient S/N for centroiding even with a 1 second exposure.

We use the Source Extractor program (http://www.astromatic.net/software/sextractor) for centroiding on bright stars to measure pointing offsets. The plate scale provided by the 100 mm focal length lens is rather coarse, 15.2 arcseconds per pixel, but the star light is spread over several pixels (due to poor optical performance, and internal scattering caused by insufficient baffling), and one can obtain sub-pixel centroided offsets. Figure 2 (right) shows an image of Polaris with intensity profile cuts. Centroiding works because of the spread in light across several pixels, but we need to over-expose the image, and yet stay below saturation. To assess how well the centroiding works, we measured pointing offsets as a function of given antenna offset, by driving the antenna along azimuth and elevation in steps of one arcsecond, and acquiring images on the same star. The exposure time was 800 ms and the star is Polaris (2nd magnitude). These results are shown in Figure 3. The rms of residual offsets are 1.3″ and 1.7″ in azoff and eloff. This performance is slightly better than our old guidescopes but we can improve it further by centroiding on multiple stars in the frame. We are investigating the optimal exposure time for stars of various magnitudes, and also developing the software for multiple star centroiding .

This new guidescope system is presently installed on antennas 1, 7 and 8. Several problems were encountered during the testing of these guidescopes. The *Mini-Box* PC computer

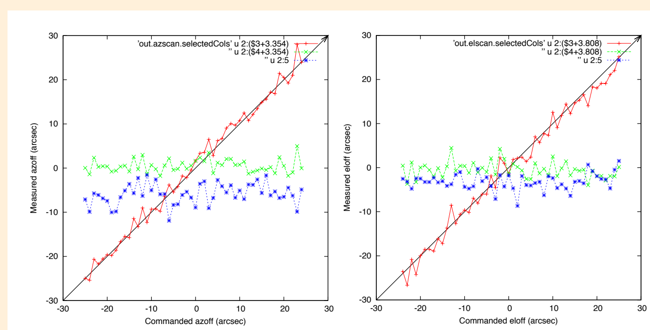

Figure 3: Test of centroiding accuracy on Polaris. The antenna was stepped in one arcsecond offsets along azimuth (left) and elevation (right). The red curve shows the measured offsets plotted vs commanded offsets and the green curves show the difference. A mean value of measured offsets has been removed (3.8″ for eloff and 3.3″ for azoff). The blue curve shows the eloff on the azscan plot, and azoff on elscan plot. The residual offsets have an rms of 1.3″ and 1.7″ for azoffs and eloffs, respectively. .

proved to be unreliable in operation at the summit and we are currently looking for other options for a more reliable embedded PC. The optical images on two of the guidescopes show distorted images due to focussing and collimation errors. We are currently solving these problems and expect to install ST-i guidescopes on the remaining antennas by the end of 2014.

Despite these problems, our tests show that the ST-i camera guidescope can be used for arcsecond accuracy pointing model calibration following array reconfigurations. Offset-guiding real-time corrections in pointing will require multi-star centroiding and a careful characterization of the plate-rotation. The compact size of this system allows for the possibility of mounting multiple guidescopes on different parts of the antenna structure providing direct measurements of mechanical flexure as a function of elevation.

SMA: FIRST DECADE OF DISCOVERY | JUNE 9 – 10, 2014

Registration opens soon!

When: June 9 – 10, 2014
Where: Radcliffe Institute, Harvard University
Cambridge, Massachusetts, U.S.A.
Sponsors: Smithsonian Astrophysical Observatory
Academic Sinica Institute of Astronomy and Astrophysics
Radcliffe Institute for Advanced Study, Harvard University

Celebrating 10 years of research with the SMA and looking forward to the future, this conference focuses on submillimeter wavelength science at high angular resolution.

Topics to be covered include star formation, protoplanetary disks, nearby and distant galaxies, magnetic fields in the interstellar medium, high energy and time variable phenomena, the galactic center, the solar system, and submillimeter instrumentation.

The conference includes invited review talks, contributed talks, and posters.

For more information about this conference please visit the conference site:

http://www.cfa.harvard.edu/sma/events/smaConf/

CALL FOR SMA SCIENCE OBSERVING PROPOSALS

The joint CfA-ASIAA SMA Time Allocation Committee (TAC) solicits proposals for observations for the period 16 May 2014 – 15 Nov 2014 (2014A semester). The deadline for submitting proposals is 2014 February 13. For more information please see link below.

http://sma1.sma.hawaii.edu/proposing.html

The deadline for the following semester (2014 Nov 16 - 2015 May 15) is expected to be on August 7, 2014.

