East-Asia ALMA Science Workshop 2017 in Korea

November 27-29, 2017
Korea Astronomy and Space Science Institute
Daejeon, Korea
http://alma.kasi.re.kr/almakasi2017

Invited Review Speakers
Mario Tafalla (IGN)
Tomoya Hirota (NAOJ)
Masato Tsuboi (JAXA/ISAS)
Kelsey Johnson (Virginia)
Ken-ichi Tadaki (NAOJ)
Sujin Kim (KASI)

Invited Speakers
Nissim Kanekar (NCRA)
Akimasa Kataoka (NAOJ)
Chin-Fei Lee (ASIAA)
Seokho Lee (Kyunghee Univ.)
Fabien Louvet (CEA)
Jennifer Donovan Meyer (NRAO)
Kyoko Onishi (Ehime Univ.)
Kenneth Wong (NAOJ)

Monday, November 27

08:30 - 09:30 *Registration*

Plenary Session 1 (Review & invited talks / Poster session)

	- Chair: Jongsoo Kim
09:30 - 09:40	• Opening
09:40 - 10:20	• Low-mass star formation: current status and future progress with ALMA (Mario Tafalla, review talk)
10:20 - 11:00	• ALMA view of high-redshift galaxies (Ken-ichi Tadaki, review talk)
11:00 - 11:30	♦ Break
	- Chair: Seheon Oh
11:30 - 12:00	• EA-ARC Activities and Exepected New Functions/Cpabilities in Cycle 6 (Hiroshi Nagai, invited talk)
12:00 - 12:30	• Poster flash talks / Photo
12:30 - 14:00	♦ Lunch

	Galactic Parallel Session 1		Extragalactic Parallel Session 1
	- Chair: Jungyeon Cho		*- Chair: Ken-ichi Tadaki*
14:00 - 14:30	• ALMA polarization of HL Tau - investigating planet formation (Akimasa Kataoka, invited talk)	14:00 - 14:30	• Strong Gravitational Lensing Observations with ALMA (Kenneth Wong, invited talk)
14:30 - 14:50	• Spinning dust emission from disks around T-Tauri and Herbig Ae/Be stars (Thiem Hoang)	14:30 - 14:50	• Kinematics in a z=7.15 Lyman Alpha Emitter Revealed by the [OIII] 88 micron and [CII] 158 micron Lines Detected with ALMA (Takuya Hashimoto)
14:50 - 15:10	• The Synthetic ALMA Multi-band Analysis of Dust Properties of the TW Hya Protoplanetary Disk (Seongjoong Kim)	14:50 - 15:10	• An ALMA CO J=4-3 Observation for LAB18 in the SSA22 protocluster at z=3.1 (Yuta Kato)
15:10 - 15:30	• Young protostellar discs and their role in planet formation and evolution (Dimitris Stamatellos)	15:10 - 15:30	• On the disappearance of a cold molecular torus around the low-luminosity active galactic nucleus of NGC 1097 (Takuma Izumi)
15:30 - 16:00	♦ Break	15:30 - 16:00	♦ Break
	- Chair: Chin-Fei Lee		*- Chair: Kelsey Johnson*
16:00 - 16:30	• Formation of Protostellar Binary system (Seokho Lee, invited talk)	16:00 - 16:30	• Cold Gas at High Redshift (Nissim Kanekar, invited talk)
16:30 - 16:50	• ALMA Cycle 2 Observations of the Class I Protostar L1489 IRS: Misaligned Disk Stracture (Jinshi Sai)	16:30 - 16:50	• Gas kinematics of star forming galaxies during early cluster formation epoch (Minju Lee)
16:50 - 17:10	• Evolutional phases of three Class 0 protostars in Serpens Main (Yusuke Aso)	16:50 - 17:10	• ALMA observation of 12/13CO(3-2) molecular gas in merging ULIRGs (Misaki Ando)
17:10 - 17:30	• Spatially resolved study of the CO selective dissociation in the Oph-A region (Mitsuyoshi Yamagishi)	17:10 - 17:30	• Molecular gas properties of HI monsters probed by the ALMA(Aeree Chung)
17:30 - 18:00	♦ Move to banquet	17:30 - 18:00	♦ Move to banquet
18:00 -	♦ Banquet	18:00 -	♦ Banquet

Poster Session

Name	Title
Tianwen Cao	• ALMA imaging of the CO(6-5) line emission in NGC 5135
Taehyun Jung	• Multi-Frequency AGN Survey with KVN (MASK): Common Sources with ALMA Calibrators
Yongjung Kim	• Quasar Feedback in the Early Universe: Lowest Eddington Ratio Quasar at z~6
Jung-Won Lee	• ASTE/ALMA band7+8 Receiver Project
Yuichi Matsuda	• ALMA rest-frame 210-micron dust continuum observations of Ly-alpha blobs at z=3.1
Suzanna Randall	• The enigmatic AGB star GX Mon
Wei-Hao Wang	• The SCUBA-2 Ultra Deep Imaging EAO Survey (STUDIES)
Suwicha Wannawichian	• Radio emission from Jupiter as an indicator of auroral magnetic footprint morphology
Kijeong Yim	• Star Formation in Vertically Resolved Edge-on Galaxies

Tuesday, November 28

Plenary Session 2 (Review & invited talks / Poster session)

	- Chair: Ken Tatematsu
09:30 - 10:10	• Microscopic World of the Galactic Center Opened by ALMA (Masato Tsuboi, review talk)
10:10 - 10:50	• The ALMA View of Nearby Galaxies (Kelsey Johnson, review talk)
10:50 - 11:10	• Report form the ALMA Science Advisory Committee (Jongsoo Kim, invited talk)
11:10 - 12:30	♦ Poster session / KASI tour
12:30 - 14:00	♦ Lunch

	Galactic Parallel Session 2		Extragalactic Parallel Session 2
	- Chair: Hyosun Kim		*- Chair: Aeree Chung*
14:00 - 14:30	• Hungry baby star eating a space hamburger and spitting spinning bullets (Chin-Fei Lee, invited talk)	14:00 - 14:30	• High-resolution Observations of Molecular Gas Kinematics in Nearby Galaxies (Kyoko Onish, invited talk)
14:30 - 14:50	• Magnetic fields of Class 0 YSOs (Woojin Kwon)	14:30 - 14:50	• Galactic scale molecular outflows in NGC 3628 (Anli Tsai)
14:50 - 15:10	• Probing the earliest stage of protostellar evolution from "pre-Class 0" to "Class 0" (Naomi Hirano)	14:50 - 15:10	• Revealing the origin of extraplanar molecular clouds in a ram pressure stripped galaxy through the ALMA (Bumhyun Lee)
15:10 - 15:30	• The molecular tracers of the spiral shell of the AGB star LL Pegasi (Alfonso Trejo)	15:10 - 15:40	• Star Formation in HI Dominated Environments (Jennifer Donovan Meyer, invited talk)
15:30 - 15:50	• Resolving Surface Activities and Magnetic Fields of Evolved Stars (Daniel Tafoya)	15:40 - 16:00	• Molecular torus in the radio galaxy NGC 1052 (Seiji Kameno)
15:50 - 16:00	♦ Break	16:00 - 16:20	• The lensed galaxy SDP.9 resolved to < 100 pc at z~1.6 (Ishida Tsuyoshi)
16:00 -	♦ Discussion (Ken Tatematsu, Tie Liu, Chin-Fei Lee, and Woojin Kwon)	16:20 - 16:30	♦ Break
		16:30 -	♦ Discussion (Wei-Hao Wang)

