AGN Group

I am 許博智 from NCU, I am in the AGN group of Radio Astronomy Cource in NTNU. For the SMA observation target, we plan to change to NGC 7479 (ICRS coordinate is 23 04 56.64 +12 19 22.35), whcih is a Seyfert 2 galaxy. This target have similar redshift (Z~0.007) with the one (NGC 1386, z~0.003) i previos found. Therefore, integration time of the source will still be 2 hours.

Sub-mm Broad Band Emission Line Observation of NGC 1386 by SMA

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We propose SMA observations with extended array configuration (EXT) towards NGC 1386, which is a Seyfert 2 galaxy found from Maia, Machado & Willmer (2003). We would like to investigate how the carbon monoxide (CO) molecular associate with the center region of the galaxy. The detailed observational setup and analysis plan are explained in the following:

Target sources and ancillary data. NGC 1386 has angular size of 3.4' $\times$ 1.3', however, in this study, we only focus on the most center region of this Seyfert galaxy. NGC 1386 has z = 0.003810 (HIPASS collaboration), which distance is about 16.80 Mpc. With small redshift, meaning that this galaxy is located in the local Universe. Nevertheless, it haven't been observed by SMA 230 GHz before.

Gomez-Guijarro et al. compared the morphologies of nearby active galactic nuclei of their sizes measured by Chandra soft x-ray and narrow line region by Hubble Space telescope [O III]. The set of NGC 1386 from Gomez-Guijarro et al. are shown in figure 1. However, CO molecular gas morphology around the core was still remain unclear.

Spectral setup. By using SMA EXT configuration, it is likely to spatially resolve the galaxy we proposed to observed. We propose to use the spectral set up of $\mathrm{LO}_{\mathrm{R\times A}}$ = 230 GHz and $\mathrm{LO}_{\mathrm{R\times B}}$ = 230 GHz. This spectral setup will cover multiple CO emission lines ranging from 219 GHz, i.e., ^{18}CO(2-1) to 230 GHz, i.e., ^{12}CO(2-1).

Angular resolution. The expected angular scales of the central region is about 6" $\times$ 10", which region is less than 0.8 kpc ($R \lesssim 0.8$ kpc). The angular resolution is about 1.47" at 230 GHz. The maximum angular recoverable angular scale is about 24.81".

Observing time. We found a similar redshift Seyfert galaxy, which is NGC 3227 (z = 0.003763, from Haynes et al.), showing distance of 16.6 Mpc. Gomez-Schinnerer, Eckart & Tacconi measured the ^{12}CO(1-0) and ^{12}CO(2-1) lines of NGC 3227 in 1997 January and February, by using IRAM PdB interferometer (PdBI) with 5 antennas in differnet configurations, providing 30 baselines, which distance ranging from 40 to 408 m. For ^{12}CO(2-1) line measurement, they have angular resolution of 0.7" $\times$ 0.5" at λ=1.3 mm (230 GHz). After cleanning procedure, they reconvolved data with a CLEAN beam of FWHM 0.6" for the ^{12}CO(2-1). The integrated intensity maps (moment-zeroth maps) of the ^{12}CO(1-0) and ^{12}CO(2-1) of NGC 3227 are shown in figure 2.

By owing peak integral intensity (9.18 Jy beam^{-1} km s^{-1}) of ^{12}CO(2-1) from the right panel of figure 2, with beam size of 0.6", we could estimate source intensity of our own. We multiply peak integral intensity with the ratio of our beam area with them, and divided by the bandwidth of their observation, which is 364 km s^{-1}. The estimate intensity of our source is about 147 mJy.

With SMA EXT configuration, we set hour angle of our source stars from -3 hours, and ends at +3 hours, the total on-source time is about 4.02 hr (including observation time, and calibration time).. With bandwidth of 100 km s^{-1}, expected sensitivity is about 10.8 mJy/beam. Detail information of the beam calculation and sensitivity estimation can be seen at figure 3, which is obtain from

Proposed Observation, Experimental Design and Analysis Plan

We, Cheng-Lin Liao, Tzu-Shuan Kuo, and Mei-Ni Chen, propose extended array configuration SMA observations towards NGC253 and M82. They are the starburst galaxies in local Universe, which are helpful for understanding the small structures of gas in galaxies. The detailed observational setup and analyses plan are explained in the following:

Target sources and ancillary data. NGC253 and M82 are the galaxies with angular size of $27' \times 6'$ and $11' \times 4'$, and they are about 3.5 Mpc away from us. We select these two galaxies as our targets because they are very bright and close to us; therefore, they can be spatial resolved by SMA observation. A 7.5 hours observation of NGC253 was carried out by SMA compact configuration, and the ^{12}CO(2-1) channel maps are demonstrated in Sakamoto et al. (2006), as shown in Figure 1. They significantly detected ^{12}CO(2-1), ^{13}CO(2-1),^{18}CO(2-1), and 1.3 mm continuum. The ^{12}CO(2-1) and ^{12}CO(3-2) of M82 were observed by SMA with resolution at about 3" in Chisholm & Matsushita (2016). They have detailed discussions about the physics in different regions (the disk, the starburst-driven bubble, and the base of a molecular streamer) of M82.