PROPOSAL STATISTICS 2013B (16 NOV 2013 – 15 MAY 2014)

The SMA received a total of 105 proposals (SAO 99, UH 6) requesting observing time in the 2013B semester. The proposals received by the joint SAO and ASIAA Time Allocation Committee are divided among science categories as follows:

Category	Proposals
high mass (OB) star formation, cores	23
low/intermediate mass star formation, cores	23
local galaxies, starbursts, AGN	15
submm/hi-z galaxies	13
protoplanetary, transition, debris disks	10
evolved stars, AGB, PPN	6
galactic center	3
GRB, SN, high energy	3
solar system	3
UH	6

TRACK ALLOCATIONS BY WEATHER REQUIREMENT (ALL PARTNERS):

PWV[1]	SAO+ASIAA	UH[2]
< 4.0mm	15A + 42B	7
< 2.5mm	36A + 22B	12
< 1.0mm	2A + 0B	0
Total	**53A + 64B**	**19**

(1) Precipitable water vapor required for the observations.

(2) UH does not list As and Bs.

TOP-RANKED SAO AND ASIAA PROPOSALS - 2013B SEMESTER

The following is the listing of all SAO and ASIAA proposals with at least a partial A ranking with the names and affiliations of the principal investigators.

GALACTIC CENTER

Dan Marrone, University of Arizona
Capitalizing on the G2 Cloud Impact: Understanding Sgr A Accretion with SMA and CARMA*

James Moran, CfA
*Monitoring the Disintegration of G2 by SgrA**

GRB, SN, HIGH ENERGY

Laura Chomiuk, Michigan State University
Exploring the Millimeter Behavior of Novae

HIGH MASS (OB) STAR FORMATION, CORES

Andres Guzman Fernandez, CfA
Fragmentation of prestellar high-mass clumps through different evolutionary stages in the Snake

Izaskun Jimenez-Serra, European Southern Observatory
Unveiling the population of deeply embedded low-mass protostars in the Monoceros R2 star cluster

Keping Qiu, School of Astronomy and Space Science, Nanjing University
Characterizing warm and dense molecular gas around a shell-like compact HII region

Mohaddesseh Azimlu, CfA
Extremly High Velocity Outflow in Small Star Forming Association

Sarah Willis, Iowa State University / CfA
Exposing an embedded massive young cluster in NGC 6334 (copied from 2013A-S025)

Xi Chen, Shanghai Astronomical Observatory
Massive star formation: accreting from the companion

Xing Lu, CfA
Gas Kinematics in Filamentary Infrared Dark Clouds

LOCAL GALAXIES, STARBURSTS, AGN

Cheng-Yu Kuo, ASIAA
Exploring the Mass Accretion Flow in M87 through time variability of Polarized Emissions and Rotation Measure

Sheperd Doeleman, SAO
Polarization Emission on Event Horizon Scales

LOW/INTERMEDIATE MASS STAR FORMATION, CORES

Anaelle Maury, CfA
On the role of magnetic braking to solve the angular momentum problem in low-mass star formation

Chin-Fei Lee, ASIAA
Mapping the B-fields in Protostellar Jets

Karin Oberg, Harvard University
Resolving the origins of low-mass protostellar complex organics

Lingzhen Zeng, CfA
Probe the magnetic field in a low-mass disk-jet protostellar system

PROTOPLANETARY, TRANSITION, DEBRIS DISKS

Ya-Wen Tang, ASIAA
Resolving molecular outflows, streamers and circumbinary disk in a young binary system

SOLAR SYSTEM

Charlie Qi, CfA
The Primary Volatile Composition of a Dynamically New Comet - C/2012 S1 (ISON)

SUBMM/HI-Z GALAXIES

Nicole Nesvadba, Institut d'Astrophysique Spatiale Orsay (France)
SMA dust interferometry of the brightest gravitational lenses on the sub-mm sky

Soh Ikarashi, University of Tokyo
Searching more [CII] emitters in a [CII] emitter group discovered by AzTEC/ASTE and SMA at z=5.7

Wei-Hao Wang, ASIAA
Precise Identification of SCUBA-2 Sources in the Chandra Deep Field-North

ALL SAO PROPOSALS - 2013B SEMESTER

The following is the listing of all proposals observed in the 2013B semester (16 Nov 2013 – 15 May 2014)

Manuel Aravena, European Southern Observatory
The last piece in the puzzle: [CII] in bright gravitationally lensed submillimeter galaxies at z~4-5

Keiichi Asada, ASIAA
Examination of Hot Accretion Flows onto the Supermassive Black Hole in M 84

Mohaddesseh Azimlu, CfA
Extremly High Velocity Outflow in Small Star Forming Association

Andrew Baker, Rutgers University
SMA mapping of ACT dusty star-forming galaxies

Cara Battersby, University of Colorado Boulder
The Role of Feedback on Core Fragmentation

Maite Beltran, Osservatorio Astrofisico di Arcetri
A new laboratory for the earliest phases of high-mass star formation

Sandrine Bottinelli, Institut de Recherche en Astrophysique et Planétologie
Presence of a jet or a cavity in the low-mass protostar IRAS16293-2422

Hannah Broekhoven-Fiene, University of Victoria
Characterizing bright protoplanetary disks in the Auriga-California Giant Molecular Cloud

Joanna Brown, CfA
Determining the origin of warm water vapour around young stellar objects

Scott Chapman, IoA, Cambridge
An SMA, [CII] Survey around two z~4.4 massive radio galaxies

Rosie Chen, Max Planck Institute for Radio Astronomy
The Birth Environment of Super-Star Clusters at Low-Metallicity

Vivien Huei-Ru Chen, National Tsing Hua University
Are Dense Clumps in M17 SWex Nurturing O Stars?