Wednesday, November 29

Plenary Session 3 (Review, invited & contributed talks)

	- Chair: Hirano Naomi
09:30 - 10:10	• Solar astrophysics with ALMA (Sujin Kim, review talk)
10:10 - 10:50	• Recent progress in high-mass star-formation studies with ALMA (Tomoya Hirota, review talk)
10:50 - 11:10	♦ Break
	- Chair: Kee-Tae Kim
11:10 - 11:30	• KVN-ALMA Collaboration for Polarimetry Commissioning (Seiji Kameno)
11:30 - 11:50	• Methanol maser polarisation of massive star forming region; G10.34-0.14, with ALMA (Ji-hyun Kang)
11:50 - 12:10	• The magnetic field strength and energy balance of OMC 1 (Kate Pattle)
12:10 - 12:30	• Dynamics of jets/outflows from high-mass young stellar objects revealed by combination of ALMA and KaVA observations (Jungha Kim)
12:30 - 14:00	♦ Lunch
	- Chair: Chang Won Lee
14:00 - 14:30	• Origin of the Stellar IMF in the W43-MM1 Mini-Starbust Ridge (Fabien Louvet, invited talk)
14:30 - 14:50	• ALMA ACA 7m observations toward two Orion cores very close to the onset of star formation (Ken Tatematsu)
14:50 - 15:10	• ALMA reveals sequential high-mass star formation in the G9.62+0.19 complex (Tie Liu)
15:10 - 15:30	• The physical properties of massive young stellar objects (Fernando Olguin Choupay)
15:30 - 16:00	♦ Break
16:00 - 17:00	♦ Discussion presentations
17:00 - 17:30	♦ Summary talks (Daisuke Iono & Tetsuo Hasegawa)
17:30 -	♦ Closing

Abstract (Oral presentations)

Monday, November 27

Plenary Session 1

Low-mass star formation: current status and future progress with ALMA (Review talk)

-Mario Tafalla (Observatorio Astronomico Nacional, IGN)

Low-mass star-formation studies tend to focus on the birth of individual solar-type stars occurring in nearby molecular clouds. While this isolated mode of star formation may not represent the most common manner of stellar birth, its study often provides first evidence for the more general ingredients of star formation, such as gravitational infall, disk formation, or outflow acceleration. In this talk I will attempt to review the current status and main challenges in our understanding of low-mass star formation, and to show how ALMA is playing a decisive role in its current progress.

ALMA view of high-redshift galaxies (Review talk)

-Ken-ichi Tadaki (NAOJ)

ALMA allows us to study the spatially resolved properties of distant galaxies in millimeter-submillimeter wavelength. I focus on reviewing ALMA results with high-resolution observations of high-redshift galaxies.

EA-ARC Activities and Exepected New Functions/Cpabilities in Cycle 6 (Invited talk)

-Hiroshi Nagai (NAOJ)

I will review EA-ARC activities which is deemed to be useful for users and expected new functions and capabilities of ALMA observations and operations in Cycle 6.

Galactic Parallel Session 1

ALMA polarization of HL Tau - investigating planet formation (Invited talk)

-Akimasa Kataoka (NAOJ)

Constraining the grain size in protoplanetary disks is a key to understanding the first stage of planet formation. The grain size has been estimated by measuring the spectral index at millimeter wavelengths, while it has huge uncertainties. We have proposed that millimeter-wave polarization is another method to constrain the grain size. We show that thermal dust emission is scattered off of other dust grains and the residual polarization is up to 2.5 %, which is detectable with ALMA. This self-scattering polarization is efficient only if the maximum grain size is comparable to the wavelengths. Therefore, we can constrain the grain size from millimeter-wave polarization of protoplanetary disks. Then, we have observed the protoplanetary disk around HL Tau with ALMA polarization mode at 3.1 mm, and found that the disk shows the azimuthal polarization vectors. The vectors are completely different from those at 1.3 mm, which are previously obtained with CARMA. We interpret that the 3.1 mm polarization is dominated by the grain alignment with radiation fields, and 1.3 mm by the self-scattering. By modeling the wavelength dependence, the grain size is constrained to be 70 micron.

Spinning dust emission from disks around T-Tauri and Herbig Ae/Be stars

-Thiem Hoang (KASI/UST)

Future ALMA band 1 and SKA are valuable tools to observe anomalous microwave emission (AME) from spinning nanoparticles. In this talk, I will present microwave emission by spinning polycyclic aromatic hydrocarbons (PAHs) from 60 circumstellar disks (PPD) around Herbig Ae/Be stars and T Tauri stars. The size distribution and total mass of PAHs are constrained by mid-IR PAH emission. We account for the realistic rotational dynamics of PAHs by including the dominant interaction processes, such as ion collisions and IR emission. We will discuss some specific PPDs for which AME may be detected by ALMA band 1.

The Synthetic ALMA Multi-band Analysis of Dust Properties of the TW Hya Protoplanetary Disk

-Seongjoong Kim (Tokyo Institute of Technology)

TW Hya is one of the well studied protoplanetary disks (PPDs) with its proximity. Recently, high spatial resolution ALMA observations have revealed clear gap structures and the radial profiles of dust properties of the disk (e.g., Andrews et al. 2016, Tsukagoshi et al. 2016). Multi-band observations of dust continuum emission is useful to constrain the radial profiles of dust temperature and dust opacity which help us to understand physical and chemical properties, such as dust evolution as well as locations of snowlines, in the disk. In this work, we have performed the sensitivity analysis of the synthetic ALMA observations to find the best set of ALMA multi-band observation for constraining dust properties of TW Hya PPD. First, we derived radial profiles of dust temperature Td, optical depth τ_ν, and opacity power-law index β with the assumption of $\kappa_\nu \propto \nu^\beta$using the existing ALMA Band 4, 6 and 7 high spatial resolution data. However, this data set was too sensitive to the errors in observed intensity so that only 10% errors make it difficult to make constraint on Td, τ_ν and β. Thus, we have performed synthetic ALMA multi-band observation. Our result suggests the best set is ALMA Band [10,7,3]. Taking account the effect of Blackbody (BB) curve shape, we also can make good constraint on dust properties by choosing one band which are close to the peak of BB curve and having enough frequency intervals between the bands.

