MASK: Multi-Frequency AGN Survey with KVN

Taehyun Jung (Korea Astronomy and Space Science Institute)

Available (known) VLBI sources at high frequencies (e.g. >22GHz) are very limited - mainly due to atmospheric fluctuations, which degrade 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, MASK (Multi-Frequency AGN Survey with the KVN) project has started in order to densify an existing VLBI catalog of extragalactic radio sources at 22/43/86/129GHz as a KVN legacy program. In this talk, we will report current updates and future plans of MASK project.

A performance evaluation of KVN Frequency Phase Transfer

Jung, Dawoon (Yonsei University)

In mm-VLBI, it is demanding to detect faint sources by integrating observation data before calibrating atmospheric phase fluctuation. However, Korean VLBI Network (KVN) has a unique system to make a 4-frequency (22/43/86/129 GHz) simultaneous observation in mm-wavelength, and Frequency Phase Transfer (FPT) calibration technique has effectively calibrated atmospheric phase fluctuation in the simultaneous multi-frequency observation of the KVN. We have evaluated the FPT performance of the KVN in various atmospheric conditions in terms of the coherence function, the Allan standard deviation (ASD) and the Root Mean Square (RMS). We observed 37 bright AGNs multiple times at 22/43/86/129 GHz during four epochs and obtained 336 scan data sets (continuous observation on a single target source for 30 minutes) in 2013. We investigated the System Equivalent Flux Density (SEFD) distributions at four frequencies and classified all scan data into two atmospheric condition groups (Typical and worse). Under the typical atmospheric condition, the coherence time during which VLBI data can be integrated without severe signal loss was increased from tens of seconds to about 25, 20 and 15 minutes at 43, 86 and 129 GHz after the FPT. The ASDs after the FPT at four frequencies were reduced to 10^-14 level by one-fourth compared to before the FPT, implying that the accumulated phase noise did not exceeded one radian. The RMS of fringe phases after the FPT were also reduced to less than one radian (18, 26 and 44° at 43, 86 and 129 GHz) by effectively suppressing the power of residual phase noise. On the other hand, the FPT failed to completely compensate for atmospheric phase fluctuation leaving strong residual phase noise (the RMS at 86 and 129 GHz: 80°) except for 43 GHz under the worse atmospheric condition. The coherence time was severely limited to less than several minutes at 86 and 129 GHz, but it was able to increase to 20 minutes at 43 GHz. The

remaining tropospheric turbulence at 86 and 129 GHz still made the fringe phases continuously varying which led to the ASD to two times greater than the typical atmospheric condition. From the FPT performance evaluation, we anticipate the typical sensitivity of KVN VLBI will be able to improve to 24, 47 and 80 mJy at 43, 86 and 129 GHz after the FPT with 5σ detection threshold and 64 MHz bandwidth.

Molecular Absorption Lines in the Circumnuclear Region Resolved by KVN

SAWADA-SATOH, Satoko (Kagoshima University)

High angular resolution studies of molecular gas in the center of the extragalaxies (< 1 kpc) have been obtained with millimeter interferometers. The size of the circumnuclear torus, however, is smaller than 10pc, and a milliarcsecond (mas) resolution is required to study its internal structure in nearby AGNs. VLBI observations have revealed the parsec- or subparsec-scale morphology of nearby AGNs. Although thermal emission lines from molecular gas are not luminous enough to detect with the VLBI, VLBI maps can display thermal absorption lines of the gas in silhouette against a bright background synchrotron radiation source with a mas resolution. We present the first VLBI detection of HCN molecular absorption in the nearby AGN NGC 1052 using the KVN. The absorption features are localized on the receding jet side, where the free-free absorption occurred due to the circumnuclear torus.