Xi Chen, Shanghai Astronomical Observatory
Massive star formation: accreting from the companion

Hsin-Fang Chiang, IfA, University of Hawaii
Grain Growth at the High-mass Young Stellar Object IRAS 18114-1825

Hsin-Fang Chiang, IfA, University of Hawaii
Characterizing Binary and Disk Formation in Young Protostellar Systems

Tao-Chung Ching, National Tsing Hua University
Examining ambipolar diffusion theory with CARMA, EVLA, and SMA observations

Tao-Chung Ching, National Tsing Hua University
Mapping Magnetic Fields in the NGC1333 IRAS 4A Outflows

Tao-Chung Ching, National Tsing Hua University
Magnetic field and cluster star formation

Laura Chomiuk, Michigan State University
Exploring the Millimeter Behavior of Novae

David Clements, Imperial College London
Characterising the z>4 Dusty Galaxy Population

Asantha Cooray, University of California, Irvine
The Nature of Brightest Sub-millimeter Galaxies: SMG-SMG Mergers and the Formation of Most Massive Galaxies

Martin Cordiner, NASA Goddard Space Flight Center
Characterizing the benzene-rich envelope of IRAS 19566+3423

Audrey Coutens, Niels Bohr Institute
Probing the presence of deuterated water in a Warm Carbon Chain Chemistry source

Audrey Coutens, Niels Bohr Institute
Probing the heavy water content in a star-forming region

Nathan Crockett, California Institute of Technology
Tracing Hidden Luminosity Toward Orion KL

Helmut Dannerbauer, Universität Wien, Institut für Astrophysik
Characterizing Dusty Starbursts at z=2.2 in a High Density Field

Roger Deane, Oxford University
High J CO associated with a preferentially magnified active nucleus at z=2.3

Sheperd Doeleman, Smithsonian Astrophysical Observatory
Polarization Emission on Event Horizon Scales

Christopher Faesi, Harvard University
Molecular Cloud-Scale Star Formation in NGC 300

Jose Antonio Garcia Barreto, Instituto de Astronomia, UNAM (Mexico)
CO(3-2) in two nearby barred galaxies in two different environments

Viviana Guzman, IRAM
Constraining the H2CO ortho-to-para ratio in protoplanetary disks

Andres Guzman Fernandez, CfA
Detailed Dynamics of Dense Filamentary IR-Dark Clouds

Andres Guzman Fernandez, CfA
Fragmentation of prestellar high-mass clumps through different evolutionary stages in the Snake

Jun Hashimoto, The University of Oklahoma
Probing a Potential Dust Trap in PDS 70

Michael Hecht, MIT Haystack Observatory
Mapping HDO/HH18O on Mars as a marker of atmospheric processes and climate history

Naomi Hirano, ASIAA
Probing the earliest stage of low-mass star formation

Pei-Ying Hsieh, ASIAA
Streaming of Warm Gas Filaments to the Central 50 pc of IC 342

Tien Hao Hsieh, National Tsing Hua University
Resolving a Potential Proto Brown Dwarf Binary - DCE185

Hung Jin Huang, ASIAA
Gas motions around the protostar NGC 1333 IRAS 4A

Po-Sheng Huang, ASIAA
Bullet or Jet: Shaping Outflows in PPNs

Soh Ikarashi, University of Tokyo
Searching more [CII] emitters in a [CII] emitter group discovered by AzTEC/ASTE and SMA at z=5.7

Kaiki Inoue, Kinki University
Probing the Origin of Dark Halos with Anomalous Quadruple Lenses

Izaskun Jimenez-Serra, European Southern Observatory
Unveiling the population of deeply embedded low-mass protostars in the Monoceros R2 star cluster

Joel Kastner, Center for Imaging Science, Rochester Institute of Technology
Tracing High-energy Irradiation of Evolved, Planet-forming Disks

Patrick Koch, ASIAA
Are Dust Polarization Properties Different at 230 and 345 GHz?

Cheng-Yu Kuo, ASIAA
Exploring the Mass Accretion Flow in M87 through time variability of Polarized Emissions and Rotation Measure

Chin-Fei Lee, ASIAA
Mapping the B-fields in Protostellar Jets

Katherine Lee, UIUC
Hub-Filament Structure and Star Formation in OMC-1

I-Hsiu Li, ASIAA
Investing the gas in the transition disk of LkHa330

Jeremy Lim, Department of Physics, Hong Kong University
Excitation of the Multiphase ISM in Central Cluster Galaxies: Ionizing Particles?

Hau-Yu Baobab Liu, ASIAA
A Millimeter Survey to Characterize the Environment and the Mass-loss of Accretion Outburst YSOs

Hau-Yu Baobab Liu, ASIAA
Star Formation Laws in Nearby Dwarf Galaxies

Tie Liu, Peking University
Search for infall signature in the high-mass protostellar cluster AFGL 5142

Tie Liu, Peking University
Unraveling the protostellar jets and outflows associated with the protostar Megeath 352 in HBC 498 group.

