The 10th EAMA Abstract Book

Venue: Hoam Faculty House/Samsung Convention Center
Seoul National University, Seoul, Korea

Registration opens at 5 pm on 9/26, and 8:30am every day during the meeting period.

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1. Invited/Oral talk Abstracts
Part 1. Regional Activities
25 Years of EAMA: from Cooperation to Coordination

Invited talk

Norio Kaifu¹, Cai–pin Liu², Se–Hyung Cho³
(NAOJ/Japan¹, Purple Mountain Observatory/China², KASI/Korea³)

EAMA, since its establishment in 1990, has played an important role as a stable platform to constructing various kind of regional collaboration among astronomers in East Asia. As well as many cooperative activities like EAYAM, EA–VLBI, ALMA EA consortium (now EA–ARC), etc., EAMA also worked toward construction of concrete structure for “coordination” of East Asian astronomy. In the EAMA–6, 2004, held in Seoul, EAMA proposed to organize the EACOA, “East Asian Core Observatories Association” as an organization–level platform toward the future target “East Asian Observatory” aimed an East Asian Version of ESO. The EACOA was organized in 2005 by NAOC, NAOJ, KASI and ASIAA, then the EAO (East Asian Observatory) was established in 2014 under strong leadership of EACOA directors. East Asian astronomy thus has entered into the stage of regional coordination.

Astronomy is a field of science still growing larger and more international. In parallel the strong regional coordination of astronomy is becoming more and more important especially in those regions developing their own astronomy like East Asia. In this paper I will look back the 25 years of EAMA and its achievements, and discuss about future of East Asian astronomy emphasizing growing importance of regional coordination. The role of EAMA as a grass–roots supporting body will still be important.
Report on EAO

Invited talk

Paul Ho (ASIAA, EAO/Taiwan)

We report on the status of the East Asian Observatory since its establishment in 2014. Starting in March 2015, the EAO took over the operations of the JCMT on Mauna Kea. During this past year, we had five calls for proposals, including one for Large Programs. There is a strong response from the East Asian community for JCMT science with an oversubscription rate of more than 3. The EAO Board is now preparing for taking on the next initiatives in the next year. This will include sharing time on the Subaru telescope and the SMA.
Current status and future planning of KASI

Invited talk

Inwoo Han (KASI/Korea)

We present the current status and future prospect of scientific activities and astronomical facilities in KASI.
The Latest NAOJ Activities

Invited talk

Masahiko Hayashi (NAOJ/Japan)

I will give an update of NAOJ projects
Astronomy in ASIAA and Universities in Taiwan

Invited talk

You-Hua Chu (ASIAA/Taiwan)

Astronomy in Taiwan has grown in leaps and bounds during the past 25 years. The number of scientists with PhD in astronomy/astrophysics-related fields is reaching ~200. The Institute of Astronomy and Astrophysics, Academia Sinica (ASIAA) is a government research institute and has played a major role in driving the development of astronomy in Taiwan. Several universities have also hired faculty members to initiate astronomy programs. The observing facility projects of ASIAA include ALMA, SMA, Subaru, CFHT, YTLA, JCMT, GLT, and TAOS2. The business model of ASIAA is to use in-kind contributions toward instrumentation to acquire access to forefront observing facilities. These facilities are open to all astronomers in Taiwan.
Recent Activities at Purple Mountain Observatory

Invited talk

Ji Yang (PMO/China)

Purple Mountain Observatory, a research institute under Chinese Academy of Sciences, is focused on astronomical research and applications. The observatory consists of four divisions, includes Dark Matter and Space Astronomy, Antarctic and Radio Astronomy, Applied Celestial Mechanics, and Planetary Sciences, covering a broad-range of modern astronomy from cosmology, large-scale structure and galaxies, high-energy astrophysics, star formation and evolution, Milky-Way structure, solar physics, planetary sciences to applied dynamics. The institute facilitates R&D activities for both space and ground-based astronomy. Some recent results from the selected areas will be reported. Recent major efforts at Purple Mountain Observatory, including space dark matter detector and the Antarctic observatory, will be described. A brief report on regional/international collaboration opportunities will also been presented.
Recent Astronomical Development of NARIT and the Regional Collaboration

Invited talk

Boonrucksar Soonthornthum (NARIT/Thailand)

During the past decade, Astronomy in Thailand has been developed significantly. Since the establishment of the National Astronomical Research Institute of Thailand (NARIT) on January 1, 2009, apart from a long-term plan for the human resource development and human capacity building in astronomy, the major astronomical infrastructures have been developed in Thailand to serve research and development, support education and outreach activities in Thailand. The national observatory, with the 2.4-m telescope, has been established and operated in 2013. The 5 regional observatories for the public have been constructed in 5 different regions in Thailand to disseminate the opportunity of people all over the country the ability to access astronomy. The 0.7-m remote robotic telescopes have been placed in several best astronomical sites in the world with close research and academic international collaborations.

