FROM THE DIRECTOR

Dear SMA Newsletter readers,

The month of June was an exciting time for the SMA, first with the SMA: First Decade of Discovery Conference, followed immediately by the SMA Advisory Committee Meeting. I take this opportunity to thank all involved for making both events enjoyable and successful.

For some time now, the SMA digital group has been working on adding additional correlator capacity with a new correlator, called SWARM, based on the ROACH-2 platform developed by the CASPER collaboration. We have hoped to offer additional bandwidth on a shared risk basis for some time, and I am happy to report that we will offer an additional 2 GHz of bandwidth alongside the 4 GHz bandwidth afforded by the original SMA ASIC correlator this fall. With the SMA’s double sideband receivers, this will result in a total processed bandwidth of 12 GHz: 8 GHz from the ASIC correlator, and 4 GHz from SWARM. This will provide increased sensitivity for continuum observations, and additional, though not spectrally contiguous, bandwidth for spectral line observations. Specifically, the ASIC correlator will cover the IF range of 4 – 6 GHz and 9 – 11 GHz, and SWARM will cover 8 – 9 GHz and 11 – 12 GHz. An updated version of the SMA passband visualization tool has been developed and is available to help prepare observing proposals and observations.

Assuming the initial observations with SWARM proceed as planned, we expect to offer even more bandwidth in the following semester.

Ray Blundell
SMA OBSERVATIONS OF SPATIALLY RESOLVED CONTINUUM AND [CII] EMISSION FROM A STRONGLY LENSED INTERACTING SYSTEM AT Z=5.24


Observation of atomic and molecular line emission from galaxies is an important diagnostic tool, providing insight into processes such as star formation, active galactic nuclei (AGN) fueling, and the state of the interstellar medium (ISM). The line emission is dictated by local conditions such as density, temperature, and abundance, and if resolved spectrally, dynamics. These conditions change with time, and observations of galaxies at high redshift can provide information on the evolution of molecular material in the universe. However, galaxies at high redshift appear relatively small and faint; their line emission (and even continua) are difficult to detect and resolve. A useful technique to overcome these challenges is observation of lensed objects, which benefit from magnification via an intermediate massive object. The magnification both increases the observed flux density along with the linear size of the lensed object, albeit with a distorting lens. Nonetheless, observations using sensitive interferometers such as the SMA (and now ALMA) allow for detection and resolution of star-forming galaxies at high redshift in the millimeter and submillimeter bands.

SMG HLSJ091828.6+514223 (HLS0918 hereafter) was discovered in widefield Herschel/SPIRE observations of the region around the massive cluster A773 obtained for the Herschel Lensing Survey (Egami et al 2010) program. HLS0918 is an unusually bright “500 μm peaker” source in the Herschel/SPIRE data. The source was initially described using spatially integrated observations of mm/submm spectral lines and continuum in Combes et al (2012).

Figure 1: Imaging of HLS0918 covering a 10"×10" field centered on the lensed source. (left) Map of redshifted [CII] integrated line emission observed with the SMA (color scale and dark contours). (center) 1mm observed frame continuum emission morphology (also reproduced as white contours in left and right panels) showing resolved structure indicative of lensed. (right) complementary map of redshifted CO(1-0) integrated line emission observed with the VLA. (from Fig. 1 of Rawle et al 2014)
Combes et al (2012) used the peak of the observed $^{12}$CO(6-5) line redshift galaxy ($z=0.63$) which dominates the optical imaging. The spatially integrated complex spectrum of [CII] is shown in Fig. 1, left and center panels. The integrated continuum flux density at 1mm is $103\pm9$ mJy.

At the position of the mm/submm emission lies an intermediate redshift galaxy ($z=0.63$) which dominates the optical imaging. Combes et al (2012) used the peak of the observed $^{12}$CO(6-5) line to derive a redshift for the lensed source at $z=5.2429$, and estimated the total magnification of $\mu\sim11$. Two kinematic components were identified from the CO, [NII], [CI] and water lines detected. In this new paper, Rawle et al present new, spatially resolved imaging of [CII], obtained with the SMA, and $^{12}$CO(1-0), from the JVLA, originating from HLS0918. The resolved observations are used to characterize the gas properties and morphology of the system in detail, including a new model for the combined lensing effects of the intermediate redshift galaxy along with the cluster A773.

Observations using the SMA were obtained in 2011 December (compact), 2012 February (extended) and 2012 April (very extended), with the array tuned to the redshifted [CII] line, with an observation frequency near 304.5 GHz in the USB, while the LSB sampled a line free continuum region of the spectrum. The combined uv data resulted in a synthesized resolution of $1.33\times1.10\arcsec$ FWHM for the spectral data; the 1mm continuum data, with higher SNR, were imaged with more uniform weighting emphasizing the longer baselines, resulting in a synthesized resolution of $0.69\times0.60\arcsec$. Both the continuum map and the spectrally integrated [CII] line emission above the continuum are shown in Fig. 1, left and center panels. The integrated continuum flux density at 1mm is $103\pm9$ mJy.