Yuqing Lou, Tsinghua University
SMA Observations of CO Gas along the Dust Lanes/Bar of NGC1097 to Intersect the Starburst Ring

Xing Lu, CfA
Gas Kinematics in Filamentary Infrared Dark Clouds

Xing Lu, CfA
Sgr B2: A Star-forming Cloud in the Central Molecular Zone

A-Ran Lyo, Korea Astronomy and Space Science Institute
Collimated CO bipolar jets of massive YSO with ~190 km/s

Meredith MacGregor, Harvard University
Constraining the Structure and Eccentricity of Debris Disks

Dan Marrone, University of Arizona
Capitalizing on the G2 Cloud Impact: Understanding Sgr A Accretion with SMA and CARMA*

Anaelle Maury, CfA
On the role of magnetic braking to solve the angular momentum problem in low-mass star formation

Gordon McIntosh, University of Minnesota, Morris
Observations SiO Maser Emission in L2 Puppis

James Moran, CfA
*Monitoring the Disintegration of G2 by SgrA**

Sebastien Muller, Onsala Space Observatory
Monitoring the submm variability at the jet base of the blazar PKS1830-211 with 1% accuracy

Nicole Nesvadba, Institut d'Astrophysique Spatiale Orsay (France)
SMA dust interferometry of the brightest gravitational lenses on the sub-mm sky

Karin Oberg, Harvard University
Spatially resolved survey of complex molecules in MYSO ice sources

Karin Oberg, Harvard University
Resolving the origins of low-mass protostellar complex organics

Wei-Hsiang Pan, NCU
Measurements of 12C/13C in comet C/2012 S1 (ISON)

Charlie Qi, CfA
The Primary Volatile Composition of a Dynamically New Comet - C/2012 S1 (ISON)

Keping Qiu, School of Astronomy and Space Science, Nanjing University
Characterizing warm and dense molecular gas around a shell-like compact HII region

Ramprasad Rao, ASIAA
Are Magnetic Fields important for Low Mass Star Formation?

Bo Reipurth, IfA
An SMA Study of the HH 92 Multiple Energy Source

Javier A. Rodon, European Southern Observatory
Relationship between fragmentation and deuteration in high-mass star forming regions

Raghvendra Sahai, Jet Propulsion Laboratory
Disk or Outflow: Probing the Molecular Emission in Y Gem, an AGB Star with a Disk in Active Accretion

Nami Sakai, The University of Tokyo
Exploring a Disk Formation around the Massive Protostar, NGC-2264CMM3, by Chemistry

Quentin Salome, LERMA
Positive feedback in Cen A filaments

Benjamin Sargent, Rochester Institute of Technology
Gas Mass Loss Rates and Gas-to-Dust Ratios of Galactic Bulge OH/IR Stars

Gregory Sivakoff, University of Alberta
Constraining the Jet Properties of Transient X-ray Binaries

Kazimierz Sliwa, McMaster University
Piercing the Hearts of Arp 299: A Look at the Dense Molecular Gas

Yu-Nung Su, ASIAA
Probing the Inward Motion in the Class 0 Protostar NGC 1333 IRAS 4A

Ren-Shiang Sung, National Tsing Hua University
Outflows of Very Low Luminosity Objects in Taurus

Shigehisa Takakuwa, ASIAA
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Susanne Wampfler, Centre for Star and Planet Formation, Natural History Museum of Denmark, University of Copenhagen
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Precise Identification of SCUBA-2 Sources in the Chandra Deep Field-North

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Yuan Wang, University of Geneva
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G38.95-0.47-M1:A possible case of protostellar triggered by two HII regions

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RECENT PUBLICATIONS

Title: Competitive accretion in the protocluster G10.6-0.4?
Authors: Liu, Tie; Wu, Yuefang; Wu, Jingwen; Qin, Sheng-Li; Zhang, Huawei
Publication: *Monthly Notices of the Royal Astronomical Society, Volume 436, Issue 2, p.1335-1342*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013MNRAS.436.1335L

Title: Subarcsecond Observations of NGC 7538 IRS 1: Continuum Distribution and Dynamics of Molecular Gas
Authors: Zhu, Lei; Zhao, Jun-Hui; Wright, M. C. H.; Sandell, Göran; Shi, Hui; Wu, Yue-Fang; Brogan, Crystal; Corder, Stuartt
Publication: *The Astrophysical Journal, Volume 779, Issue 1, article id. 51, 17 pp. (2013).*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013ApJ...779...51Z

Title: An Interferometric Spectral Line and Imaging Survey of VY Canis Majoris in the 345 GHz Band
Authors: Kamiński, T.; Gottlieb, C. A.; Young, K. H.; Menten, K. M.; Patel, N. A.
Publication: *The Astrophysical Journal Supplement, Volume 209, Issue 2, article id. 38, 47 pp. (2013).*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/arXiv:1309.7360