Young protostellar discs and their role in planet formation and evolution

-Dimitris Stamatellos (University of Central Lancashire, UK)

ALMA observations of gaps in young protostellar discs (e.g. HL Tau) have raised the exciting possibility that planets and planetary systems may form much faster than it has been previously thought. Therefore, their formation may be sensitive to the early properties of discs while they are still forming in collapsing molecular clouds. I will present radiative hydrodynamic simulations of self-gravitating discs forming in collapsing molecular clouds and discuss their properties. I will also discuss how Jupiter-mass planets evolve in such discs and whether young, accreting, giant planets may be observed by ALMA.

Formation of Protostellar Binary system (Invited talk)

-Seokho Lee (Kyung Hee University)

Most stars formed in multiple systems, the formation mechanism of multiple systems is, however, not well understood. Turbulent fragmentation and disk fragmentation are main theoretical formation mechanisms of the binary and multiple systems. It is crucial to observe protostellar binary systems in the early stage showing observational evidences such as separations and alignments of rotation axes to prove how they formed. A high angular resolution observation in the long-wavelength, especially ALMA, provides a chance to study the binary formation in the early stage. In this talk, I will present ALMA observation of protostellar binary systems. ALMA observations of specific targets support each formation mechanism.

ALMA Cycle 2 Observations of the Class I Protostar L1489 IRS: Misaligned Disk Stracture

-Jinshi Sai (University of Tokyo/NAOJ)

We observed the Class I protostar L1489 IRS (d = 140 pc) with ALMA during its Cycle 2 at high spatial resolutions of 0.3'' in Band 6 (230 GHz). Previous observations suggested that L1489 IRS has a Keplerian disk and two infall flows (Yen et al. 2014). Our new observations in C18O J=2-1 emission allowed us to confirm that the Keplerian disk extended to ~700 au in radius. We also found a gap structure at r~200 au, suggesting that the disk consists of an inner disk and an outer disk. To investigate kinematic structures of the disks in detail, we compared the observational results with a simple kinematic model of a Keplerian disk, revealing that the outer disk is misaligned from the inner disk by ~15 deg. Our calculation suggests that this misaligned-disk structure can be formed by non-steady accretion from the envelope around L1489 IRS with a different rotational axis.

Evolutional phases of three Class 0 protostars in Serpens Main

-Yusuke Aso (ASIAA)

We observed three protostars, SMM11a, SMM4a1, and SMM4a2, in the Serpens Main cluster forming region in 1.3 mm continuum, 12CO J=2-1 line, and C18O J=2-1 line using ALMA during its Cycle 3. These three protostars are deeply embedded, and not detected as a point source even in 70 um by the Herschel space observatory. Their bolometric temperatures indicate that all of them are in the Class 0 stage. However, our ALMA data clearly show that these three protostars have different physical and chemical properties. The continuum visibilities suggest that the disk with a size of ~400 AU has already formed in SMM4a1. On the other hand, SMM4a2 contains an embedded point source surrounded by a spherical envelope, and SMM11a is surrounded by a spherical envelope without embedded point source. The 12CO emission traces collimated outflows in SMM11a and SMM4a2, while it shows a fan-shaped outflow in SMM4a1. The C18O emission in SMM11a suggests C18O depletion by a factor of 1000 and thus that the temperature of this source is still low enough for CO molecules to be frozen-out. These results suggest that SMM11a is the youngest followed by SMM4a2 and SMM4a1 in this order.

Our results have also revealed that continuum and molecular lines in mm wavelength are useful in proving the evolutionary stage of deeply embedded protostars.

Extragalactic Parallel Session 1

Strong Gravitational Lensing Observations with ALMA (Invited talk)

-Kenneth Wong (NAOJ)

Strong gravitational lensing is a unique probe of galaxy evolution and cosmology. The lensing effect is sensitive to the total mass distribution of the lens, including both baryonic and dark matter. Furthermore, lensing magnifies the background source, allowing for high-spatial resolution studies of distant galaxies. The high sensitivity of ALMA's long baseline configuration combines the resolving power of the best ground-based submillimeter telescope with the natural cosmic telescope of gravitational lenses, allowing for galaxy studies that previously were not possible. I discuss several recent applications of ALMA observations of strong lenses, including constraints on the central supermassive black hole of lens galaxies, high-resolution studies of the star-forming properties of z~2 submillimeter galaxies, and searches for dark matter substructure.

Kinematics in a z=7.15 Lyman Alpha Emitter Revealed by the [OIII] 88 micron and [CII] 158 micron Lines Detected with ALMA

-Takuya Hashimoto (Osaka-Sangyo University, NAOJ)

We present a kinematics result of a LyA emitter at z=7.15 revealed by our ALMA observations (PI. A. K. Inoue). Our target, B14-65666, has been spectroscopically identified in LyA and has a small rest-frame equivalent width of LyA (Furusawa et al. 2016). With our ALMA Band 6 observations, we have clearly detected the [CII] 158 micron (S/N~11) and dust continuum emission (S/N~5). Furthermore, with our ALMA Band 8 observations, we have clearly detected the [OIII] 88 micron line (S/N~8), locating our target as the highest-z object with multiple detections of rest-frame far-infrared emission lines. With these spectral lines, we discuss two kinematics results. Firstly, with the LyA spectral line, we derive the LyA velocity offset with respect to the systemic redshift defined by the [CII] and [OIII] lines, Dv. The Dv value is measured to be very large, 677+/-85 km/s. We discuss an implication of this result for reionization studies. Secondly, we show that the [CII] and [OIII] lines reveal a velocity structure: the emission peak shifts from East to West about 0".5 and the velocity peak shifts about 200+/-30 km/s. We discuss a presence of merger, outflow/inflow, and or rotation in this object.

An ALMA CO J=4-3 Observation for LAB18 in the SSA22 protocluster at z=3.1

-Yuta Kato (NAOJ)

Ly-alpha Blobs (LABs) are extended Ly-alpha emitting nebulae, primarily found in over-dense regions at z~1-3, and considered to be a key objects that provide the clues on how massive galaxies are formed. The LAB18 is the unusual object among LABs in SSA22 protocluster by its highly asymmetric and filamentary structure with huge size (~100x30 kpc), and it’s morphology closely resembles to the simulated putative cold accretion flow that feeds the forming massive galaxies.

ALMA cycle 2 observation revealed LAB18 contains four ALMA galaxies with SFR>50 M/yr (LAB18.a,b,c,d), but it is not clear whether these galaxies are really associated with LAB18 due to the lack of spectroscopic observation. In ALMA cycle 4 observation, we conducted CO J=4-3 observation for LAB18. CO J=4-3 can be used to determine the precise redshift and search for cosmic streams and

recycled gas feeding into massive galaxies at z>2, which could give a hint to galaxy formation and evolution.