The spatially integrated complex spectrum of [CII] is shown in Fig. 2, which clearly shows intensity and kinematic structure. Using the [CII] line to provide an initial component model, Rawle et al use all the lines from Combes et al (2012) and the two new lines to obtain a global best simultaneous component fit, shown as overlays in Fig. 2 for [CII]. Four components are characterized: Ra: $V = +120 \pm 30 \ km \ s^{-1}$, $\Delta V_{FWHM} = 350 \pm 50 \ km \ s^{-1}$, Rb: $-130 \pm 20 \ km \ s^{-1}$, $\Delta V_{FWHM} = 350 \pm 50 \ km \ s^{-1}$.
± 20, 230 ± 30 km s−1 , B: − 470 ± 10, 160 ± 10 km s−1 , and VB: − 720 ± 40, 370 ± 170 km s−1 . The SMA [CII] and JVLA CO(1-0) data, decomposed into spectrally integrated bins covering the four identified components, are shown in Fig. 3. Concentrating first on the high S/N [CII] data (upper row), the spectral components are clearly located in distinct locations on the sky. Ra corresponds to the bright north and south peaks visible in the 1 mm continuum map. The Rb and B appear as two arcs, to the west and east, respectively, with the latter aligned to the bridge identified in the continuum map. Division of the broad “red” spectral peak into Ra and Rb components is essential to extract the western bridge. The faint VB spectral component appears as a faint source to the southeast of the continuum flux. The 12CO(1–0) data have a lower S/N and a poorer spatial resolution than [CII]. Despite these limitations, there are many similarities to the [CII] maps.

Derivation of the absolute luminosity, along with other source-plane characteristics such as the true morphology, requires a well-constrained model of the magnification and distortion due to lensing. For HLS0918, the lens model has to combine the effect of both A773 (z = 0.22) and the foreground galaxy at z = 0.63. Using the SMA [CII] data, Rawle et al use a lensing model (to be described in a future paper) to estimate the source plane structure. It is determined that the bright regions to the north and south are images of the same source with a joint magnification $\mu_{Ra} = 9.4$; The total (“flux-weighted”) magnification of the full source HLS0918 is $\mu_{Total} = 8.9 \pm 1.9$. In the final analysis, the four components are shown to originate from a source-place region separated by ~ 4 kpc, with the three reddest crossing the caustic (double images).

This comprehensive view of the gas properties and morphology of a system at $z = 5.2$ shows the power of gravitational lensing in revealing star formation and galaxy evolution in the early universe. This paper also offers a preview of the type of analysis that will become possible for a large number of high-redshift galaxies once ALMA progresses to full science operations.

**REFERENCE**

Determining the Mass Accretion Rate onto the Supermassive Black Hole in M 87

Keiichi Asada, Cheng-Yu Kuo, Ramprasad Rao, Masanori Nakamura and Patrick Koch

Active Galactic Nuclei (AGNs) are some of the most powerful (~10^{35}-10^{41} W) objects in the universe. It is widely believed that this spectacular phenomenon can be attributed to the release of gravitational energy from matter that is accreting onto a super massive (10^6-10^{10} M☉) black hole (SMBH). Therefore, the mass accretion rate onto SMBHs is one of the fundamental parameters that can be used to investigate AGNs. However, observational understanding of the mass accretion process is very limited, as there has been no direct imaging of the accretion flow thus far.

Low Luminosity Active Galactic Nuclei (LLAGNs) are an AGN subclass with sub-Eddington luminosity. Their low luminosity is thought to be caused by an optically thin and geometrically thick accretion flow with a very low accretion rate and a very low radiative efficiency. This is in contrast with the standard disk, which is optically thick with a geometrically thin disk such as in quasars. This type of accretion flow is called “radiatively inefficient accretion flow” (RIAF), and has several submodels: advection dominated accretion flow (ADAF; e.g., Narayan & Fabian 2011), adiabatic inflow-outflow solution (ADIOS; e.g., Blandford & Begelman 1999) and convection-dominated accretion flow (CDAF; e.g., Igumenshchev & Abramowicz 1999). RIAFs are very hot (the ion temperature becomes virial and the electron temperature approaches 10^9-10^{11} K around the SMBHs).

Faraday Rotation Measure (RM) observations of the continuum emission at mm/sub-mm wavelengths are one of the most powerful tools which can be used to derive the mass accretion rate of such hot accretion flows (Quataert & Gruzinov 2000). In Figure 1, we show a schematic picture of such an accretion flow. The Submillimeter Array (SMA) and other interferometer arrays operating at mm/sub-mm wavelengths have been used to probe the hot accretion flow associated with our galactic center, Sgr A* (Marrone et al. 2006). While this method has been successfully used towards Sgr A*, it has only been tested in a very limited number of other LLAGNs.

Following this successful project to study Sgr A*, we conducted SMA observations to derive the mass accretion rate onto the SMBH of M 87 (Kuo et al. 2014). This object, which is located at the center of the Virgo cluster, is one of the nearest (16.7 Mpc) low luminosity and jetted AGNs with an extremely large central SMBH of 6.6 x 10^9 M☉ (Gebhardt et al. 2011). These observations were conducted using the SMA polarimetry system in the 230 GHz band with the bandwidth doubler system.
In Figure 2, we show the observed polarization position angles as a function of the square of wavelength. The RM that was derived was \(-(2.1 \pm 1.8) \times 10^5\) rad m\(^{-2}\); due to the low sensitivity, we determine the RM to be in the range between \(-7.5 \times 10^5\) and \(3.3 \times 10^5\) rad m\(^{-2}\) with a 3 sigma confidence level. By assuming that the density profile of the accretion flow follows a power law distribution \(n \sim r^{-\beta}\) and that the magnetic field is well ordered, radial, and of equipartition strength (Marrone et al. 2007), the observed range of RM gives an upper limit of the mass accretion rate to be \(9.2 \times 10^{-4}\) M\(\odot\) yr\(^{-1}\) in the vicinity (~ 21 Schwarzschild radius: \(r_s\)) of the SMBH.