Title: MUSCLE W49: A Multi-Scale Continuum and Line Exploration of the Most Luminous Star Formation Region in the Milky Way. I. Data and the Mass Structure of the Giant Molecular Cloud
Authors: Galván-Madrid, R.; Liu, H. B.; Zhang, Z.-Y.; Pineda, J. E.; Peng, T.-C.; Zhang, Q.; Keto, E. R.; Ho, P. T. P.; Rodríguez, L. F.; Zapata, L.; Peters, T.; De Pree, C. G.
Publication: *The Astrophysical Journal, Volume 779, Issue 2, article id. 121, 28 pp. (2013)*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013ApJ...779..121G

Title: From Poloidal to Toroidal: Detection of a Well-ordered Magnetic Field in the High-mass Protocluster G35.2−0.74 N
Authors: Qiu, Keping; Zhang, Qizhou; Menten, Karl M.; Liu, Hauyu B.; Tang, Ya-Wen
Publication: *The Astrophysical Journal, Volume 779, Issue 2, article id. 182, 11 pp. (2013).*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013ApJ...779..182Q

Title: SPT 0538−50: Physical Conditions in the Interstellar Medium of a Strongly Lensed Dusty Star-forming Galaxy at z = 2.8
Authors: Bothwell, M. S.; Aguirre, J. E.; Chapman, S. C.; Marrone, D. P.; Vieira, J. D.; Ashby, M. L. N.; Aravena, M.; Benson, B. A.; Bock, J. J.; Bradford, C. M.; Brodwin, M.; Carlstrom, J. E.; Crawford, T. M.; de Breuck, C.; Downes, T. P.; Fassnacht, C. D.; Gonzalez, A. H.; Greve, T. R.; Gullberg, B.; Hezaveh, Y.; Holder, G. P.; Holzapfel, W. L.; Ibar, E.; Ivison, R.; Kamenetzky, J.; Keisler, R.; Lupu, R. E.; Ma, J.; Malkan, M.; McIntyre, V.; Murphy, E. J.; Nguyen, H. T.; Reichardt, C. L.; Rosenman, M.; Spilker, J. S.; Stalder, B.; Stark, A. A.; Strandet, M.; Vernet, J.; Weiß, A.; Welikala, N.
Publication: *The Astrophysical Journal, Volume 779, Issue 1, article id. 67, 15 pp. (2013).*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013ApJ...779...67B

Title: The awakening of BL Lacertae: observations by Fermi, Swift and the GASP-WEBT
Authors: Raiteri, C. M.; Villata, M.; D'Ammando, F.; Larionov, V. M.; Gurwell, M. A.; Mirzaqulov, D. O.; Smith, P. S.; Acosta-Pulido, J. A.; Agudo, I.; Arévalo, M. J.; Bachev, R.; Benítez, E.; Berdyugin, A.; Blinov, D. A.; Borman, G. A.; Böttcher, M.; Bozhilov, V.; Carnerero, M. I.; Carosati, D.; Casadio, C.; Chen, W. P.; Doroshenko, V. T.; Efimov, Yu. S.; Efimova, N. V.; Ehgamberdiev, Sh. A.; Gómez, J. L.; González-Morales, P. A.; Hiriart, D.; Ibryamov, S.; Jadhav, Y.; Jorstad, S. G.; Joshi, M.; Kadenius, V.; Klimanov, S. A.; Kohli, M.; Konstantinova, T. S.; Kopatskaya, E. N.; Koptelova, E.; Kimeridze, G.; Kurtanidze, O. M.; Larionova, E. G.; Larionova, L. V.; Ligustri, R.; Lindfors, E.; Marscher, A. P.; McBreen, B.; McHardy, I. M.; Metodieva, Y.; Molina, S. N.; Morozova, D. A.; Nazarov, S. V.; Nikolashvili, M. G.; Nilsson, K.; Okhmat, D. N.; Ovcharov, E.; Panwar, N.; Pasanen, M.; Peneva, S.; Phipps, J.; Pulatova, N. G.; Reinthal, R.; Ros, J. A.; Sadun, A. C.; Schwartz, R. D.; Semkov, E.; Sergeev, S. G.; Sigua, L. A.; Sillanpää, A.; Smith, N.; Stoyanov, K.; Strigachev, A.; Takalo, L. O.; Taylor, B.; Thum, C.; Troitsky, I. S.; Valcheva, A.; Wehrle, A. E.; Wiesemeyer, H.
Publication: *Monthly Notices of the Royal Astronomical Society, Volume 436, Issue 2, p.1530-1545*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013arXiv1309.1282R