We detected CO J=4-3 line from LAB18.b with >10σ level. The derived systematic redshift is z(CO)=3.09368 ± 0.0002, which is consistent with the protocluster redshift. The far-infrared and CO J=4-3 luminosity suggests LAB18.b is class of ULIRGs. The stellar mass calculated from rest-frame UV to NIR SED (logM*~10.68) and CO derived gas mass (logMgas~9.76/conversion factor=0.8) imply LAB18.b has very low gas mass and gas fraction (fgas~10%). This value is lower than the z=2-3 field and protocluster previous samples, suggesting that this LAB18 environment may waste their molecular gas, in opposite to its filamentary structure.

On the disappearance of a cold molecular torus around the low-luminosity active galactic nucleus of NGC 1097

-Takuma Izumi (NAOJ)

We used the Atacama Large Millimeter/submillimeter Array (ALMA) to map the CO(3-2) and the underlying continuum emissions around the type 1 low-luminosity active galactic nucleus (LLAGN; bolometric luminosity < 1e42 erg/s) of NGC 1097 at ~10 pc resolution. These observations revealed a detailed cold gas distribution within a ~100 pc of this LLAGN. In contrast to the luminous Seyfert galaxy NGC 1068, where a ~7 pc cold molecular torus was recently revealed, a distinctively dense and compact torus is missing in our CO(3-2) integrated intensity map of NGC 1097. Based on the CO(3-2) flux, the gas mass of the torus of NGC 1097 would be a factor of >2-3 less than that found for NGC 1068 by using the same CO-to-H2 conversion factor, which implies less active nuclear star formation and/or inflows in NGC 1097. Our dynamical modeling of the CO(3-2) velocity field implies that the cold molecular gas is concentrated in a thin layer as compared to the hot gas traced by the 2.12 Î¼m H2 emission in and around the torus. Furthermore, we suggest that NGC 1097 hosts a geometrically thinner torus than NGC 1068. Although the physical origin of the torus thickness remains unclear, our observations support a theoretical prediction that geometrically thick tori with high opacity will become deficient as AGNs evolve from luminous Seyferts to LLAGNs.

Cold Gas at High Redshift (Invited talk)

-Nissim Kanekar (National Centre for Radio Astrophysics, India)

The gas mass and star formation rate of damped Lyman-alpha absorbers (DLAs), a population of high-redshift absorption-selected galaxies, have been open questions in the field of galaxy evolution for more than three decades. This talk will describe recent results from ALMA searches for CO and CII-158 micron emission from a sample of DLAs over a wide range of redshifts, z~0.5-4.2. These are the first CO and CII-158 micron detections in DLA host galaxies, opening a window on physical conditions in absorption-selected galaxies, and yielding an exciting new tool to identify DLA hosts at high redshifts.

Gas kinematics of star forming galaxies during early cluster formation epoch

-Minju Lee (The University of Tokyo)

The overdense region of high redshift universe is a unique place to trace the early build-up of massive red-and-dead galaxies. The gas kinematics provides a vital information in understanding the structural formation and galaxy evolution. We present our ALMA cycle 3 CO (4-3) observations at a resolution of 0”.3 (~2.5 kpc at z=2.49) targeting star forming galaxies selected as H-alpha emission that are associated to a high-z (z=2.49) protocluster. The ALMA detection in CO (4-3) reveals a variety of kinetic properties including an ordinary disk, which allows us to model its kinematic parameter, and a disturbed velocity gradient that is perhaps associated with mergers. All of these are occurred at a stellar

masses of above 4e10 Msun. The AO images of Kp-band in Subaru give additional information of the stellar structure of these galaxies at similar or better resolution. We discuss on these findings to provide a picture the galaxy formation and evolution during cluster forming epoch. I finally present future prospects on protocluster studies regarding the synergies of multi-band observations in understanding galaxy evolution in high-z.

ALMA observation of 12/13CO(3-2) molecular gas in merging ULIRGs

-Misaki Ando (SOKENDAI/NAOJ)

Galaxy merger plays an important role in the evolutionary process of galaxies, as it changes the physical and chemical condition of the ISM, and intensifies the starburst activity as seen in the frequent occurrence of mergers in Ultra/Luminous Infrared Galaxies (U/LIRGs). Observations of multiple molecular gas will allow us to investigate the physical condition of the ISM and star formation properties triggered during mergers. Here we present the results of 12CO(3-2) and 13CO(3-2) observations obtained toward six merging U/LIRGs with ALMA. We compare the distribution of 12CO/13CO(3-2) line intensity ratio at ~ 250 pc resolution, and discuss the variation of physical/chemical conditions as a function of merger stage and starburst/AGN activity.

Molecular gas properties of HI monsters probed by the ALMA

-Aeree Chung (Yonsei University)

The cold gas reservoir surrounding present day massive galaxies like MW is generally insufficient to explain their current star formation rate or their baryonic mass assembly history. Therefore, additional mass accretion mechanism such as a cold flow is necessary in order to account for the observed properties. This problem becomes more severe in the earlier epochs (z~1 to 3), when the average star formation rate and gas mass fraction for such galaxies are thought to be much higher. We have identified a sample of local analogs with a large cold gas reservoir, dubbed HI monsters, to investigate the path(s) and efficiency of the conversion of the neutral atomic gas into molecular form, which is expected to ultimately fuel their present star formation activities. These objects also represent special laboratories for investigating process of building a massive cold gas reservoir from its environment. In this talk, we present the ALMA 12CO (1-0) data of 10 HI monsters, and discuss their cold gas morphology and kinematics to probe the potential origin of these extremely gas-rich galaxies.

Tuesday, November 28

Plenary Session 2

Microscopic World of the Galactic Center Opened by ALMA (Review talk)

-Masato Tsuboi (Institute of Space and Astronautical Science, JAXA)

The Galactic Center is the nuclear region of the nearest spiral galaxy, Milky Way, and harbors the Galactic Center black hole, Sagittarius A*. Its environment is unique in the galaxy, in which the region contains several peculiar objects. However, their true characters have been concealed although they might play important roles in the region. ALMA has over ten times high sensitivity and over ten times high angular resolution compared with existing millimeter telescopes. Now, ALMA is making the microscopic views of these objects clear. The overview of the early ALMA observations of the Galactic Center will be presented in this paper.

The ALMA View of Nearby Galaxies (Review talk)

-Kelsey Johnson (University of Virginia)

Now that ALMA is reaching its full power, we are able to carry out studies of nearby galaxies with a level of detail previously only possible in the Milky Way. In this presentation I will overview results from ALMA from roughly the past year that are giving us new insight into galaxies in the local (z<1) universe. The results include studies of the behavior of molecular gas at low metallicity, the physical conditions of the ISM, star-formation rates and “laws”, and the environment of central AGN. Although ALMA has made tremendous advances in these areas, I will also argue that we, as a community, can take better advantage of these new capabilities to address major outstanding questions in astrophysics.