X-ray observations independently estimated the mass accretion rate at a distance of \(~10^5\) \(r_s\), which corresponds to the size of the sphere of influence of the SMBH (Di Matteo et al. 2003). This accretion rate was \(0.1\) M\(\odot\) yr\(^{-1}\). Our estimated mass accretion rate is at least two orders of magnitude smaller than that estimated by X-ray observations. As mentioned earlier, determination of the mass accretion rate provides an effective way to constrain the accretion flow models. The ADAF model requires the mass accretion rate to be of comparable value all the way from the outer part of accretion flow to the event horizon of the BH, while the ADIOS and the CDAF models require a substantial decrease of the accretion rate towards the inner region. Our new results indicate significant suppression of the mass accretion rate in the inner region of the accretion flow; it rules out the possibility of classical ADAF, and prefers either the ADIOS or CDAF models.

The current RM accuracy is limited both by the low signal-to-noise ratio and inadequate frequency separation. Therefore, in the future, it is important to have higher sensitivity observations with significantly longer lever arm in the frequency space for a more reliable RM detection. Recently, a new capability of using wider separation between the two 2 GHz sub-bands with the bandwidth doubler system has been available for SMA observations. By using this setup, we have started follow-up observations in order to derive a tighter constraint on the mass accretion rate onto the M 87 SMBH. Furthermore, future mm/submm VLBI polarimetry including SMA and Greenland Telescope will reveal the spatial distribution of the RM. This will enable us to investigate the radial profile of the accretion flow together with the shadow of the SMBH and the structure of the magnetic field at the launching region of the relativistic jet.

REFERENCES

SUBMILLIMETER INTERFEROMETRY OF THE LUMINOUS INFRARED GALAXY NGC 4418: A HIDDEN HOT NUCLEUS WITH AN INFLOW AND AN OUTFLOW

Kazushi Sakamoto

The luminous nucleus of the spiral galaxy NGC 4418 is among the most obscured in the local universe. The luminosity source behind the ≈50 mag of visual extinction has been suspected to be an AGN for nearly three decades (Roche et al. 1986) but conventional diagnostics do not work with such a heavy obscuration. As the obscuring dust is a good emitter of submillimeter continuum, we observed the nucleus with the SMA to use the new submillimeter diagnostic previously applied to Arp 220 in Sakamoto et al. (2008); see also the Aug. 2008 issue of SMA Newsletter. Namely, we aimed at measuring the bolometric luminosity \(L_{\text{bol}}\) and luminosity to mass ratio \(L_{\text{bol}}/M_{\text{dyn}}\) to characterize the nucleus.

Our 850 and 450 \(\mu\)m images of the nucleus are in the upper panels of Fig. 1. The 850 \(\mu\)m continuum is partially resolved. We obtained the source size of \(\sim 20\) pc (0.1") and (peak) brightness temperature of 120–210 K from the visibility fitting (Fig. 1, lower-left). The 20 pc core has thus a bolometric luminosity of about \(10^{11}L_{\odot}\). We also obtained its luminosity-to-mass ratio of \(\sim 500 L_{\odot}/M_{\odot}\) by supplementing the dynamical mass we estimated from our simultaneous molecular line observations.

This \(L/M\) in the central 20 pc of NGC 4418 is so high that it can be only explained with an AGN or a starburst younger than about 10 Myr (see Fig. 2, left). Interestingly, the \(L/M\) for the central 20 pc of NGC 4418 is comparable to the one we previously measured for the central 50–80 pc of the western nucleus of Arp 220. A high \(L/M\) like this in a dusty environment is expected to cause an ISM outflow through radiation pressure on dust. In Arp 220, we found through P-Cygni profiles (i.e., blueshifted absorption) of molecular lines an outflow on both of the two merger nuclei (Sakamoto et al. 2009). In NGC 4418, however, redshifted absorption and hence inflow has been found through Herschel observations of molecular lines by González-Alfonso12. Although we did not see an outflow in our SMA data, we found (almost by chance when looking at public optical images from the Sloan Digital Sky Survey) a clear kpc scale outflow cone in dust reddening (Fig. 2, right). The nucleus of NGC 4418 thus has both an inflow and an

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**Figure 1** **Top:** 860 and 450 \(\mu\)m continuum emission of the nucleus of NGC 4418. The nucleus is detected at 5.8 \(\sigma\) at 450 \(\mu\)m. **Bottom:** Baseline– amplitude plots for the 860 \(\mu\)m continuum of NGC 4418 and a test source, Titan.
outflow. These dynamic features imply that the nucleus is rapidly evolving.

There have been more recent developments on NGC 4418. Costagliola et al. (2013) reported SMA 1.3 mm imaging of the nucleus at ~0.4 resolution. Among their interesting observations are detection of vibrationally excited HNC and HC$_N$ lines at vibrational temperatures of about 300 K. This is consistent with the SMA detection of vibrationally excited HCN with $T_{\text{vib}} \approx 230$ K (Sakamoto et al. 2010). These lines suggest the presence of warm molecular gas and strong IR radiation in the nucleus. Moreover, Varenius et al. (2014) resolved the 5 GHz emission of the nucleus at the resolution of ~15 mas using EVN and MERLIN and found clumps that they infer to be super star clusters and possibly an AGN. Interestingly the group extent of their most prominent peaks is about 0.1 and comparable to our SMA 860 μm size. It is plausible that we are seeing the same luminous core at the nucleus.

There were two technical achievements in our SMA observations. First, we could measure a size of 0.1 at 850 μm. We verified our size measurement capability by observing a distant quasar and Titan. We found the quasar to be a point source, as it should be, and we could measure the known subarcsec size of Titan (~0.8) with an accuracy of 3% or 20 mas (Fig. 1, lower-right). Secondly, we could use the SMA in its largest configuration (VEX config.) at 660 GHz. The fringes of our gain calibrator 3C273 are shown in Fig. 3. The 450 μm image in Fig. 1 must be among the highest resolution images made with the SMA alone.