Title: Gravitational Lens Models Based on Submillimeter Array Imaging of Herschel-selected Strongly Lensed Submillimeter Galaxies at z > 1.5
Authors: Bussmann, R. S.; Pérez-Fournon, I.; Amber, S.; Calanog, J.; Gurwell, M. A.; Dannerbauer, H.; De Bernardis, F.; Fu, Hai; Harris, A. I.; Krips, M.; Lapi, A.; Maiolino, R.; Omont, A.; Riechers, D.; Wardlow, J.; Baker, A. J.; Birkinshaw, M.; Bock, J.; Bourne, N.; Clements, D. L.; Cooray, A.; De Zotti, G.; Dunne, L.; Dye, S.; Eales, S.; Farrah, D.; Gavazzi, R.; González Nuevo, J.; Hopwood, R.; Ibar, E.; Ivison, R. J.; Laporte, N.; Maddox, S.; Martínez-Navajas, P.; Michalowski, M.; Negrello, M.; Oliver, S. J.; Roseboom, I. G.; Scott, Douglas; Serjeant, S.; Smith, A. J.; Smith, Matthew; Streblyanska, A.; Valiante, E.; van der Werf, P.; Verma, A.; Vieira, J. D.; Wang, L.; Wilner, D.
Publication: *The Astrophysical Journal, Volume 779, Issue 1, article id. 25, 26 pp. (2013).*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013ApJ...779...25B

Title: Gravitational Lens Models Based on Submillimeter Array Imaging of Herschel-selected Strongly Lensed Submillimeter Galaxies at z > 1.5
Authors: Bussmann, R. S.; Pérez-Fournon, I.; Amber, S.; Calanog, J.; Gurwell, M. A.; Dannerbauer, H.; De Bernardis, F.; Fu, Hai; Harris, A. I.; Krips, M.; Lapi, A.; Maiolino, R.; Omont, A.; Riechers, D.; Wardlow, J.; Baker, A. J.; Birkinshaw, M.; Bock, J.; Bourne, N.; Clements, D. L.; Cooray, A.; De Zotti, G.; Dunne, L.; Dye, S.; Eales, S.; Farrah, D.; Gavazzi, R.; González Nuevo, J.; Hopwood, R.; Ibar, E.; Ivison, R. J.; Laporte, N.; Maddox, S.; Martínez-Navajas, P.; Michalowski, M.; Negrello, M.; Oliver, S. J.; Roseboom, I. G.; Scott, Douglas; Serjeant, S.; Smith, A. J.; Smith, Matthew; Streblyanska, A.; Valiante, E.; van der Werf, P.; Verma, A.; Vieira, J. D.; Wang, L.; Wilner, D.
Publication: *The Astrophysical Journal, Volume 779, Issue 1, article id. 25, 26 pp. (2013).*
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2013ApJ...779...25B

Title: Detection of a Magnetized Disk around a Very Young Protostar
Authors: Rao, Ramprasad; Girart, Josep M.; Lai, Shih-Ping; Marrone, Daniel P.
Publication: *The Astrophysical Journal Letters, Volume 780, Issue 1, article id. L6, 5 pp.*
Publication Date: 11/2013
Abstract: http://adsabs.harvard.edu/abs/arXiv:1311.6225

Title: On the origin of the molecular outflows in IRAS 16293-2422
Authors: Girart, Josep M.; Estalella, Robert; Palau, Aina; Torrelles, Jose M.; Rao, Ramprasad
Publication: *The Astrophysical Journal Letters, Volume 780, Issue 1, article id. L11, 7 pp*
Publication Date: 11/2013
Abstract: http://adsabs.harvard.edu/abs/arXiv:1311.4745

Title: SMA observations on faint Submillimeter Galaxies with S_{850} < 2 mJy: Ultra Dusty Low-Luminosity Galaxies at High Redshift
Authors: Chen, Chian-Chou; Cowie, Lennox L.; Barger, Amy J.; Wang, Wei-Hao; Williams, Jonathan P.
Publication: *eprint arXiv:1311.2943*
Publication Date: 11/2013
Abstract: http://adsabs.harvard.edu/abs/arXiv:1311.2943

Title: Interplay between chemistry and dynamics in embedded protostellar disks
Authors: Brinch, C.; Jørgensen, J. K.
Publication: *Astronomy & Astrophysics, Volume 559, id.A82, 8 pp.*
Publication Date: 11/2013
Abstract: http://adsabs.harvard.edu/abs/2013A%26A...559A..82B

Title: Multiple Monopolar Outflows Driven by Massive Protostars in IRAS 18162-2048
Authors: Fernández-López, M.; Girart, J. M.; Curiel, S.; Zapata, L. A.; Fonfría, J. P.; Qiu, K.
Publication: *The Astrophysical Journal, Volume 778, Issue 1, article id. 72, 11 pp. (2013).*
Publication Date: 11/2013
Abstract: http://adsabs.harvard.edu/abs/arXiv:1310.1011