What we have learned about Gamma-ray bright AGNs with the iMOGABA

Lee, Sang-Sung (KASI)

The iMOGABA program continues to aim at revealing the origins of the gamma-ray flares that are often detected in active galactic nuclei (AGNs). Here in this talk, we would like to talk about what we have learned about the Gamma-ray bright AGNs based on the recent results of the KVN Key Science Program: the iMGOABA. The talk will include a) the source properties of the whole samples obtained from a single-epoch observation, and b) some of scientific highlights for the iMOGABA on specific sources. From those highlighted works, we find that the Gamma-ray bright AGNs become fainter at higher frequencies, yielding optically thin spectra at mm wavelengths. Based on the studies on specific sources, taking into account the synchrotron self-absorption model of the relativistic jet, we estimated the magnetic field strength in the mas emission region during the observing period.

BISTRO updates

Kwon, Woojin (KASI)

The B-fields in star-forming region observations (BISTRO) is a JCMT large program. I will update the status of the project.

On investigation of molecular clouds and supershells

Park, Geumsook (Seoul National University)

One of the fundamental questions in the study of the diffuse interstellar medium is how molecular clouds form and evolve. A favorable formation site is supershells where material swept up by energetic shock is compressed and has enough column density to form molecular clouds. The shock process can destroy pre-existing molecular clouds, however. Using public CO survey data (mainly, the CfA 12CO J=1-0 survey with FWHM of 8.4'), we have explored whether CO emission features appear in the walls of thirty-eight Galactic shells/supershells. These shell/supershell objects have been found from the I-GALFA HI survey data with FWHM of 4'. Thirteen of them are the previously-known objects in the low-resolution (36') catalog of Heiles (1979), which are confirmed by our study, and the remainder is new shell candidates. Their geometric mean diameters and velocity extents range about 1-13 degree and 7-65 km/s, respectively. Fourteen and twenty-four are located in the inner and outer Galaxy, respectively. About half of the objects appear to have associated CO emission features, but most of them require higher resolution CO data to confirm the association. In this talk, we will present the results of our work and a plan of TRAO observations.

Radio properties of X-ray selected local AGNs

Baek, Junhyun (Yonsei University)

We report preliminary results from our radio study of X-ray selected local AGNs using 1.4 GHz VLA, 5 GHz Green-bank, and 22 GHz KaVA data. The main goal is to probe black hole properties from the perspective of the radio power of X-ray AGNs, which has not been done systematically before. The BASS (Burst Alert Telescope AGN spectroscopic survey) sample from the Swift-BAT hard X-ray all-sky survey provides a less biased AGN sample against torus obscurations compared to optically selected AGNs, providing ideal targets to study the general properties of local AGNs in radio wavelengths. Combining our radio data with BASS DR1 measurements, we will show the relations of radio powers with the fundamental quantities of black holes such as bolometric luminosity, black hole mass, and Eddington ratio. Using these relations, we will discuss our current

understandings of how X-ray, optical and radio properties of local AGNs are linked together, and what they imply for the nature of our AGN sample.

Physical Properties of Filaments and Dense Cores in California Molecular Cloud

Chung, Eun Jung (KASI)

How dense cores and filaments in molecular clouds form is one of key questions in star formation. To challenge this issue we started to make a systematic mapping survey of nearby molecular clouds in various environments with TRAO 14m telescope equipped with 16 beam array, in high (N2H+, HCO+ 1-0) and low (C18O, 13CO 1-0) density tracers (TRAO Multi-beam Legacy Survey of Nearby Filamentary Molecular Clouds, PI: C. W. Lee). We pursue to dynamically and chemically understand how filaments, dense cores, and stars form under different environments. We have performed On-The-Fly (OTF) mapping observations toward L1478 of California MC from Jan to May, 2017 and obtained ~1.1 square degree area map of 13CO and C18O and ~0.1 square degree area map of N2H+ and HCO+, respectively. Our 13CO and C18O dataset show long network of filamentary structure pervades over the whole observed region like the Herschel data. From C18O datacube, we identified 8 filaments and derived their physical properties such as filament mass, length, linear mass, and thermal and nonthermal velocity dispersions of filaments and dense cores. The distribution of YSOs is also examined with the filament property. In this talk, I'll give a brief report on the observation and show preliminary results of California MC.