REFERENCES


Figure 2 Left: Luminosity-to-mass ratio for starburst as a function of age as well as $L/M$ at the Eddington limit. Right: Optical color index image of NGC 4418 showing a kpc-scale dust outflow cone along a semi-minor axis.

Figure 3: SMA fringes at 455 μm (658 GHz) toward 3C273 (~4 Jy) on Mar. 3, 2010. The projected baseline length varied between 420–460 m in the upper panel and 140–230 m in the lower. The bandwidth is 1 GHz and each point is from nine 20 sec integrations. Bandpass and gain calibrations have been applied with 1.5 hr smoothing in the latter.
MOST IN-DEPTH VIEW OF THE INITIAL STAGES OF MASSIVE CLUSTERED STAR FORMATION

Ke Wang (ESO) and Qizhou Zhang (CfA)

Massive stars drive the evolution of galaxies, but how they come into existence is still a fundamental open question. Particularly critical and still poorly understood is the very early stage of evolution, i.e., initial conditions in molecular clouds leading to the onset of massive star formation.

We have carried out a series of studies on infrared dark clouds (IRDCs) aiming to characterize the early stages of evolution (Zhang et al. 2009; Zhang & Wang 2011; Wang et al. 2011, 2012ab, 2013, 2014). Seen as shadows against the Galactic IR background, IRDCs are extremely cold and dense molecular clouds that represent the early stages of massive star formation. Our dedicated observing campaign is carefully designed to resolve the initial fragmentation of dense IRDC clumps (using SMA dust continuum) and at the same time to measure the gas temperature and turbulence (using VLA NH₃ lines) at a matching resolution. This coordinated effort allows us to infer the nature of the fragmentation and to constrain theoretical models.

Highlighted here is a prime example of IRDCs catalogued as G11.11-0.12, also known as the “Snake Nebula” (Wang et al. 2014). This giant molecular cloud sketches a striking dark semi-sinuous feature in the mid-IR sky, and transitions to emission at far-IR wavelength (Figure 1). The S-shaped Snake measures 30 pc in the sky at a distance of 3.6 kpc. Approximately $10^4 M_\odot$ of dense gas is inferred for the entire cloud based on the *Herschel* dust emission. Seen at higher resolution, the cloud is highly structured: it comprises of several clumps of ~1 pc in size and 18 protostellar cores of ~0.1 pc in size. The cores are identified as point sources from deep *Herschel* images (Henning et al. 2010). However, detailed structures beyond the core scale, the key to understand the early fragmentation that directly initiates subsequent clustered star formation, are only accessible by deep interferometric imaging. With the SMA and VLA, we peered into the two most massive ($\sim 10^3 M_\odot$) and low-luminosity ($10^2-10^3 L_\odot$) clumps within the Snake nebula, designated as P1 and P6.

As shown in Figure 2, the high-resolution, high-sensitivity SMA continuum images at 1.3 and 0.88 mm resolve two levels of fragmentation in both P1 and P6: the clump (~1 pc in size) fragments into 6 dense cores (~0.1 pc), some of which further fragment into even smaller condensations (~0.01 pc). While the clump fragmentation is consistent with the gravitational collapse of a gaseous cylinder, the masses of the dust cores and condensations are...
much greater than the respective thermal Jeans masses (see Figure 3). This is similar to what was found in IRDCs G28.34+0.06 (Zhang et al. 2009; Wang et al. 2011, 2012a) and G30.88+0.13 (Zhang & Wang 2011), suggesting that turbulence supported fragmentation is common in the initial stages of massive star formation.

A total of 23 condensations sized ~0.01 pc with masses ranging from 5 to 25 M☉ are resolved in P1 and P6. These are the smallest "seeds" of star formation; each will form one or a multiple system of stars. Some of the seeds are clearly forming stars -- as indicated by protostellar outflows, shocked NH₃ gas, and masers -- while others appear to be still quiescent. For instance, the discovery of an East-West outflow in P1-SMA1 provides critical support to a long hypothesized North-South disk surrounding the central protostar. Furthermore, millimeter spectra of the condensations differentiate them from each other in terms of variations in evolutionary stages. Seeds associated with star formation are chemically active, with spectral line emission similar to hot molecular cores but at a lower gas temperature of <30 K; quiescent seeds have very little detectable lines, some only show ¹²CO. The observed snapshots of physical and chemical properties can be placed along an apparent evolutionary sequence, which is subject to further tests by chemical modeling.

For the first time, enrichment of ortho-NH₃ is found to increase along protostellar outflows downstream. We find ortho/para-NH₃ abundance ratios of 1.1 ± 0.4, 2.0 ± 0.4, and 3.0 ± 0.7 associated with all three identified outflows in clump P6, at locations of 0.03, 0.15, and 0.3 pc to protostars, respectively. This suggests that the NH₃ molecules have been released to gas phase from dust grains by outflow shocks, and that the ortho-NH₃ is preferentially desorbed than para-NH₃ because the former requires less energy for desorption than the latter, due to the energy difference in the lowest ortho and para states.

Because of the large mass reservoir in the cloud, P1 and P6 will become star clusters that contain massive stars, once the mass accretion is complete. By then, the Snake nebula will dissolve and shine as a chain of several star clusters.
Our combined SMA and VLA observations of IRDCs present the most in-depth view so far of the early stages of massive star formation prior to the hot core phase. We find that the early phase is characterized by hierarchical fragmentation at multiple levels that leads to structures at multiple spatial scales, ranging from ~1 pc down to ~0.01 pc, where turbulence dominates the fragmentation at all scales probed. These results are yet to be fully implemented by theoretical models. The observations of P1 and P6 have been published in Wang et al. (2014). Multi-scale fragmentation and gas kinematics of the entire Snake nebula will be addressed by our upcoming ALMA observations.