Recently, NARIT has been appointed for the IAU’s Regional Office of Astronomy for Development in Southeast Asia and also the UNESCO’s International Training Centre in Astronomy for promoting human resource development and human capacity building in Astronomy, not only for Thailand and the Southeast Asian countries but worldwide. The institute has also developed several major astronomical collaborative projects internationally for the advancement on astronomical development in Thailand. The MoU with DESY for the collaboration on Astroparticle Physics and the MoU with the Polar Research Institute of China (PRIO) for the collaboration on Antarctic astronomy have been signed. In 2016, NARIT has started to build a second astronomical infrastructure, namely a 40-meter dish for Radio Astronomy and a 13-meter dish for Geodesy, with a future plan to establish radio astronomy and geodetic Thai VLBI network (TVN) in Thailand and to collaborate with the East Asia VLBI Network (EVN).
The Development of Astrophysics in Vietnam: Challenges, Opportunities and International Collaboration

*Invited talk*

*Ngoc Phan–Bao (International University – Vietnam National University HCMC/Vietnam)*

I present the current situation of Astrophysics in education and research in Vietnam. I also discuss the opportunities and challenges in the development of Astrophysics in the country as well as possibilities of international collaboration in Astrophysics and related fields.
Part 2. Current and Future Facilities
ALMA – science today and tomorrow

Invited talk

Tetsuo Hasegawa (NAOJ/Japan)

With its unprecedented resolution, sensitivity and image quality, ALMA is revolutionizing our mm/submm view of the universe ranging from the solar system objects to the forming galaxies at the cosmic dawn. The talk will present recent highlights of scientific results. In accordance with the current and future scientific needs, ALMA conducts the development for its future capabilities, with an active participation from East Asian member countries. The role of ALMA in the RAMA context will be discussed briefly.
KaVA: KVN and VERA Array

Invited talk

Do-Young Byun (KASI/Korea)

KaVA is a combined VLBI array with KVN in Korea and VERA in Japan. Due to complimentary combination of KVN’s short baselines and VERA’s long baselines, KaVA has very nice imaging capability. Through 15-year close collaboration between KASI and NAOJ for VLBI, KaVA is now in steady and stable operational phase yielding early science outputs. Recently, KaVA launched three large programs. This talk introduces current status and science activities with the KaVA.
The East–Asian VLBI Network

*Invited talk*

Zhi–Qiang Shen (SHAO/China)

With the gradual increasing seen in the Very Long Baseline Interferometry (VLBI) activities in the East Asia region, it is quite natural to consider/form a combined regional array/network to enhance the capability of the joint VLBI observations. Over the last 10 years or so, the East–Asian VLBI Network (EAVN) has been steadily developed, thanks to the close collaborations among researchers from China, Japan and Korea. I will report the recent EAVN progress in the technical development and the science explorations.
Nobeyama Radio Observatory

Oral talk

Masao Saito (NRO/Japan)

Nobeyama Radio Observatory (NRO) of National Astronomical Observatory of Japan has operated the Nobeyama 45-m telescope for more than 30 years since its beginning. We continually invested resources in enhancing capabilities of the 45-m telescope enabling us to produce scientific results. We also started discussion on the direction of future development in the coming years to further improve science capabilities. For example, we recently succeeded in remote observation from KASI. Summary of recent activities and possible future development scenarios will be presented in the conference.
Upgraded TRAO and its performance

Oral talk

Chang Won Lee (KASI/Korea)