Report form the ALMA Science Advisory Committee (Invited talk)

-Jongsoo Kim (KASI)

The ALMA Science Advisory Committee (ASAC) is given by the ALMA Board six charges: issues related to scientific capabilities, system performance, science output, scientific impact, user community, and development program. In additional to them, the ASAC is also given by ad-hoc charges. The main function of the ASAC is identify recommendations/concerns related the charges and report them to the ALMA Board. The ASAC has two face-to-face meetings per year and irregular teleconferences. The ASCA members are composed of 12 people: 4 from North America, 4 from Europe, 3 from East Asia and 1 from Chile. Some of important recommendations/concenrs for the user community made by the ACSA during the last face-to-face meeting are as follows:

- 2-year cycle of the configuration schedule
- stand-alone high frequency and polarization capabilities for ACA be offered in Cycle 6
- the faster spectral scan mode and circular polarization capabilities will not be offered in Cycle 6
- the page limit on the scientific justification to a total of 3 pages
- adding a checkbox for the PI in the OT to confirm that no duplications exist
- tracking the requests for extensions of the data proprietary period

One of important charges of the ASAC is for the (E)ASAC members to hear the voices from the user community and convey them to the ALMA board. I hope that there will be many conversations between (E)ASAC members and users of ALMA during the EA ALMA science workshop.

Galactic Parallel Session 2

Spatially resolved study of the CO selective dissociation in the Oph-A region

-Mitsuyoshi Yamagishi (ISAS/JAXA)

Deep understandings of interactions between UV and the ISM in PDRs are essential to study molecular evolutions in the Universe. A characteristic result probed by radio observations in PDRs is selective dissociation of CO; UV selectively dissociates rare CO isotopologues more effectively than major CO isotopologues because of the difference in the self shielding. Until now, however, layer structures of CO isotopologues have not been detected because very high angular resolution is required for such observations, although large-scale (~0.1 pc) variations of CO isotopic ratios have been examined in Orion and L1551. In ALMA cycle2, we observed the Oph-A region, the closest PDR (d=120 pc). As a result of the observations of 12CO (2-1), 13CO (2-1), and C18O (2-1) with resolution of 1.5" = 0.001 pc, we find that the molecular clouds traced by 12CO, 13CO, and C18O are clearly shifted from the HII shell, and that the each spatial separation is ~10” (0.007 pc). Furthermore, the 13CO/C18O ratios are enhanced to ~20 near the HII shell, while they are ~10 inside the molecular cloud. Hence these results for the first time observationally confirm the layer structures of CO isotopologues dissociated by UV.

Hungry baby star eating a space hamburger and spitting spinning bullets (Invited talk)

-Chin-Fei Lee (ASIAA)

With unprecedented angular resolution of 0.02" of ALMA, we have resolved the disk and jet system in the young protostellar system HH 212. The disk is resolved for the first time in the vertical direction, showing a dark lane sandwiched between two bright features, appearing as a hamburger. The disk is flared as expected for an accretion disk. A highly collimated jet is also detected ejecting from the disk, consisting of a train of fast-moving bullets. It is resolved, showing a rotation across the jet axis. Thus, our ALMA observations show a hungry baby star is spitting a chain of spinning bullets when eating a space hamburger. I will discuss the formation mechanism of this disk and jet system.

Magnetic fields of Class0 YSOs

-Woojin Kwon (KASI)

Stars are formed in cold and dense molecular clouds by gravitational collapse. This big picture has well been drawn in the last few decades. However, many details are little known. One of long-standing, fundamental questions in star formation is what the roles of magnetic fields are. Since several years ago theoretical and observational studies have suggested that magnetic fields also significantly affect formation of circumstellar disks at the earliest stages of young stellar objects. The effects of magnetic fields on early disk formation will be discussed with my recent ALMA observations toward the youngest protostellar systems, which show the magnetic fields in small scales.

Probing the earliest stage of protostellar evolution — from "pre-Class 0" to "Class 0"

-Naomi Hirano (ASIAA)

Two extremely young protostars, B1-bN and B1-bS, and a Class 0 protostar, B1-c have been observed with the Atacama Large Millimeter/submillimeter Array at an angular resolution of ~0.2". The high resolution data successfully revealed spatially compact C17O emission localized to B1-bN and B1-bS, toward which C-containing molecules are depleted in the gas phase. The radii of the C17O emitting regions, which correspond to the CO evaporation radii, around B1-bN and B1-bS are ~0.15" (58 AU)

and ~0.5" (115 AU), respectively. On the other hand, the C17O is spatially extended more than 1" in the Class 0 protostar, B1-c. These results confirmed that both B1-bN and B1-bS are in the earlier evolutionary stage than Class 0. Toward the continuum peaks of B1-bS and B1-c, the methanol emission lines in the vt=0 and vt=1 states, including the one having the upper energy above 500 K, are detected. The methanol emission originates from the central r < 30--40 AU region in both sources. No methanol emission has been detected toward the continuum source of B1-bN. The C17O and methanol results imply that B1-bS is in the evolutionary stage between B1-bN and B1-c, and is likely to be the earliest phase of hot corino.

The molecular tracers of the spiral shell of the AGB star LL Pegasi

-Alfonso Trejo (ASIAA)

AGB stars are the progenitors of PPN/PN, which respectively exhibits spherically and polar-axis symmetric features, it is crucial to understand the shaping mechanisms that already take place during the late AGB phase. Recent ALMA CO observations were used to map the entire gas envelope of the AGB star LL Peg, and revealed the intricate details of its spiral shape. Kim et al. (2017) modeled the molecular CO, 13CO and HC3N line emission and demonstrated that such spiral is produced by the interaction of a binary system in an eccentric orbit. In this work, we further investigate the observed signatures of refractory tracers such as SiS, SiO and SiC2 imaged in the same set of ALMA observations. We present the results of our imaging model-observations comparison, such as kinematic and spatial morphology, line profiles, and derived physical parameters. We additionally compare the implications of the chemistry processes with previous literature
results.

Resolving Surface Activities and Magnetic Fields of Evolved Stars

-Daniel Tafoya (NAOJ)

It is now possible to image the immediate circumstellar environment of evolved stars in order to investigate the mass loss processes that drive interstellar enrichment, and that are responsible for significant dust injection into the interstellar medium. ALMA long baseline observations can now be used to image the stellar surface of evolved stars and probe the role of for example convection and non-radial pulsations in the mass loss. At the same time polarization observations can reveal the magnetic field structure (and strength) down to the stellar surface. I will present ALMA observations of the surface of the AGB star Mira as well as the first observations of magnetically aligned dust around the red supergiant VY CMa.

Extragalactic Parallel Session 2

High-resolution Observations of Molecular Gas Kinematics in Nearby Galaxies (Invited talk)

-Kyoko Onishi (Ehime University)

Recent ALMA Observations have allowed one to measure the masses of Supermassive black holes in nearby galaxies with its high-angular resolution and sensitivity achieved. I will show a couple of examples of black hole mass measurements using molecular gas kinematics, together with recently delivered results from our ALMA Cycle 3 and 4 projects.