REFERENCES

- Henning Th. et al., 2010, A&A, 518, L95
- Wang K. et al., 2013, Protostars and Planets VI, #1S025, 25
The SMA Wideband Astronomical Roach2 Machine (SWARM) correlator is currently being implemented and is expected to be fully operational during this observing semester (2014A). The Passband Visualizer tool on the SMA Observer Center website, was written by Chris Schaab and maintained by Ryan Howie. This tool needed improvements to the user interface, enhanced clarity in graphical and textual elements, and expansion of spectral range to include the extra 4 GHz of bandwidth for SWARM. We have created a new passband visualizer with significantly enhanced usability, a more comprehensive database of molecular lines, and additional 4 GHz of bandwidth for SWARM. The correlator configuration for SWARM portion of the bandwidth is not required since the spectral resolution is fixed at the highest resolution of 122 KHz per channel in the new chunks S49 and S50. And the correlator configuration for the ASIC correlator remains the same as before, so the previous tool can be used for specifying/checking the assignment of number of channels in various spectral chunks in S1 to S48.

The new passband visualizer is available under Tools on the Observer Center website, was written by Chris Schaab and maintained by Ryan Howie. This tool needed improvements to the user interface, enhanced clarity in graphical and textual elements, and expansion of spectral range to include the extra 4 GHz of bandwidth for SWARM. We have created a new passband visualizer with significantly enhanced usability, a more comprehensive database of molecular lines, and additional 4 GHz of bandwidth for SWARM. The correlator configuration for SWARM portion of the bandwidth is not required since the spectral resolution is fixed at the highest resolution of 122 KHz per channel in the new chunks S49 and S50. And the correlator configuration for the ASIC correlator remains the same as before, so the previous tool can be used for specifying/checking the assignment of number of channels in various spectral chunks in S1 to S48.

The SMA Passband Visualizer is available under Tools on the Observer Center website (http://sma1.sma.hawaii.edu/smaPassbandViewer/smaPassbandVis.html). Frequencies of the molecular lines were obtained from the ALMA Spectroscopy Group's Splatalogue website, and JSON format database entries were created for display on the webpage using Jquery and Flot packages. Atmospheric transmission curves can be overlaid on the spectral coverage displays for 1, 2.5 and 4 mm of precipitable water vapor levels. These curves are obtained from Scott Paine's latest version of his Atmospheric Model code (see SMA technical memo number 152, "The am Atmospheric Model", 3 March 2014). As before, the Orion line survey can be plotted. The SMA IRC+10216 line survey data in 345 and 400 GHz bands can also be overlaid. Plots of spectral coverage can be zoomed and scrolled with an overview display showing the full tuning range. Spurs caused by the YIG frequency for a given LO frequency and PLL harmonic, are shown in both the sidebands as black lines. These spurs can be relocated by changing the PLL harmonic value to place them away from spectral windows including lines of interest.

We hope this new version of the SMA Passband Visualizer will be helpful in planning the tuning setup for observations using SWARM as well as the legacy ASIC correlator.
INTERFEROMETRIC POINTING CAN NOW BE FASTER

Ken Young (CfA)

The ipoint command, which determines pointing offsets for the antennas by observing a strong unresolved or weakly resolved source, can now run faster. By default, ipoint takes data at five positions: on-source and offset by 1/2 primary beam in +-Az and +-El. The new faster mode takes data on only three positions, each 1/2 beam from the nominal pointing, and located at the vertices of an equilateral triangle. The new faster mode (selected with the -3 option on the ipoint command) takes only 60% of the time required by the default mode. The new mode derives pointing corrections which are consistent with the default mode, as long as the required corrections are less than 1/2 of the primary beam width. This new mode should be helpful for PIs who request frequent pointing updates during their science tracks.

NEW OPTIONS FOR SMA DATA REDUCTION

Eric Keto and Ken Young (CfA)

The SMA has a new data reduction website:
http://www.cfa.harvard.edu/sma/smaData/

The new site presents two cookbook-style tutorials, which emphasize illustrative plots and detailed discussion of SMA data reduction.

The two new sites are:
1. "Eric Keto's MIR Website", which presents a streamlined version of the standard MIR calibration. (Standard MIR is discussed at https://www.cfa.harvard.edu/~cqi/mircook.html.)

   Both MIR versions have their situations of optimal use.
2. "SMA CASA Website", which presents both calibration and imaging of raw SMA data.

   CASA is an alternative to MIR and/or Miriad processing.

Several example tracks, including a very old data set, are calibrated and/or imaged to completion.

We intend to add additional tutorials to this website and welcome feedback from the user community. Please send suggestions or comments to smaCAL@cfa.harvard.edu.
POSTDOCTORAL OPPORTUNITIES AT THE SMA

Applications are now being accepted for SMA Postdoctoral Fellowships starting Summer/Fall 2015. These positions are aimed chiefly at research in submillimeter astronomy, and successful candidates will participate either in observations with the SMA, research in their interpretation, or instrument development.

While the SMA fellowships are intended primarily for research associated with the SMA, being located at the Center for Astrophysics, fellows have unique opportunities to develop collaborations within the wider CfA community and enjoy extraordinary freedom in structuring their own research activities.

Applicants must have a recent PhD in astronomy or a related field. Experience in millimeter or submillimeter astronomy, radio interferometry, radio frequency instrumentation, or research in processes in the interstellar medium is desirable.

The SMA is a collaboration between the Smithsonian Astrophysical Observatory and the Academia Sinica Institute of Astronomy and Astrophysics in Taipei, Taiwan. The Smithsonian Astrophysical Observatory is an Equal Opportunity/Affirmative Action Employer where all qualified applicants receive equal consideration without regard to race, color, creed, national origin or gender.