TRAO has been recently upgraded with a multi-beam receiver system, 16 pixel MMIC preamplifiers in a 4x4 array, a FFT spectrometer, and new control computer systems. In our new receiver systems one can make simultaneous observations with two molecular lines maximum 15 GHz apart with a spectral band width of 60 MHz. Typical system temperatures are about 160 – 200 K at 86 ~ 100 KHz and 400 – 500 K at 115 GHz in the dry weather. The new systems using On-The-Fly mode were found to be very efficient for making quick maps of large clouds with a high velocity resolution (~0.04 km/s at 100 GHz), TRAO now calls for proposals for 2016 and 2017 observing season for everybody. In the talk we will introduce the status of TRAO upgrade and its scientific preliminary results.
Current status of the JCMT

Invited talk

Jessica Dempsey (EAO/USA)

The East Asian Observatory took over the operations of the James Clerk Maxwell Telescope in March 2015. Operations successfully resumed, and we have had 5 successful calls for proposals. In this talk, we will review the current on-going science programs, including the Large Programs which are in progress, and also results from the newly commissioned POL-2 which is the SCUBA-2 polarimeter. We will also report on current plans to upgrade the suite of instruments at the JCMT.
Greenland Telescope (GLT)

Oral talk

Satoki Matsushita (ASIAA/Taiwan)

M87 is a promising candidate to reveal the shadow image of its Supermassive Black Hole (SMBH). Greenland Telescope (GLT) project is aiming at the shadow image combined with the other sub-millimeter telescopes like the Phased ALMA in Chile, JCMT and SMA in Hawaii. The big triangle formed by GLT–ALMA–JCMT/SMA provides 20 micro arcsecond resolutions at 350 GHz towards M87, whose shadow size are expected to be about 40 micro arcsecond. LMT in Mexico is located almost at the center of the big triangle, and other Event Horizon Telescope (EHT) antennas would provide the high quality image of the shadow. GLT project is led by ASIAA, Taiwan, collaborating with SAO, MIT Haystack Observatory, NRAO, NAOJ, and Osaka Prefecture University. Most of the GLT antenna components are now in Norfolk, USA, for the pre-assembly, and planning to ship to Thule, Greenland, from there in July 2016. Soon after the disembarkation at Thule, the telescope will be reassembled there to make a few initial VLBI observations in 2017/2018. We will also arrange the infrastructures of the final destination, the Isi at the summit of Greenland. In this presentation, we will report the current status of the telescope.
Radio Spectroscopy with Tianma 65m and also FAST

Invited talk

Junzhi Wang (SHAO/China)

I will introduce the capabilities of radio spectroscopy with Tianma 65m telescope and some of our planned key programs on: star formations in the Milky Way, ISM in the Milky Way, dense gas and star formation in nearby galaxies, Mega-maser and AGN. I will also introduce some of the possible programs of radio spectroscopy with the coming FAST.
A general purpose 6.5 meter optical telescope in China

*Invited talk*

*Xuebing Wu (Peking University/China)*

The largest optical telescope in the world is about 10 meters in diameter, and three 30-meter class telescopes will be built in the next decade. However, currently the largest general purpose optical telescope in China is a 2.4-meter telescope, which makes Chinese optical astronomers difficult to compete with astronomers in the developed countries. Recently a 12-meter segmented mirror optical telescope was proposed by Chinese astronomers, but it will need more than 10 years to build it. If no other optical telescopes with larger aperture will be built, we will have to use 2-meter size telescopes in the next 10 more years in China. To avoid this situation, we proposed to build a general purpose 6.5-meter optical telescope in China in the next 5 years. This is a single honeycomb mirror telescope and the main mirror will be built by the mirror lab at University of Arizona. With the location in the best site of western China and the most advanced instruments in optical imaging and spectroscopy, this telescope will become the most important workhorse telescope for Chinese astronomers to carry out the cutting-edge observational studies on exoplanets, stars and galaxies in the next two decades.
Transneptunian Automated Occultation Survey (TAOS II)

Invited talk

Shiang-Yu Wang (ASIAA/Taiwan)

The Transneptunian Automated Occultation Survey (TAOS II) will aim to detect occultations of stars by small (~1 km diameter) objects in the Kuiper Belt and beyond. Such events are very rare events and short in duration, so many stars must be monitored at a high readout cadence. TAOS II will operate three 1.3 meter telescopes at the Observatorio Astronomico Nacional at San Pedro Martir in Baja California, Mexico. With a 2.3 square degree field of view and a high speed camera comprising CMOS imagers, the survey will monitor ~10,000 stars simultaneously with all three telescopes at a readout cadence of 20 and 40Hz. The event rate is expected to be few tens to one hundred every year. Construction of the site began in the fall of 2013, and the survey will begin in the summer of 2017.
IGRINS: The Immersion Grating Infrared Spectrometer