Title: Luminous Infrared Galaxies with the Submillimeter Array. IV. 12CO J = 6-5 Observations of VV 114
Authors: Sliwa, Kazimierz; Wilson, Christine D.; Krips, Melanie; Petitpas, Glen R.; Iono, Daisuke; Juvela, Mika; Matsushita, Satoki; Peck, Alison; Yun, Min
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Authors: Hwang, Ho Seong; Andrews, Sean M.; Geller, Margaret J.
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Authors: Lee, Chin-Fei; Sahai, Raghvendra; Sánchez Contreras, Carmen; Huang, Po-Sheng; Hao Tay, Jeremy Jian
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Authors: Wang, Liang-Yao; Shang, Hsien; Su, Yu-Nung; Santiago-García, Joaquín; Tafalla, Mario; Zhang, Qizhou; Hirano, Naomi; Lee, Chin-Fei
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Authors: Dowell, C. Darren; Conley, A.; Glenn, J.; Arumugam, V.; Asboth, V.; Aussel, H.; Bertoldi, F.; Bethermin, M.; Bock, J.; Boselli, A.; Bridge, C.; Buat, V.; Burgarella, D.; Cabrera-Lavers, A.; Casey, C. M.; Chapman, S. C.; Clements, D. L.; Conversi, L.; Cooray, A.; Dannerbauer, H.; De Bernardis, F.; Ellsworth-Bowers, T. P.; Farrah, D.; Franceschini, A.; Griffin, M.; Gurwell, M. A.; Halpern, M.; Hatziminaoglou, E.; Heinis, S.; Ibar, E.; Ivison, R. J.; Laporte, N.; Marchetti, L.; Martinez-Navajas, P.; Marsden, G.; Morrison, G. E.; Nguyen, H. T.; O'Halloran, B.; Oliver, S. J.; Omont, A.; Page, M. J.; Papageorgiou, A.; Pearson, C. P.; Petitpas, G.; Perez-Fournon, I.; Pohlen, M.; Riechers, D.; Rigopoulou, D.; Roseboom, I. G.; Rowan-Robinson, M.; Sayers, J.; Schulz, B.; Scott, Douglas; Seymour, N.; Shupe, D. L.; Smith, A. J.; Streblyanska, A.; Symeonidis, M.; Vaccari, M.; Valtchanov, I.; Vieira, J. D.; Viero, M.; Wang, L.; Wardlow, J.; Xu, C. K.; Zemcov, M.
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Authors: Liu, Tie; Wu, Yuefang; Zhang, Huawei
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Title: PO and PN in the wind of the oxygen-rich AGB star IK Tauri
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Authors: Takakuwa, Shigehisa; Saito, Masao; Lim, Jeremy; Saigo, Kazuya
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Authors: Chen, Chian-Chou; Cowie, Lennox L.; Barger, Amy J.; Casey, Caitlin. M.; Lee, Nicholas; Sanders, David B.; Wang, Wei-Hao; Williams, Jonathan P.
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Authors: Müller, T. G.; Miyata, T.; Kiss, C.; Gurwell, M. A.; Hasegawa, S.; Vilenius, E.; Sako, S.; Kamizuka, T.; Nakamura, T.; Asano, K.; Uchiyama, M.; Konishi, M.; Yoneda, M.; Ootsubo, T.; Usui, F.; Yoshii, Y.; Kidger, M.; Altieri, B.; Lorente, R.; Pál, A.; O'Rourke, L.; Metcalfe, L.