Galactic scale molecular outflows in NGC 3628

-Anli Tsai (National Central University)

Galactic molecular outflow plays a key role on galaxies evolution. Galaxies eject molecular gas and energy into the intergalactic medium through galactic outflows. This process affects star formation activities in galaxies. NGC3628 is a nearby starburst galaxies with several kpc hot ionized outflows. The past observations do not detect large size molecular outflow due to its small FOV and poor sensitivity. Our recent observations detected molecular gas in large scale. We will present our newest results.

Revealing the origin of extraplanar molecular clouds in a ram pressure stripped galaxy through the ALMA

-Bumhyun Lee (Yonsei University)

NGC 4522, a spiral galaxy in the Virgo cluster, is one of the most remarkable cases of ram pressure stripped galaxies, due to its extraplanar HI/CO gas and Hα patches. While it is evident that the HI gas has been stripped from the disk, the origin of the extraplanar molecular gas is not conclusive, i.e. whether it has directly come from the disk as HI, or it could have formed out of stripped atomic gas. In this talk, we present the ALMA 12/13CO (1-0) data of NGC 4522 to examine the origin of its extraplanar molecular gas (e.g. directly stripped vs. newly formed). The detection of extraplanar 13CO supports that the molecular gas outside the stellar disk is likely to originate from the disk, i.e. momentum-transferred by strong ram pressure. In addition, we probe the Kennicutt-Schmidt relation of NGC 4522 at sub-kpc scale. In the extraplanar space, we find relatively low star formation efficiency compared to disk.

Star Formation in HI Dominated Environments (Invited talk)

-Jennifer Donovan Meyer (Stony Brook University)

I will discuss recent work on star forming, HI-dominated environments from nearby dwarf galaxies to nearby, extended ultraviolet (XUV) disks. Both environments are forming stars at low levels, requiring interstellar media capable of doing so, but the gas column densities and molecular fractions in these regions differ substantially from those in the main disks of normal, star forming galaxies. With resolved observations of dwarfs and XUV disks, we present comparisons of the gas available for stars to form between these very different environments. I will also introduce CHILES, an ongoing pencil beam survey at the VLA capable of observing HI simultaneously between z=0-0.5, and ALMA followup observations of our highest redshift detection to date (z=0.376).

KVN-ALMA Collaboration for Polarimetry Commissioning

-Seiji Kameno (NAOJ/JAO)

ALMA is preparing to improve polarization capability, such as circular polarimetry, wider field of views, and shorter calibrations, to be offered in Cycle 6 or later. The ALMA polarization commissioning team has started collaborated with KASI to verify ALMA's polarimetry performance. The major item is measurements of circular polarization in different bases - circular and linear feeds in KVN and ALMA antennas. We have observed SiO maser sources on the same day and got consistent results between KVN and ALMA. We also found a substantial level of difference, which can caused by cross-polarization leakage. We summarize the results and achieved polarization capability.

The lensed galaxy SDP.9 resolved to <100 pc at z~1.6

-Ishida Tsuyoshi (The University of Tokyo)

We present long-baseline Band 6 ALMA observational results of a strongly lensed galaxy H-ATLAS J090740.0-004200 (SDP.9) at z=1.5747. Due to the magnification, the effective resolution at the source

plane reaches ~40-70 pc, which can resolve the scale of giant molecular clouds. ALMA observes the CO rotational line (J=6-5) and the continuum. By identifying four pairs of multiple images from the data and using previous HST observations as additional constraints, we construct the mass model of the lensing galaxy. The model consists of an elliptical power-law and an external shear component. We find our model has the slightly steeper slope (=2.13) than isothermal one (=2). We search for the demagnified central image from the velocity integrated CO map, but we could not detect any emission from the centroid and put a 3 sigma upper limit of 0.0471 Jy km/s. We have also tried to construct more accurate mass models by using the surface brightness distribution as a constraint. We use these models and reconstruct the source plane by our own algorithm GLEAN. GLEAN is based on the idea of CLEAN deconvolution algorithm. GLEAN finds the peak position on the image plane and calculate the corresponding source position. Then, GLEAN calculates corresponding image positions and subtracts it from the observed image. This procedure is repeated to the residual image and finally we get the modeled image and source plane. We show preliminary results of the continuum and CO maps on the source plane.

Wednesday, November 29

Plenary Session 3

Solar astrophysics with ALMA (Review talk)

-Sujin Kim (KASI)

Our understanding of the Sun has been improved by development of ground-based and space-borne observations and numerical modelling. Nevertheless, we still have questions on unsolved long standing problems on the solar physics, such as chromospheric and coronal heating. The ALMA observations which provide unprecedented high spatial and temporal resolution in mm/sub-mm give a chance to look at the sun with new eyes and definitely help us to better understand the sun. In this talk, I will introduce subjects for solar science with ALMA and recent research results using ALMA data, which was obtained from solar campaign observation in 2015 December.

Recent progress in high-mass star-formation studies with ALMA (Review talk)

-Tomoya Hirota (NAOJ)

Formation processes of high-mass stars have been long-standing issues in astronomy and astrophysics. This is mainly because of major difficulties in observational studies such as extremely large opacity of interstellar dust except for centimeter to submillimeter wavelengths, larger distances and more complex structures in young high-mass clusters compared with nearby low-mass isolated star-forming regions, and smaller number of high-mass young stellar objects (YSOs) due to shorter evolutionary time scale. High resolution and high sensitivity observations with ALMA at millimeter/submillimeter wavelengths can overcome these observational difficulties even for statistical studies with increasing number of high-mass YSO samples. I will review recent progress in high-mass star-formation studies with ALMA along with related observational and theoretical studies. I will present recent results from ALMA for giant molecular cloud complexes and infrared dark clouds, high-mass protostellar disks and outflows, and hyper/ultra-compact HII regions. In particular, I will emphasize future higher-resolution observations of high-mass YSOs in the ALMA era.

Molecular torus in the radio galaxy NGC 1052

-Seiji Kameno (NAOJ/JAO)

We report KVN and ALMA observations of the nearby radio galaxy NGC 1052. Using ALMA, we discovered molecular absorption lines of CO, HCN, HCO+, CS, SO, and CN toward bright unresolved nucleus. The absorptions show wide (FWHM ~ 160 km/s) and redshifted profiles with respect to the systemic velocity. We located the HCN absorber using the KVN and identified clumps within 0.5 pc from the nucleus. These results indicate the molecular absorption feature is ascribed to a molecular torus seen edge-on. ALMA and KVN are the best combination to find molecular tori and image them in detail.

Methanol maser polarisation of massive star forming region; G10.34-0.14, with ALMA

-Ji-hyun Kang (KASI)

We present the preliminary results of the full polarization ALMA observations of the 95 GHz Class I methanol maser transition line toward a massive star forming region, G10.34-0.14. The ALMA observations revealed over 30 maser features together with weak thermal lines. Thermal emission shows about 20000 AU-sized blue/red-shifted ring-like features indicating outflows or rotating

circumstellar disk. The strongest two maser features are located at the tip of EGO outflow feature, which is perpendicular to the thermal methanol ring, while the rest masers tend to be close to the central continuum sources. Linear polarization has been detected toward the two strongest masers of which polarization properties are similar to the previous single dish and VLBI polarimetric observations performed with the KVN telescope.