Application information and instructions can be found at http://www.cfa.harvard.edu/opportunities/fellowships/sma/

Questions can be directed to smapostdoc@cfa.harvard.edu

Online applications are due October 1, 2014.

SMA: FIRST DECADE OF DISCOVERY

On June 9 and 10, 2014, the SMA hosted The Submillimeter Array: First Decade of Discovery. Over 100 people attended this scientific conference, held at the Marriott Courtyard Boston Cambridge, which showcased the scientific results from and instrumentation advances of the SMA since the official science dedication in November 2003. Presentations also discussed proposed and future studies using the SMA and the continuing importance of the SMA in the age of ALMA.

After an informal opening reception Sunday night, the conference officially kicked off Monday morning with remarks by former SMA director Jim Moran and SAO director Charles Alcock. Monday sessions highlighted the areas of protoplanetary disks, nearby galaxies, high redshift galaxies, solar system astronomy, evolved stars, and studies of the galactic center, while Tuesday shifted focus to star formation, time-domain astronomy, Event Horizon Telescope/Very Long Baseline Interferometry, and discussions about the future of the SMA. Forty posters were displayed throughout the meeting, with over half of the presenters participating in the Poster Blast on Monday. On Monday night, attendees were invited to the conference banquet, where Irwin Shapiro gave the keynote address followed by additional remarks from Ray Blundell, Ben Bosma, Fred Lo, Jim Moran and Antony Schinckel.

Poster and oral presentations will be archived online at the conference website:

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

The photo of conference attendees can be found at:

http://www.cfa.harvard.edu/sma/SMApics/sma10groupPhoto9June2014.jpg
The slide show of historical photos is available through the conference site:

http://www.cfa.harvard.edu/sma/events/smaConf/SMASlideShow.m4v

For those having playback errors, another version is also available:

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

Thank you and congratulations to both the Local Organizing Committee and Scientific Organizing Committee on an informative and successful conference.

**SPECIAL MENTION: LES SHIRKEY IS AWARDED SMITHSONIAN INSTITUTION 2014 SAFETY PERSON OF THE YEAR AWARD**

Les is the lead mechanical technician at the Mauna Kea Summit and works full time maintaining heavy equipment. Les takes it upon himself to ensure safety barriers are around hazardous equipment, ensures appropriate lockout/tagout procedures are followed, provides icy weather driver training and is a medical first responder.

We congratulate Les on his good work!

**CALL FOR SMA SCIENCE OBSERVING PROPOSALS**

The joint CfA-ASIAA SMA Time Allocation Committee (TAC) solicits proposals for observations for the period 16 November 2014 - 15 May 2015 (2014B semester). The deadline for submitting proposals is 7 August 2014. For more information please see link below.

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

The deadline for the following semester (16 May 2015 - 15 Nov 2015) is expected to be on 12 February 2015.


The SMA received a total of 101 proposals requesting observing time in the 2014A semester. The proposals received by the joint SAO and ASIAA Time Allocation Committee are divided among science categories as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Proposals</th>
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<tr>
<td>high mass (OB) star formation, cores</td>
<td>30</td>
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<tr>
<td>low/intermediate mass star formation, cores</td>
<td>21</td>
</tr>
<tr>
<td>submm/hi-z galaxies</td>
<td>12</td>
</tr>
<tr>
<td>protoplanetary, transition, debris disks</td>
<td>11</td>
</tr>
<tr>
<td>local galaxies, starbursts, AGN</td>
<td>10</td>
</tr>
<tr>
<td>evolved stars, AGB, PPN</td>
<td>9</td>
</tr>
<tr>
<td>galactic center</td>
<td>3</td>
</tr>
<tr>
<td>other</td>
<td>3</td>
</tr>
<tr>
<td>GRB, SN, high energy</td>
<td>2</td>
</tr>
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</table>
TRACK ALLOCATIONS BY WEATHER REQUIREMENT (ALL PARTNERS):

<table>
<thead>
<tr>
<th>PWV</th>
<th>SAO+ASIAA</th>
<th>UH</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4.0mm</td>
<td>10A + 28B</td>
<td>0</td>
</tr>
<tr>
<td>&lt; 2.5mm</td>
<td>20A + 28B</td>
<td>6</td>
</tr>
<tr>
<td>&lt; 1.0mm</td>
<td>3A + 3B</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>33A + 59B</td>
<td>6</td>
</tr>
</tbody>
</table>

(1) Precipitable water vapor required for the observations.
(2) UH does not list As and Bs.

TOP-RANKED SAO AND ASIAA PROPOSALS - 2014A 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.

**EVOLED STARS, AGB, PPN**
Wouter Vlemmings, Chalmers University of Technology
*The magnetic field of binary evolved stars*

**GALACTIC CENTER**
Dan Marrone, University of Arizona
*Probing the G2 Gas Cloud Disruption by Sagittarius A* with SMA and CARMA Polarimetry*
James Moran, CfA
*G2 Impact - Short Time-Scale Monitoring*

**HIGH MASS (OB) STAR FORMATION, CORES**
Karin Öberg, Harvard University
*A complete, spatially resolved survey of complex molecules in MYSO ice sources*
Keping Qiu, School of Astronomy and Space Science, Nanjing University
*A Toroidal Magnetic Field in the Brightest YSO Radio Jet in our Galaxy? (copied from 2012B-S020)*
Keping Qiu, School of Astronomy and Space Science, Nanjing University
*A twin jet powered by a massive protobinary in IRAS 16547-4247?*
Pau Frau, Observatorio Astronomico Nacional (OAN) - Centro de Astrobiologia (CSIC-INTA)
*Assessing the role of magnetic fields in a filament with super-Jeans fragmentation*