Turbulent properties in two different star-forming regions: the OMC 1-4 and L1688 regions

Yun, Hyeong-Sik (Kyung Hee University)

Molecular clouds are the sites of stellar birth, and conditions within the clouds control the mode and tempo of star formation. In particular, turbulence largely determines the density and velocity fields, and can affect the gas kinetic temperature as it decays via shocks. However, despite its central role in star formation and many years of study, the properties of turbulence remain poorly understood. As a part of the TRAO Key Science Program (KSP), "Mapping turbulent properties of star-forming molecular clouds down to the sonic scale (PI: Jeong-Eun Lee)", we are mapping two star forming molecular clouds, the Orion A and the ρ Ophiuchus molecular clouds in three sets of lines (13CO 1-0/C18O 1-0, HCN 1-0/HCO+ 1-0 and CS 2-1/N2H+ 1-0) using the Taeduk Radio Astronomy Observatory (TRAO) 14-m telescope. We apply two statistical methods, the Principal

Component Analysis (PCA) and the Spectral Correlation Function (SCF), which are known to be useful to study underlying turbulent properties. We will present the preliminary results of our TRAO KSP toward two regions: the OMC 1-4 region in the Orion A cloud, and the L1688 region in the ρ Ophiuchus cloud.

Investigations of star formation with ALMA and JCMT

Lee, Jeong-Eun (Kyung Hee University)

TBD

Investigation of radiation driven implosion in BRCs

Archana Soam (KASI)

We are carrying a survey of molecular line studies in nearby BRCs using TRAO facility in KASI. This study will help in understanding the kinematics of these clouds. Along with an aim to support the star formation activity in these regions, we would also try to establish the plausible link between the star formation activity and the observed external influence.These BRCs with and without star formation activities are also good candidates to investigate the radiation driven implosion process. I will also present some JCMT POL-2 results obtained under BISTRO large program.

Understanding high-mass star formation through KaVA observations of water and methanol masers

Kim, Kee-Tae (KASI)

We have started a systematic observational study of the 22 GHz water and 44 GHz class I methanol masers in high-mass star-forming regions as a four-year KaVA (KVN and VERA Array) large program since 2016. The primary science goal is to understand the dynamical evolution and circumstellar structures of high-mass young stellar objects (HM-YSOs) by measuring spatial distributions and 3D velocity fields of water and methanol maser features. Our sample consists of 87 HM-YSOs in various evolutionary phases, many of which are associated with multiple maser species. In the first year, we carried out snap-shot imaging survey of 25 water masers and 19 methanol masers to check detectability and variability of maser features. In particular, all the 44 GHz methanol masers but one have been first observed with VLBI. Based on these results along with the archive data of VERA and KVN, we will select suitable target sources and start multi- epoch monitoring

observations to measure the proper motions of maser features from the second year. By combining follow-up observations with VERA (astrometry), JVN/EAVN (6.7 GHz class II methanol masers), ALMA (thermal molecular lines and continuum), and single-dish spectral line data, we will reveal the physical properties and 3D dynamical structures of disk, jet/outflow, and infalling envelope, and their relationship between the evolutionary phases of HM-YSOs. In this talk, we will present brief summary of our large program and show the initial results.

Inner Bar Region Survey of the Milky Way

Youngung Lee (KASI/TRAO)

We have observed a part of the Milky Way Bar region in 12CO(1-0) and 13CO(1-0) using the multibeam receiver system (SEQUOIA-TRAO) installed on the 14 m telescope at Taeduk Radio Astronomy Observatory. The observed region is L=12 to 17, and B= -0.5 to +0.5 (5 square degrees). The selected velocity resolution is 0.04 km/sec, which is smoothed to 0.2km/sec for the final database, and the covered velocity is about 160 km/sec. The target region is the most crowded part with molecular clumps on the Galactic Plane, which were identified using 12CO UMSB and Bell Lab 13CO surveys. In addition, we developed a new reduction method, which effectively deals with a relatively noisy 3-dimensional database. The temperature sensitivity goal per channel is 0.2 K. As it is located in the innermost part of the Galaxy, discrimination of the various arm components would be important. Distribution, concentric feature, and physical properties of the clumps should be clarified, especially on the bar region.