Spectral setup. We will use the setup that $\mathrm{LO}_{R\times A}$ =230 GHz and $\mathrm{LO}_{R\times B}$ =230 GHz. This observation will cover multiple CO emission lines, such as ^{12}CO(2-1) [230.53 GHz], ^{13}CO(2-1) [220.40 GHz], and ^{18}CO(2-1) [219.56 GHz], which are good tracers of molecular hydrogen.

Angular resolution The expected angular scales are about 50" $\times$ 40" for the central region ($R \lesssim$ 0.4 kpc) of NGC253 and 10" $\times$ 20" for the central region ($R \lesssim$ 0.3 kpc) of M82. The angular resolutions is about 1.3" at 230 GHz, while the maximum recoverable angular scale is about 8".

Observing time. Based on previous ^{12}CO(2-1) observation by SMA compact configuration, the expected ^{12}CO(2-1) peak intensity in the central region of NGC253 observed by SMA extended configuration is about 1.2 Jy/beam (or 16.8 K), as discussed in Figure 1. To achieve a 10 σ measurement of the ^{12}CO(2-1) peak at 1 km/s resolution, it will take about 2 hours to observe the target and obtain the noise intensity level at about 0.12 Jy/beam (or 1.72 K). Therefore, we request to observe NGC253 staring from HA= -1.5 to HA= 1.5, including the on-source time and the instrument calibration time. The prediction about the observation from SMA Beam Calculator / Sensitivity Estimator is in Figure 3.

The zeroth-moment map, which is the integrated intensity map, of ^{12}CO(2-1) in the central region of M82 is presented in Chisholm & Matsushita (2016), as shown in Figure 2, where the peak ^{12}CO(2-1) integrated intensity is about 2250 K km/s. We divide the peak integrated intensity by the bandwidth they integrated, 330 km/s, and obtain the average intensity as 6.8 K, which served as the lower limit of the expected peak intensity. To achieve at least a 4.5 σ measurement of the ^{12}CO(2-1) peak at 1 km/s resolution, it will need about 3-hour on-source time to obtain the noise intensity level at about 1.54 K. Therefore, we request to observe M82 staring from HA= -5.5 to HA= -1.5, including the on-source time and the instrument calibration time. The prediction about the observation from SMA Beam Calculator / Sensitivity Estimator is in Figure 4.

We summarize some information related to the observation of our targets in Table below, where frequency dependent quantities are estimated at 230 GHz and the sensitivity is at 1 km/s. Figure 5 demonstrates the altitude of the targets and the moon during the night on 11, Nov, 2022 at Mauna Kea Observatory.

Targets	RA & Dec	Intensity	Sensitivity	S/N	HA	Beam	Max Scale
NGC253	$00^h47^m33.2^s$ $-25°17'17.1"$	16.8 K	1.72 K	10	$-1.5 \sim +1.5$	1.44"×1.19"	10.24"×8.46"
M82	$09^h55^m51.9^s$ $+69°40'47.1"$	6.8 K	1.54 K	4.5	$-5.5 \sim -1.5$	1.79"×1.18"	10.12"×6.67"

Reference

[1] Sakamoto et al. 2006, 636, 685 [2] Chisholm & Matsushita 2016, 830, 72

We aim to study star-forming region NGC 2024 FIR5 in the Orion B molecular cloud at a distance of ∼415 pc (Alves et al. 2011). The cloud harbors a binary system SMM1 and SMM2 with masses of ∼1.7 $M_{\odot}$ and 0.7 $M_{\odot}$ and a separation of ∼4" from previous SMA observations at 850 μm (Fig. 1; Chen et al. 2013). We request continuum observation at 1.3 mm in EXT configuration. The existing SMA 850 μm data of NGC 2024 FIR5 with a resolution of 2.2"×1.3" shows a flux level of 42 mJy/beam near the edge of the source. Scaling to the EXT beam size of 1.1"×1.0", the expected flux level at 1.3 mm would be 5.6 mJy/beam for a typical spectral index of -2.5. Based on the sensitivity estimator, one ∼4 hour EXT track will give a rms of 0.39 mJy/beam, enough to provide $> 10\sigma$ detection.