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Authors: Williams, Jonathan P.; Cieza, Lucas A.; Andrews, Sean M.; Coulson, Iain M.; Barger, Amy J.; Casey, Caitlin M.; Chen, Chian-Chou; Cowie, Lennox L.; Koss, Michael; Lee, Nicholas; Sanders, David B.
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Authors: Takahashi, Satoko; Ohashi, Nagayoshi; Bourke, Tyler L.
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Authors: Jorstad, Svetlana G.; Marscher, Alan P.; Smith, Paul S.; Larionov, Valeri M.; Agudo, Iván; Gurwell, Mark; Wehrle, Ann E.; Lähteenmäki, Anne; Nikolashvili, Maria G.; Schmidt, Gary D.; Arkharov, Arkady A.; Blinov, Dmitry A.; Blumenthal, Kelly; Casadio, Carolina; Chigladze, Revaz A.; Efimova, Natalia V.; Eggen, Joseph R.; Gómez, José L.; Grupe, Dirk; Hagen-Thorn, Vladimir A.; Joshi, Manasvita; Kimeridze, Givi N.; Konstantinova, Tatiana S.; Kopatskaya, Evgenia N.; Kurtanidze, Omar M.; Kurtanidze, Sofia O.; Larionova, Elena G.; Larionova, Liudmilla V.; Sigua, Lorand A.; MacDonald, Nicholas R.; Maune, Jeremy D.; McHardy, Ian M.; Miller, H. Richard; Molina, Sol N.; Morozova, Daria A.; Scott, Terri; Taylor, Brian W.; Tornikoski, Merja; Troitsky, Ivan S.; Thum, Clemens; Walker, Gary; Williamson, Karen E.; Sallum, Stephanie; Consiglio, Santina; Strelnitski, Vladimir
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Authors: Wardlow, Julie L.; Cooray, Asantha; De Bernardis, Francesco; Amblard, A.; Arumugam, V.; Aussel, H.; Baker, A. J.; Béthermin, M.; Blundell, R.; Bock, J.; Boselli, A.; Bridge, C.; Buat, V.; Burgarella, D.; Bussmann, R. S.; Cabrera-Lavers, A.; Calanog, J.; Carpenter, J. M.; Casey, C. M.; Castro-Rodríguez, N.; Cava, A.; Chanial, P.; Chapin, E.; Chapman, S. C.; Clements, D. L.; Conley, A.; Cox, P.; Dowell, C. D.; Dye, S.; Eales, S.; Farrah, D.; Ferrero, P.; Franceschini, A.; Frayer, D. T.; Frazer, C.; Fu, Hai; Gavazzi, R.; Glenn, J.; González Solares, E. A.; Griffin, M.; Gurwell, M. A.; Harris, A. I.; Hatziminaoglou, E.; Hopwood, R.; Hyde, A.; Ibar, E.; Ivison, R. J.; Kim, S.; Lagache, G.; Levenson, L.; Marchetti, L.; Marsden, G.; Martinez-Navajas, P.; Negrello, M.; Neri, R.; Nguyen, H. T.; O'Halloran, B.; Oliver, S. J.; Omont, A.; Page, M. J.; Panuzzo, P.; Papageorgiou, A.; Pearson, C. P.; Pérez-Fournon, I.; Pohlen, M.; Riechers, D.; Rigopoulou, D.; Roseboom, I. G.; Rowan-Robinson, M.; Schulz, B.; Scott, D.; Scoville, N.; Seymour, N.; Shupe, D. L.; Smith, A. J.; Streblyanska, A.; Strom, A.; Symeonidis, M.; Trichas, M.; Vaccari, M.; Vieira, J. D.; Viero, M.; Wang, L.; Xu, C. K.; Yan, L.; Zemcov, M.
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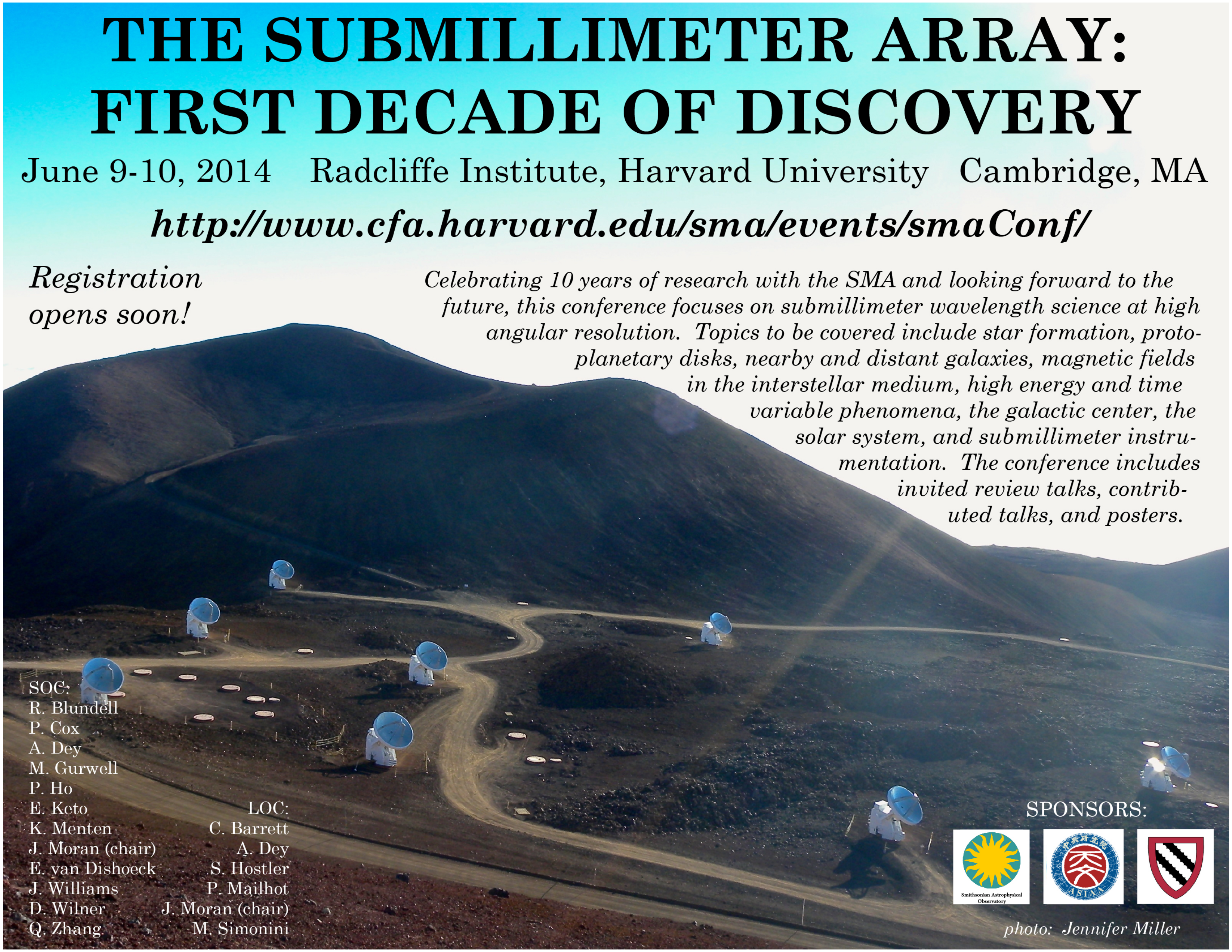
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