Infrared and Radio Observations of Evolved Stars

Suh, Kyung-Won (Chungbuk National University)

In this talk, I would like to review recent research topics on evolved stars which use infrared and radio observational data. JCMT as well as other observations would be helpful to study structure and evolution of evolved stars.

KaVA AGN LP and AGN Reseach Group activities

Bong-Won Sohn (KASI)

TBD

Signature of chemical differentiation in Orion complex; λ Orionis, Orion A and Orion B clouds

Hee-Weon Yi (Kyung Hee University)

We conducted a KVN single dish observation for 80 dense cores in the Orion molecular cloud complex to study their physical and chemical states with N2H+, HCN, HCO+ and H13CO+ transition line and SiO, H2O and CH3OH masers and also HDCO (2 0,2 − 10,1), H2CO (21,2 −11,1) and H213CO+ (21,2 − 11,1) line. In our previous study, 103 Planck Galactic Cold Clumps (PGCCs) were observed in 850um dust continuum with SCUBA-2/JCMT in the λ Orionis cloud, Orion A and B molecular clouds and we detected 119 dense cores. The detected cores have high densities (= 1.6 × 10 23 cm−2) but low masses (= 1.2M⊙) and are very faint in IR, indicating that they are deeply embedded in dense envelopes. In combination with SCUBA-2 results and the KVN resulting database will enable the statistical study of Orion molecular cloud complex in a context of star formation in very early stages and also in different environments.

On a Cloud Collision with the OMC-1

Kwang-Tae Kim (Cnungnm National University)

A clear piece of evidence for a collision of a cloud with the OMC-1 is found utilizing both the existing observational data for Orion A and the TRAO 13CO, 12CO data for 1°×1° region centered on M42 collected in 2012. This small cloud has a long cylinder shape of ~0.1 pc × 2 pc, and shows a well developed train of clumps of a few solar masses, and is situated in the dust complex between M42 and M43. The motion of the cloud is analysed to be moving at about 2.6 km s-1, and to transverse the Orion Nebula ~2 pc above from the nebula, toward the direction of about 60° to the line of sight. This cloud seemed to have undergone a tidal splitting about a million years ago and to have formed a very thin and long cylindrical core well before being engaged in the collision. Implications of the collisions are discussed in relation to star formation mechanisms in GMCs.

ALMA observations of the extraplanar molecular gas in a ram pressure stripped galaxy

Bumhyun Lee (Yonsei University)

Ram pressure due to the intracluster medium (ICM) is known to play a crucial role in removing cold gas content of a galaxy on a short timescale, potentially driving a star forming galaxy to evolve into a red passive population. Although many HI imaging studies find clear evidence of diffuse atomic gas stripping from cluster galaxies, it is still debatable whether the ram pressure can also strip dense

molecular gas. NGC 4522, a Virgo spiral, undergoing strong ram pressure stripping, is one of the few cases where extraplanar CO emission together with stripped HI gas has been identified, providing an ideal laboratory to study the molecular gas stripping event associated with the ICM pressure. The aim of this work is to investigate the origin of extraplanar molecular clouds near NGC 4522 (e.g. stripped or formed in situ), and to study how strong ram pressure changes the molecular gas properties, especially in the extraplanar space, using ALMA Cycle 3 12CO and 13CO (J=1-0) data of NGC 4522. In this talk, we present the results from our ALMA observations, and discuss possible scenarios for the origin of extraplanar molecular clouds found in NGC 4522.

The TOP-SCOPE:
Follow-up observations of Planck cold clumps with ground-based telescopes

Tie Liu (KASI)