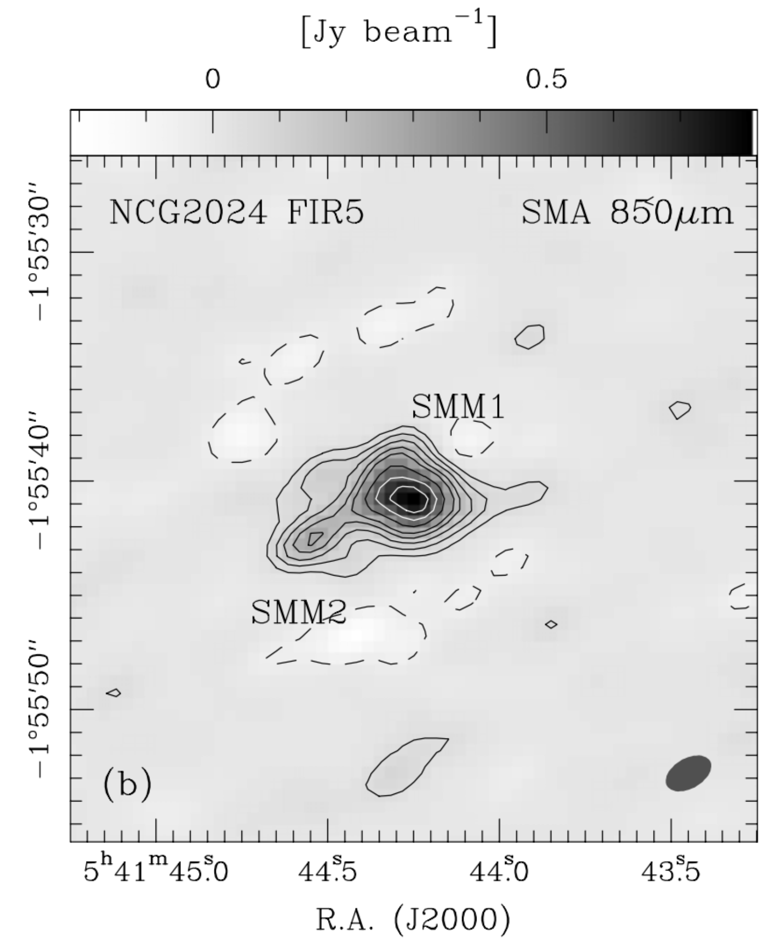

Figure 1. SMA 850 μm dust continuum image of NGC 2024 FIR5 overlapped by contours of -3σ, 3σ, 6σ, 10σ, 15σ, 20σ, 30σ, 40σ, and 50σ with 1σ ∼14 mJy/beam. The figure is extracted from Chen et al. (2013).

Reference
Alves F. O., et al., 2011, ApJ, 726, 63; Chen X., et al., 2013, ApJ, 768, 110

Example: Proposed Observation, experimental Design and analysis plan

We propose extended array configuration SMA observations towards 2MASS J04124068+2438157 (hereafter: J0412). Our main goal is the spectral index analyses to examine whether or not the disks around the low-mass protostars harbor grown dust that may facilitate pebble accretion. The detailed observational setup and analyses plan are explained in the following:

Target sources and ancillary data. The previous ALMA Band-6 observation towards a very low-mass star J0412 shows a (disk) structure. Low-mass stars have a small number of objects whose protoplanetary disks can be observed. We have already submitted a SMA proposal to observe several low-mass stars. This object is suitable for observation in this time because the number of observations is still small.

Spectral setup. track-1 (replicate in case you need more than a track):
Array configuration: any
Required observing time in the target source loop: 60 min
receiver tuning (230/345): 204 GHz, LSB, s1
receiver tuning (240/400): 233 GHz, LSB, s1
target source (name, R.A., Decl., vlsr in km/s unit): J0412, 04:12:40.716, +24:38:15.327,0
If this is polarization track: No

Angular resolution The target diameter is 1.5 arcsec. The purpose of the observation is to measure the flux density accurately for SED study. So we do not need to resolve the target.

Observing time. In the previous ALMA observation, the total flux is about 7 mJy. The target has 1.5 arcsec diameter. Therefore, the target can be observed with two beams of SMA. The expected flux density is 3.5 mJy/beam. For the SED study, we need to accurately measure the total flux of the target, so we request observing time to achieve 5-σ SNR for the tuning. Therefore, we request one-hour of on-source time to achieve 0.7 mJy/beam.

Reference