**LOW/INTERMEDIATE MASS STAR FORMATION, CORES**
Hsi-Wei Yen, ASIAA
*Linking velocity and magnetic-B field analyses from disks to associated clouds*

**PROTOPLANETARY, TRANSITION, DEBRIS DISKS**
Meredith Hughes, Wesleyan University
*HD 166191: Giant Debris Impact or Late-Stage Transition Disk?*
Sean Andrews, CfA
*A Size--Luminosity Scaling for Protoplanetary Dust Disks*

**SUBMM/HI-Z GALAXIES**
Nicole Nesvadba, Institut d’Astrophysique Spatiale Orsay (France)
*Probing intense star-formation in the brightest gravitationally lensed high-z galaxies discovered with Planck*
Wei-Hao Wang, ASIAA
*SMA Identification of Strongly Amplified SCUBA-2 Sources*
The following is the listing of all SAO proposals observed in the 2013B semester (16 November 2013 – 15 May 2014)

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

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

Cara Battersby, CfA
*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*

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

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

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

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

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

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

Izaskun Jimenez-Serra, ESO
*Unveiling the population of deeply embedded low-mass protostars in the Monoceros R2 star cluster*

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*

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

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

Xing Lu, CfA
*Gas Kinematics in Filamentary Infrared Dark Clouds*

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*

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

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 Öberg, Harvard University
*Spatially resolved survey of complex molecules in MYSO ice sources*

Karin Öberg, Harvard University
*Resolving the origins of low-mass protostellar complex organs*

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

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

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

Arthur Cheng-Hung Tsai, National Tsing Hua University
*Resolving Extreme High Velocity Components of the Highly Collimated NGC 2023 MM1 Outflows*

Viviana Guzman Veloso, CfA
*Constraining the H2CO ortho-to-para ratio in protoplanetary disks*

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

Yuan Wang, University of Geneva
*Investigating the sequential star formation in S235 complex*

Yoshimasa Watanabe, The University of Tokyo, Department of Physics
*Imaging the Molecular Distributions in the Spiral Arm of M51*
Sarah Willis, Iowa State University / CfA
Exposing an embedded massive young cluster in NGC 6334 (copied from 2013A-S025)

Hsi-Wei Yen, ASIAA
Revealing Accretion Flow toward the Keplerian Disk around a Low-mass Protostar L1489 IRS

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

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Publication</th>
<th>Publication Date</th>
<th>Abstract</th>
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<tr>
<td>Interferometric Follow-Up of WISE Hyper-Luminous Hot, Dust-Obscured Galaxies</td>
<td>Wu, Jingwen; Bussmann, R. Shane; Tsai, Chao-Wei; Petric, Andreea; Blain, Andrew; Eisenhardt, Peter R. M.; Bridge, Carrie R.; Benford, Dominic J.; Stern, Daniel; Assef, Roberto J.; Gelino, Christopher R.; Moustakas, Leonidas; Wright, Edward L.</td>
<td>eprint arXiv:1405.1147</td>
<td>05/2014</td>
<td><a href="http://adsabs.harvard.edu/abs/arXiv:1405.1147">http://adsabs.harvard.edu/abs/arXiv:1405.1147</a></td>
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Title: Multifrequency Studies of the Peculiar Quasar 4C +21.35 during the 2010 Flaring Activity

Publication Date: 05/2014
Abstract: http://adsabs.harvard.edu/abs/2014ApJ...786..157A

Title: A Luminous Infrared Merger with Two Bipolar Molecular Outflows: ALMA and SMA Observations of NGC 3256
Authors: Sakamoto, Kazushi; Aalto, Susanne; Combes, Francoise; Evans, Aaron; Peck, Alison

Publication: eprint arXiv:1403.7117
Publication Date: 03/2014

Title: ALMA Observations of the Orion Proplyds
Authors: Mann, Rita K.; Di Francesco, James; Johnstone, Doug; Andrews, Sean M.; Williams, Jonathan P.; Bally, John; Ricci, Luca; Hughes, A.; Meredith, Mathews, Brenda C.

Publication Date: 03/2014
Abstract: http://adsabs.harvard.edu/abs/2014ApJ...784...82M
Title: Submillimeter Array observations of the proto brown dwarf candidate SSTB213 J041757
Authors: Phan-Bao, N.; Lee, C.-F.; Ho, P. T. P.; Martin, E. L.
Publication Date: 04/2014
Abstract: http://adsabs.harvard.edu/abs/2014arXiv1403.1926P

Title: Measuring Mass Accretion Rate onto the Supermassive Black Hole in M87 Using Faraday Rotation Measure with the Submillimeter Array
Publication Date: 03/2014

Title: A subarcsecond study of the hot molecular core in G023.01-00.41
Authors: Sanna, A.; Cesaroni, R.; Moscadelli, L.; Zhang, Q.; Menten, K. M.; Molinari, S.; Caratti o Garatti, A.; De Buizer, J. M.
Publication Date: 05/2014
Abstract: http://adsabs.harvard.edu/abs/2014arXiv1402.3518S

Title: SMA Millimeter Observations of Hot Molecular Cores
Authors: Hernández-Hernández, Vicente; Zapata, Luis; Kurtz, Stan; Garay, Guido
Publication Date: 05/2014
Abstract: http://adsabs.harvard.edu/abs/2014arXiv1402.2682H