Stars form in dense regions within molecular clouds, called pre-stellar cores (PSCs), which provide information on the initial conditions in the process of star formation. The low dust temperature (<14 K) of Planck Galactic Cold Clumps (PGCCs) makes them likely to be pre-stellar objects or at the very initial stage of protostellar collapse. "TOP-SCOPE" are joint survey programs targeting at Planck Cold Clumps. "TOP", standing for "TRAO Observations of Planck cold clumps", aims at an unbiased CO/13CO survey of 2000 Planck Galactic Cold Clumps with the Taeduk Radio Astronomy Observatory 14-meter telescope. "SCOPE", standing for "SCUBA-2 Continuum Observations of Pre-protostellar Evolution", is a legacy survey using SCUBA-2 onboard of the James Clerk Maxwell Telescope (JCMT) at East Asia Observatory (EAO) to survey 1000 Planck galactic cold clumps at 850 micron. We are also actively developing follow-up observations with other ground-based telescopes (NRO 45-m, Effelsberg 100-m, IRAM 30-m. SMT, KVN, SMA, ALMA). We aim to statistically study the initial conditions of star formation and cloud evolution in various kinds of environments. I will present the progress and the future plans of this internationally collaborating project. Especially, I will discuss our follow-ups with the SMA. We have discovered one extremely young Class 0 object and a proto-brown dwarf candidate in a Planck cold clump. I will discuss their properties. I will also present our future plans to use the wSMA/ALMA as follow-up.

Large-scale View of Molecular Gas Around the Enormous H II Region CTB 102

Kang, Sung-Ju (KASI)

We investigated the bright outer Galaxy Region CTB 102 with TRAO in order to make a 12CO and 13CO map. CTB 102 (also known as KR 1) is one of the largest H II regions/bubble structures in the Milky Way, but nothing is known about the associated molecular material as it does not fall within the coverage of any the two main high resolution FCRAO CO surveys (OGS and GRS). Therefore in this observation, we observed the first high resolution look at the molecular gas along the line of sight of allowing us to determine likely sites of ongoing star-formation associated with CTB 102 and to investigate the structure of a large-scale local cloud.

KVN observations of a blazar 0716+714 and a radio galaxy 3C 75

Kang, Sincheol (KASI/UST)

In this presentation, we present preliminary results of single dish polarization observations of a blazar 0716+714 during 2014.02 ~ 2016.01, as part of the KVN monitoring program MOnitoring of GAmma-ray Bright AGNs (MOGABA). The observations were conducted one or two times per month, except summer maintenance period (June ~ August). Each observation consists of 3 to 11 scans. Also, each scan consists of 8 cross-scans and 8 position-switchings and duration of each scan was about 40 minutes. We observed the source at 22, 43, 86, and 129 GHz. We obtained total fluxes, linear polarization angles, and fractional linear polarizations. From total fluxes, we can estimate spectral indices, turnover frequencies, and maximum total fluxes at turnover frequencies, Also, we can estimate Faraday rotation measures from obtained linear polarization angles. Comparing the maximum total fluxes and Faraday rotation measures, we can study the variation of magnetic field around the jet. Also, we present preliminary results of VLBI observations of radio galaxy 3C 75. The source is known for binary supermassive black hole system. The source shows very unique morphology with large scale images. We tried to observe the source with higher resolution using KVN VLBI in order to study the interactions between the two black holes in inner part. Since the source is very weak at mm-wavelength, we aimed to detect the source at first. Unfortunately, the source was not detected with 1Gbps mode. Thus, we tried to observe the source with 8Gbps mode. In this presentation, we present preliminary results of 3C 75 using 8Gbps mode.

Revealing the Nature of Blazar Radio Cores through Multi-Frequency Polarization Observations with KVN

Park, Jongho (Seoul National University)

The origin and the nature of the VLBI radio cores of blazars are still unclear. Competing descriptions are provided by two models: (i) the standard Blandford & Konigl (BK) conical jet model, and (ii) a standing conical (recollimation) shock. These models are supported by observations of core shift effect at cm wavelengths and the coincidence of high-energy flares with the emergence of new jet components, respectively. In the latter case, no core shift is expected. These apparently contradictory observations are reconciled if the radio core is a recollimation shock upstream of a BK jet that is optically thick at cm wavelengths. The two models can be tested by measurements of Faraday rotation measures (RMs) at mm wavelengths: the core RM is expected to increase with frequency in the former case and to be independent of frequency in the latter case. In order to test these predictions, we launched a Korean VLBI Network (KVN) large program that monitors about 15 compact blazars monthly at 22, 43, 86, and 129 GHz quasi-simultaneously. In this talk, we present our early science results that show (i) a median RM of our sources of 1.61 x 10^3, 1.29 x 10^4, and 8.71 x 10^4 rad/m^2 between 22/43, 43/86, and 86/129 GHz, respectively, (ii) a weighted mean of a in the relation $|RM_core| \propto nu^a$ of 1.91 +- 0.11, indicating that the cores correspond to spherical or conical outflows at 22~129 GHz, (iii) a saturation of RM increase at ~250 GHz in the source's rest frame for 3C 279 and CTA 102, implying that we might see a recollimation shock in the core at >250 GHz, and (iv) detection of very high rotation measure (>~ 10^5 rad/m^2) in the core of 3C 273 at 86/129 GHz. Our large program is going to continue for the next 3 years at least and will make it possible to reveal the nature of blazar radio cores.