Oral talk

Jae-Joon Lee (KASI/Korea)

The Immersion Grating Infrared Spectrometer (IGRINS) is a revolutionary instrument that exploits broad spectral coverage at high-resolution in the near-infrared. IGRINS employs a silicon immersion grating as the primary disperser and volume-phase holographic gratings cross-disperse the H and K bands onto Teledyne Hawaii-2RG arrays, providing simultaneous wavelength coverage from 1.45 – 2.5 μm with R~45,000 in a single exposure. It was built as part of a collaboration between the University of Texas (UT), the Korea Astronomy and Space Institute (KASI), and Kyung Hee University. The instrument is being operated at the 2.7-m Harlan J. Smith Telescope of the McDonald observatory after a successful commissioning in early 2014. I will summarize the performance of IGRINS and its current status. IGRINS observed Solar System objects like Pluto and Ceres, comets, nearby young stars, star forming regions like Taurus and Ophiuchus, the interstellar medium, photodissociation regions, the Galactic Center, planetary nebulae, galaxy cores and supernovae. I will discuss how the rich near-infrared spectra of these objects taken by IGRINS enable unique science cases.
Subaru Strategy for 2020's

Invited talk

Nobuo Arimoto (NAOJ/Japan)

Recent scientific results of Subaru Telescope will be presented. The strategic plan of Subaru in the era of 2020's will also be introduced. Subaru has decided to invest a large number of nights in wide field surveys with instruments such as HSC, PPS, and Ultimate–Subaru. These surveys are expected not only to reveal the distribution of dark matter, the acceleration of the expanding universe, and the first generation of stars and galaxies, but to provide original targets to TMT. Possible collaborations between Subaru and East Asian Communities will be discussed to seek for collaborative efforts.
Current Status of the Giant Magellan Telescope

Invited talk

Byeong-Gon Park (KASI/Korea)

Korea has been participating in the Giant Magellan Telescope (GMT) Project through Korea Astronomy and Space Science Institute (KASI) since 2009. GMT is an international project being conducted by eleven partner institutions in four countries, building a 25.4m telescope composed of seven mirrors; the diameter of each primary segment is 8.4m and that of secondary segment is 1.06m. The project has successfully passed a conceptual design phase from 2003 until 2006, a design development phase from 2007 until 2014, and is currently in the construction and commissioning phase aiming to get the first light in 2022. KASI is actively working with GMTO and partner institutions to bring this ambitious project to success. The areas in which KASI is being involved include the fast steering secondary mirror system, visible band high resolution spectrograph, and near infrared high resolution spectrograph. In this contribution, the activities of the GMT project including construction works at the telescope installation site and the current status of the technical developments will be presented.
Thirty Meter Telescope (TMT) Project Status

Invited talk

Tomonori Usuda (NAOJ/Japan)

The TMT is a project to build an extremely large 30-meter optical/infrared telescope under the collaboration of five partner countries including Japan, the United States of America, Canada, China, and India. In 2014, an agreement was executed between the participating organizations, TMT International Observatory was founded to assume the construction and operation of the observatory, and construction commenced.

Although the commencement of full-fledged construction was planned for Fiscal Year 2015, construction was halted due to a protest movement against construction. Additionally, the supreme court of Hawai‘i ruled in favor of a claim that cited a problem in the approval process of the land use permit for the Maunakea Conservation District and remanded it in December 2015. Although this has caused delays to construction onsite, mass production of the telescope primary mirror, design works of the telescope subsystems including science instruments have proceeded according to plan in the partner countries. We present the progress of the TMT project, status of the Hawai‘i construction site, and Japan’s progress on its work share.
Update and status of CFHT

Oral talk

Daniel Devost (CFHT/USA)