Title: High-resolution Submillimeter and Near-infrared Studies of the Transition Disk around Sz 91
Authors: Tsukagoshi, Takashi; Momose, Munetake; Hashimoto, Jun; Kudo, Tomoyuki; Andrews, Sean; Saito, Masao; Kitamura, Yoshimi; Ohashi, Nagayoshi; Wilner, David; Kawabe, Ryoho; Abe, Lyu; Akiyama, Eiji; Brandner, Wolfgang; Brandt, Timothy D.; Carson, Joseph; Currie, Thayne; Egner, Sebastian E.; Goto, Miwa; Grady, Carol; Guyon, Olivier; Hayano, Yutaka; Hayashi, Masahiko; Hayashi, Seiko; Henning, Thomas; Hodapp, Klaus W.; Ishii, Miki; Iye, Masanori; Janson, Markus; Kandori, Ryo; Knapp, Gillian R.; Kuwabara, Nobuhiko; Kuzuhara, Masayuki; Kwon, Jungmi; McElwain, Mike; Matsuo, Taru; Mayama, Satoshi; Miyama, Shoken; Morino, Jun-ichi; Moro-Martín, Amaya; Nishimura, Tetsuro; Pyo, Tae-Soo; Serabyn, Eugene; Suenaga, Takuya; Suto, Hiroshi; Suzuki, Ryuji; Takahashi, Yasuhiro; Takami, Hideki; Takami, Michihiro; Takato, Naruhisa; Terada, Hiroshi; Thalmann, Christian; Tomono, Daigo; Turner, Edwin L.; Usuda, Tomonori; Watanabe, Makoto; Wisniewski, John P.; Yamada, Toru; Tamura, Motohide
Publication Date: 03/2014
Abstract: http://adsabs.harvard.edu/abs/2014ApJ...783...90T

Title: HerMES: Spectral Energy Distributions of Submillimeter Galaxies at z > 4
Publication Date: 03/2014
Abstract: http://adsabs.harvard.edu/abs/2014ApJ...784...52H
| Title: | MAGIC gamma-ray and multifrequency observations of flat spectrum radio quasar PKS 1510-089 in early 2012 |
| Publication: | eprint arXiv:1401.5646 |
| Publication Date: | 01/2014 |
| Abstract: | http://adsabs.harvard.edu/abs/2014arXiv1401.5646M |

| Title: | Submillimeter Array and Very Large Array Observations in the Hypercompact H II Region G35.58-0.03 |
| Authors: | Zhang, Chuan-Peng; Wang, Jun-Jie; Xu, Jin-Long; Wyrowski, Friedrich; Menten, Karl M. |
| Publication Date: | 04/2014 |

| Title: | Hierarchical fragmentation and differential star formation in the Galactic 'Snake': infrared dark cloud G11.11-0.12 |
| Authors: | Wang, Ke; Zhang, Qizhou; Testi, Leonardo; Tak, Floris van der; Wu, Yuefang; Zhang, Huaweif; Pillai, Thushara; Wyrowski, Friedrich; Carey, Sean; Ragan, Sarah E.; Henning, Thomas |
| Publication Date: | 04/2014 |

| Title: | Is There a Maximum Star Formation Rate in High-redshift Galaxies? |
| Authors: | Barger, A. J.; Cowie, L. L.; Chen, C.-C.; Owen, F. N.; Wang, W.-H.; Casey, C. M.; Lee, N.; Sanders, D. B.; Williams, J. P. |
| Publication Date: | 03/2014 |
Title: SMA Submillimeter Observations of HL Tau: Revealing a Compact Molecular Outflow
Authors: Lumbreras, Alba M.; Zapata, Luis A.
Publication Date: 04/2014
Abstract: http://adsabs.harvard.edu/abs/2014AJ....147...72L

Title: Serendipitous ALMA detection of a distant CO-emitting galaxy with a buried active galactic nucleus beyond the nearby merging galaxies VV114
Authors: Tamura, Yoichi; Saito, Toshihi; Tsuru, Takeshi G.; Uchida, Hiroyuki; Iono, Daisuke; Yun, Min S.; Espada, Daniel; Kawabe, Ryohei
Publication: eprint arXiv:1401.0003
Publication Date: 12/2013
Abstract: http://adsabs.harvard.edu/abs/2014arXiv1401.0003T

Title: The accretion-ejection coupling in the black hole candidate X-ray binary MAXI J1836-194
Publication Date: 04/2014
Abstract: http://adsabs.harvard.edu/abs/2014MNRAS.439.1390R

Title: Hot Core, Outflows, and Magnetic Fields in W43-MM1 (G30.79 FIR 10)
Authors: Sridharan, T. K.; Rao, R.; Qiu, K.; Cortes, P.; Li, H.; Pillai, T.; Patel, N. A.; Zhang, Q.
Publication Date: 03/2014

Title: Herschel-ATLAS: deep HST/WFC3 imaging of strongly lensed submillimeter galaxies
Publication: eprint arXiv:1311.5898
Publication Date: 11/2013
Abstract: http://adsabs.harvard.edu/abs/2013arXiv1311.5898N

Title: The State of the Warm and Cold Gas in the Extreme Starburst at the Core of the Phoenix Galaxy Cluster (SPT-CLJ2344-4243)
Authors: McDonald, Michael; Swinbank, Mark; Edge, Alastair C.; Wilner, David J.; Veilleux, Sylvain; Benson, Bradford A.; Hogan, Michael T.; Marrone, Daniel P.; McNamara, Brian R.; Wei, Lisa H.; Bayliss, Matthew B.; Bautz, Marshall W.
Publication Date: 03/2014
Abstract: http://adsabs.harvard.edu/abs/2014ApJ...784...18M
The Submillimeter Array (SMA) is a pioneering radio-interferometer dedicated to a broad range of astronomical studies including finding protostellar disks and outflows; evolved stars; the Galactic Center and AGN; normal and luminous galaxies; and the solar system. Located on Mauna Kea, Hawaii, the SMA is a collaboration between the Smithsonian Astrophysical Observatory and the Academia Sinica Institute of Astronomy and Astrophysics.