ALMA Observations of High-mass Young Stellar Objects with a Parsec-scale H2 Outflow in the IRDC Core MSXDC G053.11+00.05 MM1

Kim, Hyun-Jeong (SNU)

We present the preliminary results of the ALMA observations of high-mass young stellar objects (YSOs) in the infrared dark cloud (IRDC) core MSXDC G053.11+00.05 MM1 at the distance of 1.7 kpc. At the center of the core, two Class I YSOs separated by ~8"" have been identified in infrared with a parsec-scale molecular hydrogen (H2 1-0 S(1)) outflow at 2.12 micron. The spectral energy distributions of the YSOs and total H2 outflow luminosity of > 1 Lsun as well as the detection of methanol masers imply that at least one of the two YSOs is massive (M > 8 Msun). From the ALMA Band 7 observations with a resolution of ~0.5"", we have found a dust filament of < 0.1 pc with a few dense cores at 870 micron continuum. While

the brightest core is consistent with one of the two YSOs previously detected in near- and mid-infrared, the other cores are newly discovered implying their very deeply embedded status. We also have detected several molecular line emission including H13CO+, C17O, and 13CO outflow with complicated structure. The methanol line (CH3OH) tracing hot cores has revealed velocity gradients in the dense cores. We present the properties of the dense cores and discuss their association with the YSOs and the H2 outflow detected in infrared with some implications of high-mass star-formation process occurring in IRDC cores.

대덕전파천문대 운영상황

Lee, Chang Won (KASI)

최근 대덕전파천문대의 업그레이드, 관측운영 상황 및 주요 관측 결과들을 소개한다.

Molecular line observations of HII region G84.9+0.5

Il-Gyo Jeong (KASI)

We present CO molecular line studies towards the Galactic HII region G84.9+0.5 observed with the TRAO and JCMT telescopes. From our observations, the distinct ring-like morphology and clumps were detected in the vicinity of the HII region with a small radius (~ 3'). The infrared (IR) emissions from the Spitzer and Herschel data well matched with the molecular shell, as well as the IR point sources which associated dense molecular clumps. In the northern area, especially, the bright IR arch-shaped structure and point sources were associated with dense gas spatially correlated with the CO line broadening features with more than 10 km/s line width which might be the evidence of the existence of the young stellar objects. We investigated the properties of the HII region G84.9+0.5 and presenting our preliminary results.

Report on an Update of the EAO/JCMT

Kim, Jongsoo (KASI)

TBD

Current Status and Future Plan of KVN

Byun, Do-Young (KASI)

KVN is continuing stable operation for more than 3500 hour VLBI observations and a few 100 hours single-dish observations in a year. The number of publications with KVN was increased up to around 20 in 2016. This talk will summarize operational results of 2016B and 2017A seasons and introduce a few highlights of KVN and KaVA. KVN began to support new observation modes - 8Gbps mode and 129GHz polarization observation. Upgrade activities and plan of KVN and KaVA will be introduced.