The magnetic field strength and energy balance of OMC 1

-Kate Pattle (University of Central Lancashire)

We present a Chandrasekhar-Fermi analysis of the OMC 1 region of the Orion A filament, using polarimetric data taken with POL-2 on the JCMT as part of the BISTRO (B-Fields in Star-Forming Region Observations) survey and archival SCUBA-2 and HARP data. We estimate a plane-of-sky magnetic field strength in OMC 1 of B = 6.6 ± 4.7 mG, using a novel method analogous to unsharp masking to account for the large-scale variation in magnetic field direction across the region. We find that OMC 1 is in approximate equipartition between gravitational and magnetic energy, comparable to the energy density in the explosive Orion BN/KL outflow, suggesting that the outflow may have sufficient energy to significantly alter the global energy balance of OMC 1 . However, we find that neither the local Alfvén velocity nor the velocity of the super-Alfvénic outflow ejecta is sufficiently large for the BN/KL outflow to have caused large-scale distortion of the local magnetic field in the ∼500-year lifetime of the outflow. Hence, we propose that the hour-glass magnetic field morphology in OMC 1 is caused by the distortion of an initially cylindrically-symmetric magnetic field by the gravitational fragmentation of the filament and/or the gravitational interaction of the BN/KL and S clumps. We find that OMC 1 is currently in or near magnetically-supported equilibrium, and that the current large-scale morphology of the BN/KL outflow is regulated by the geometry of the magnetic field in OMC 1, and not vice versa.

ALMA ACA 7m observations toward two Orion cores very close to the onset of star formation

-Ken Tatematsu (Nobeyama Radio Observatory)

I will introduce ALMA Cycle 4 Supplemental program with ACA 7m Array toward Orion cores very close to the onset of star formation. One of them shows doubly peaked N2D+ emission peaks with spatially complicated CO emission. I will compare the distribution and kinematics of various molecular lines to see how star formation starts.

Origin of the Stellar IMF in the W43-MM1 Mini-Starbust Ridge (Invited talk)

-Fabien Louvet (Universidad de Chile)

Studying extreme protoclusters is necessary to test if the IMF origin can be independent of cloud local characteristics. The W43-MM1 ridge, being extreme in terms of cloud concentration and star formation activity, is a case-study to confront models up to their limits. In Cycle 2, ALMA performed a deep, large mosaic of the 5 pc2 ridge. The 1mm image reveals an exquisite hub of spiraling filaments and a rich cluster of about 300 cores with 2000 AU sizes. A temperature model was built from the knowledge of the main hot core characteristics and the heating of protostars identified with ALMA. The resulting core mass function (CMF) definitively is `top-heavyâ€™, for both the low- and high-mass regimes. For the first time, one can question the origin of stellar masses for solar-type to O-type (1-100 Msun) stars in a single cloud. I will present various interpretations for this `top-heavyÂ´ CMF in the framework of mini-starburst events.

Dynamics of jets/outflows from high-mass young stellar objects revealed by combination of ALMA and KaVA observations

-Jungha Kim (NAOJ)

We have started survey observations of the 22 GHz water maser sources associated with high-mass young stellar objects (HM-YSOs) as a part of the KaVA (KVN and VERA Array) large program (LP). The aim of our LP is to understand dynamical evolution of jets/outflows from HM-YSOs by analyzing 3D velocity structures of water maser features. In the first year (2016-2017), an imaging survey toward 25 HM-YSOs at 22 GHz has been conducted to check detectability and variability of the water masers. To complement physical properties in the vicinity of HM-YSOs, we have also carried out ALMA cycle 3 observations of thermal molecular lines and continuum emissions toward 11 selected samples. In this talk, I will report summary of the KaVA first year observations and the initial results from the ALMA and KaVA data toward one of the observed HM-YSOs, G25.82-0.17. We identified 1.3 mm dust continuum source powering water maser with high angular resolution (0.2”-0.3”). High velocity (~10 km s-1) of SiO J=5-4 emission was detected indicating the presence of outflowing gas from the source. In addition, the velocity gradients within the compact thermal methanol line emission which are possible signature of rotating disk were shown. In the future, we are going to investigate dynamical structure of jets/outflows and mass loss/accretion processes by combining ALMA results with measured proper motion of water maser by KaVA observations.

ALMA reveals sequential high-mass star formation in the G9.62+0.19 complex

-Tie Liu (KASI/ESO)

Stellar feedback from high-mass stars (e.g., H{\sc ii} regions) can strongly influence the surrounding interstellar medium and regulate star formation. Our new ALMA observations reveal sequential high-mass star formation taking place within one sub-virial filamentary clump (the G9.62 clump) in the G9.62+0.19 complex. The 12 dense cores (MM 1-12) detected by ALMA are at very different evolutionary stages, from starless core phase to UC H{\sc ii} region phase. Three dense cores (MM6, MM7/G, MM8/F) are associated with outflows. The mass-velocity diagrams of outflows associated with MM7/G and MM8/F can be well fitted with broken power laws. The mass-velocity diagram of SiO outflow associated with MM8/F breaks much earlier than other outflow tracers (e.g., CO, SO, CS, HCN), suggesting that SiO traces newly shocked gas, while the other molecular lines (e.g., CO, SO, CS, HCN) mainly trace the ambient gas continuously entrained by outflow jets. Five cores (MM1, MM3, MM5, MM9, MM10) are massive starless core candidates whose masses are estimated to be larger than 25 M$_{\sun}$, assuming a dust temperature of $\leq$ 20 K. The shocks from the expanding H{\sc ii} regions (``B" \& ``C") to the west may have great impact on the G9.62 clump through compressing it into a filament and inducing core collapse successively, leading to sequential star formation. Our findings suggest that stellar feedback from H{\sc ii} regions may enhance the star formation efficiency and suppress the low-mass star formation in adjacent pre-existing massive clumps.

The physical properties of massive young stellar objects

-Fernando Olguin Choupay (National Tsing Hua University)

The study of accretion during the formation of massive stars is key to understanding whether their formation is a scaled-up version of low-mass star formation or not. Massive young stellar objects (MYSOs) are where the star is still likely to be accreting at a high rate, but the forming star has not ionised the bulk of the parental material. The study of their matter distribution can therefore provide insights about accretion, the interaction of jets and winds with the envelope, and the outflow mechanism. In this presentation/poster I will show the results of our study on the physical properties of the prototypical MYSO GL 2591. I will present the density, temperature and velocity distributions obtained by our 3-D radiative transfer modelling which are constrained by interferometric and single-

dish observations from the near-IR to mm wavelengths. In particular, the models attempt to match spatially resolved Herschel 70 micron data as well as the methyl cyanide emission at ~5000 au scales, which are relevant for inflow/outflow processes. Finally, I will introduce our current project to extend this study to a larger MYSO sample using ALMA observations.