The East Asian community is an important part of CFHT since two of our partners, China and Taiwan are currently getting data from us. I will give an update of CFHT’s current capabilities, including SITELLE, our new IFTS capable of observing the whole visible spectrum on a 11x11 arcmin field of view at resolutions up to 20000. I will also give an update on the development of SPIRou, our upcoming infrared high resolution spectrograph that will gather spectra from 0.98 to 2.35 microns in one single shot and measure radial velocities down to 1 m/s. SPIRou is expected to arrive at CFHT late 2017 – early 2018.
Large Area Imaging Spectroscopic Survey of Near-Infrared Sky in Space

Invited talk

Woong-Seob Jeong (KASI/Korea)

Based upon the previous heritages from MIRIS project, KASI is developing the Near-infrared Imaging Spectrometer (NISS) onboard NEXTSat-1. The NISS has a capability of imaging spectroscopy in the near-infrared by using the special spectral filters, LVPs (Linear Variable Filter). The main scientific targets are nearby galaxies, galaxy clusters, star-forming regions and low background regions. The off-axis optical design of the NISS with 15cm aperture was optimized to obtain a wide field of view (FoV) of 2 deg. × 2 deg. with a spatial resolution of 15 arcsec as well as a wide spectral coverage. The engineering qualification model of the NISS was tested in the space environment including the launch-induced vibration and shock. After the final test of flight model, the NISS will be launched in 2017 and explore the large areal near-infrared sky up to 200 sq. deg. in order to get both spatial and spectral information for astronomical objects.

As an extension of the NISS, KASI is planning to participate in a new small space mission together with Caltech. The promising candidate of NASA SMEX mission, SPHEREx (Spectro-Photometer for the History of the Universe Epoch of Reionization, and Ices Explorer) in Phase-A study is an all-sky spectral survey mission designed to reveal the origin of the Universe and water in the planetary systems and to explore the evolution of galaxies. The SPHEREx will perform the first near-infrared all-sky imaging spectroscopic survey with the wider spectral range from 0.7 to 5μm and the wider FoV of 3.5 deg. × 7 deg. (6.5 arcsec. resolution) like the similar observational concept of the NISS.
Status of KAGRA

Invited talk

Hyung Won Lee (Inje University/Korea)

In this presentation, I will report briefly the current status of KAGRA, an underground cryogenic gravitational wave observatory. Currently, KAGRA has finished successfully its first test operation to check its functionality and it is upgrading for KAGRA configuration.
Part 3. East Asian Future Planning for Astronomy
EAMA, EACOA, EAO, and further

Oral talk

Makoto Inoue (ASIAA/Taiwan)

Since the first EAMA meeting a quarter-century ago, we have made remarkable progress in the East Asia region. Here a brief and personal summary of the activities is given, and some suggestions to promote further activities will be discussed.
Perspectives on the Future of Hawaii Astronomy

Oral talk

Simons Doug (CFHT/USA)

The future of Hawaii astronomy hinges upon a number of complex matters ranging from Native Hawaiian interests to TMT to the renewal of the Master Lease for the Maunakea Science Reserve. The Maunakea Observatories have been deeply involved in trying to resolve the conflict, promoting a balanced and sustainable approach that advances cultural, environmental, and scientific interests in the future of Maunakea. This presentation will provide both background and the latest information about the conflict, identifying paths forward, the use of new approaches to community outreach, and some of the most difficult challenges that lie ahead.
Part 4. Sciences
Preferred axis in cosmology

Invited talk

Wen Zhao (USTC/China)

The foundation of modern cosmology relies on the so-called cosmological principle which states an homogeneous and isotropic distribution of matter in the universe on large scales. However, recent observations, such as the temperature anisotropy of the cosmic microwave background (CMB) radiation, the motion of galaxies in the universe, the polarization of quasars and the acceleration of the cosmic expansion, indicate preferred directions in the sky. If these directions have a cosmological origin, the cosmological principle would be violated, and modern cosmology should be reconsidered. In this paper, by considering the preferred axis in the CMB parity violation, we find that it coincides with the preferred axes in CMB quadrupole and CMB octopole, and they all align with the direction of the CMB kinematic dipole. In addition, the preferred directions in the velocity flows, quasar alignment, anisotropy of the cosmic acceleration, the handedness of spiral galaxies, and the angular distribution of the fine-structure constant are also claimed to be aligned with the CMB kinematic dipole. Since CMB dipole was confirmed to be caused by the motion of our local group of galaxies relative to the reference frame of the CMB, the coincidence of all these preferred directions hints that these anomalies have a common origin, which is not cosmological or due to a gravitational effect. The systematical or contaminative errors in observation or in data analysis, which can be directly related to the motion of our local group of galaxies, can play an important role in explaining the anomalies.
Cosmological Constraints from Galaxy Clustering Anisotropy