Korea ALMA Status

A-Ran Lyo (Korea Astronomy and Space Science Institute)

TBD

Report of the KVN Evolved Star Key Science Project

Se-Hyung Cho (Korea Astronomy and Space Science Institute)

2015A 관측시즌부터 본격적인 관측연구가 시작된 Evolved Star Key Science Project는 2016A 관측시즌까지는 16개 대상천체에 대하여 H2O 및 SiO 메이저선의 동시 모니터링 관측을 평균 2개월 단위로 수행해 왔다. 이 중 9개 천체에서 Source Frequency Phase Referencing (SFPR) 방법에 의한 H2O 및 SiO 메이저가 동시에 Register된 멥을 얻을 수 있었다. 따라서 2016B 시즌부터는 이러한 9 천체에 집중하여 약 한달 단위의 VLBI 모나터링을 관측을 수행해 오고 있다. 이 중 몇 개의 천체에 대해서 그 분석과 과학적 해석을 진행하며 논문의 초안을 작성하고 있다. 사용자회의에서는 전체의 진행상황을 보고하고 앞으로의 계획을 발표할 예정이다.

[Poster] THE JCMT TRANSIENT SURVEY: DETECTION OF SUB-MM VARIABILITY IN A CLASS I PROTOSTAR EC 53 IN SERPENS MAIN

Yoo, Hyunju (Chungnam National University)

During the protostellar phase of stellar evolution, accretion onto the star is expected to be variable, but this suspected variability has been difficult to detect because the protostar is deeply embedded. In this paper, we describe the sub- mm luminosity burst of the Class I protostar EC 53 in Serpens Main, the first variable found during our dedicated JCMT/SCUBA-2 monitoring program of eight nearby star-forming regions. EC 53 remained quiescent for the first 6 months of our survey, from February to August 2016. The sub-mm emission began to brighten in September 2016, reached a peak brightness of 1.5 times the faint state, and has

been decaying slowly since February 2017. The change in sub-mm brightness is interpreted as dust heating in the envelope, generated by a luminosity increase of the protostar of a factor of $\geq$ 4. The 850 μm lightcurve resembles the historical K-band lightcurve, which has varied by a factor of $\sim$ 6 with a period of 543 days and is interpreted as accretion variability excited by interactions between the accretion disk and a close binary system. The predictable, multi-wavelength detections of accretion variability observed at both near-infrared and sub-mm wavelengths make the system a unique test-bed, enabling us to capture the moment of the accretion burst and study the consequences of the outburst event on the protostellar disk and envelope.

[Poster] FPT-square: Beyond frequency phase transfer

Zhao Guang-Yao (KASI)

TBD

[Poster] ALMA observation of the Class I protostar IRAS 03445+3242

Lee, Seokho (Kyung Hee Univ.)

We report the high resolution (0".20 x 0".08) ALMA Cycle 3 observations of molecular lines and 850 um dust continuum emission toward IRAS 03445+3242. This source is a Class I protostar and has formed from one out of four widely separated condensations. We observed it with IGRINS, the high resolution near-infrared spectrometer, and detected emission lines such as CO overtone bands, Na I, and Ca I, which trace the inner hot gaseous disk. The ALMA 850 um continuum emission revealed that this source is a close binary-like system. Two components (source A and B) are separated by 0"".18 (42 AU) nearly along the outflow direction. All gas emission (HCO+ 4-3 and HCN 4-3) seems to be associated with the known protostar, Source A. The characteristics of Source B are not clear, so more observations need. The gas emission traces a disk rotation and outflow associated with Source A. The protostellar mass calculated from the ALMA molecular spectra is consistent with what derived from the IGRINS spectra.

[Poster] TRAO Survey of Nearby Filamentary Molecular Clouds: Progress Report

Kim, Shinyoung (KASI/UST)

To dynamically and chemically understand how filaments, dense cores, and stars form under different environments, we are conducting a systematic mapping survey of nearby molecular clouds using the TRAO 14 m telescope with high

(N2H+(1-0), HCO+(1-0), SO(32-21), and NH2D(1-0)) and low (13CO(1-0), C18O(1-0)) density tracers. The goals of this survey are to obtain the velocity distribution of low dense filaments and their dense cores for the study of their origin of the formation, to understand whether the dense cores form from any radial accretion or inward motions toward dense cores from their surrounding filaments, and to study the chemical differentiation of the filaments and the dense cores.