Abstract (Poster session)

ALMA imaging of the CO(6-5) line emission in NGC 5135

-Tianwen Cao (NAOC)

I would report the Atacama Large Millimeter Array (ALMA) observations of the CO (6-5) line emission and of 435 μm dust continuum emission in the nuclear region of NGC5135, a local luminous infrared galaxy (LIRG) at a distance of 59Mpc, which contains a Compton-thick active galactic nucleus (AGN).

Multi-Frequency AGN Survey with KVN (MASK): Common Sources with ALMA Calibrators

-Taehyun Jung (KASI)

Available (known) VLBI sources at high frequencies (e.g. >22GHz) are very limited, mainly due to atmospheric fluctuations, which limit a coherence time, and a power-law energy distribution of particles in case of AGNs. However, simultaneous multi-frequency VLBI receiving system of the Korean VLBI Network (KVN) and its powerful VLBI phase calibration technique offer benefits in finding more (weak) sources at millimeter wavelengths. Based on this aspect, a new mm-VLBI survey with KVN, so called 'MASK (Multi-Frequency AGN Survey with the KVN)' is currently underway. MASK as a KVN legacy program aims to densify an existing a VLBI catalog of extragalactic radio sources at 22/43/86/129 GHz. The sample is based on KVN Calibrator Survey (KVNCS: Lee et al. 2016) with a total of 1500 sources and has more than 200 common sources with ALMA calibrators. We report the current status of MASK project including detection results of ALMA common sources and its prospects.

Quasar Feedback in the Early Universe: Lowest Eddington Ratio Quasar at z~6

-Yongjung Kim (Seoul National University)

A number of studies have suggested the co-evolution of the quasars and their host galaxies in the early universe, which is consistent with a scenario of the rapid growth of black holes residing in the center of quasar at z > 6 (or just 1 Gyr after the Big Bang), while star formation of its host galaxy might be suppressed by the quasar activity. Unfortunately, the investigated sample so far is biased toward high luminous quasars with extreme accretion rates, preventing us from the understanding of the properties of whole quasar population at z~6. Recently, we discovered IMS J2204+0112, one of the faintest quasars at z~6, which contains a supermassive black hole as massive as 10^9 solar mass with the lowest Eddington ratio of ~0.1 at z~6, estimated so far. Through the sub-mm observation with ALMA, the flux of IMS J2204+0112 at 1.2 mm is 1.474 mJy, which is 11 times brighter than the expected one, calibrated from the luminosity relation of other high redshift quasars. This implies that IMS J2204+0112 is in a different star-forming stage, which might be due to its low Eddington ratio distinguished from others. Here, we present the possible explanations for the quasar and its host in a view of co-evolution.

ASTE/ALMA band7+8 Receiver Project

-Jung-Won Lee (KASI)

Korea and Japan in EA ALMA cosortium have been developing a ALMA band7+8 receiver as a prototype focal plane array on the Total Power Array, which will enhance single-dish observation speed for large structures. We report status of the development.

ALMA rest-frame 210-micron dust continuum observations of Ly-alpha blobs at z=3.1

-Yuichi Matsuda (NAOJ)

We present 0.3"" resolution ALMA observations of four giant (100kpc-scale) Ly-alpha Blobs (LABs) in the SSA22 protocluster at z=3.1. In our 860-micron continuum maps with a sensitivity of rms=44uJy/beam, we detect 9 sources (1-4 sources per field) above 5 sigma, compared to ~1 expected in a blank field, suggesting a tight connection between giant LABs and dusty star-forming regions. The integrated 860-micron flux densities and intrinsic 860-micron angular sizes of the ALMA sources are in the range of S_860=0.5-4.5mJy (star-formation rate of SFR~80-1000Msolar/yr) and FWHM~0.1""-0.5"" (1-4kpc at z=3.1). By assuming that the rest-frame 210-micron dust continuum emission is dominated by star-formation, we derive the SFR surface densities of Sigma_SFR~20-800Msolar/yr/kpc^2, which exceed the expected threshold for gas outflows. The combination of proto-cluster environment and gas outflows may play an important role in producing giant LABs.

The enigmatic AGB star GX Mon

-Suzanna Randall (ESO, Garching)

We recently obtained ALMA observations of CO 2-1 as well as other molecular dust and gas tracers around the oxygen-rich AGB star GX Mon. The spatial distribution of the CO is rather intriguing and points towards an unseen binary companion. We will present the first results from a preliminary analysis of our data.

The SCUBA-2 Ultra Deep Imaging EAO Survey (STUDIES)

-Wei-Hao Wang (ASIAA)

STUDIES is a JCMT Large Program to obtain extremely deep 450 um images for the center of COSMOS and SXDS fields. I will present the current status and latest results from the survey. We welcome astronomers in the EA society to join our survey and plan their ALMA followup observations. This is a poster presentation.

Radio emission from Jupiter as an indicator of auroral magnetic footprint morphology

-Suwicha Wannawichian (Chiang Mai University, Thailand)

Magnetic footprint is one of prominent emissions in Jupiter's auroral region. The emission and morphology of the magnetic footprint is a direct evidence of interactions between Jovian satellites and the planet's magnetic field. The variation of magnetic footprint brightness and morphology can be studied via the FUV imaging by Advanced Camera for Survey (ACS) on board the Hubble Space Telescope (HST). Satellite's magnetic footprint variation was found to be under the influence of the plasma fluctuation inside Jupiter magnetosphere. The fluctuation is mostly due to the volcanically active satellite, Io, and partly due to external factors, dominated by the solar wind. Based on the strong radio decametric emission from Jupiter, time variation of radio signals detected from Jupiter could have a connection with the variation of electromagnetic interaction between the satellite and Jupiter's magnetic field. The cooperation of multi-frequency studies of Jupiter's auroral region will be an important tool to understand the dynamics inside Jupiter's magnetosphere.

Star Formation in Vertically Resolved Edge-on Galaxies

-Kijeong Yim (KASI)

We study vertical structure of a sample of edge-on galaxies (NGC 891, 4013, 4157, 4565, and 5907) using BIMA/CARMA 12CO (J=1->0), VLA/EVLA HI, and Spitzer 3.6 micron data in order to investigate the relationship between star formation and the ISM. In addition to the sample of galaxies, we plan to observe more galaxies in the southern sky using ALMA (12CO). Measurements of the gas disk thickness (along with radial surface density profiles) will allow us to derive the average volume density of the gas. The gas volume density provides a new approach probing the star formation law, one that is more physically relevant to the star formation rate. In addition, the volume density will enable us to derive the turbulent interstellar pressure which is suggested to control the molecular gas fraction as well as the star formation rate. We will be able to better understand physics responsible for producing the observed exponent on the star formation law by accessing the vertical distribution.

List of participants

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