Invited talk

Changbom Park (KIAS/Korea)

A new method for measuring the cosmological parameters governing the expansion history of the universe is introduced. The method uses the Alcock–Paczynski (AP) test applied to the shape of the galaxy two-point correlation function along and across the line-of-sight. The redshift-space distortion (RSD) effects have been the major obstacle for the AP test. We find that the RSD effects on the correlation function are large at a given redshift but do not vary much as redshift increases, and that the shape of the correlation function is nearly conserved. If a wrong cosmology is adopted, the conversion from the observed galaxy redshift to comoving distance results in distortion of the shape of the correlation function that varies systematically in redshift. We applied to this method to simulated data and also to the recent SDSS DR12 galaxy survey data to obtain an impressive constraint on the dark energy equation of state $w$ and matter density parameter $\Omega_m$. 
A New Large CMB non–Gaussianity aligned with Cosmic Structure

Oral talk

Luis Campusano (University of Chile/Chile)

We provide evidence of the detection of a new non–Gaussian anomaly in the cosmic microwave background (CMB) radiation which has larger statistical significance than the Cold Spot (CS) anomaly and comparable size. This temperature anomaly is aligned with a huge large quasar group (the optical HLQG), and for this reason we call it the HLQG anomaly.

We analyze the CMB Planck satellite temperature map of the region of sky corresponding to the angular position of the HLQG, and compute an inner and an outer temperature by averaging the CMB map over respectively the region subtended by the optical HLQG on the sky, and over a region surrounding it. It turns out that the inner region is warmer than the outer one, with a measured temperature difference of $\Delta T \approx 43 \mu K$. The temperature excess is then compared with the results of Monte Carlo simulations of random Gaussian realizations of the CMB map, indicating with at least a $2.3 \sigma$ confidence level, that the measured $\Delta T \approx 43 \mu K$ cannot be attributed to primordial Gaussian fluctuations. Its angular extension in the longitudinal direction is about three times that of the CS, while its total angular area is comparable, due to its elongated shape compared to the CS. Our results are stable under the choice of different simulations methods and different definitions of the inner and outer regions.
Cosmic Microwave Background Temperature Anisotropy from the Kinetic Sunyaev–Zel'dovich Effect

Oral talk

Hyunbae Park (KASI/Korea)

We discuss the kinetic Sunyaev–Zel'dovich effect on the Cosmic Microwave Background (CMB): temperature fluctuations via the Doppler shift induced by the line-of-sight (LOS) component of the momentum of electrons in the ionized IGM. For the EoR contribution to the signal, we calculate the expected signal from simulations of cosmic reionization that includes the effect of “self-regulation” of reionization: star formation in low-mass galaxies. For the post-reionization signal, we revisit the currently used model for non-linear transverse momentum power spectrum with a particular emphasis on the connected term that has been neglected in the literature. In addition to the effect of nonlinear growth, the effects of baryonic physics on the free electron density suppresses the signal nearly cancelling out the nonlinear effect. We show how we model these baryonic effects using the Illustris simulation and report our preliminary result, D_\perp(l=3000) = 1.5 \text{ micro K}^2.
Ensemble Mass Distribution of Galaxy Clusters from the CLASH Survey

*Invited talk*

Keiichi Umetsu (ASIAA/Taiwan)

Clusters of galaxies play a fundamental role in testing models of structure formation. The ability of massive clusters, to significantly distort the images of background objects via gravitational lensing, can provide direct and unique constraints on the nature of the underlying matter distribution. I will present results from a comprehensive strong-lensing, weak-lensing shear and magnification analysis of a sample of 20 high-mass clusters targeted in the CLASH survey. Our analysis combines high-quality data from 16-band Hubble Space Telescope observations and wide-field multi-color imaging taken primarily with Suprime-Cam on the Subaru Telescope. We reconstruct surface mass density profiles of individual clusters from a joint analysis of the full lensing constraints, and determine masses and concentrations for all clusters. For the X-ray-selected subsample, we examine the concentration-mass relation and its intrinsic scatter using a Bayesian regression approach. We show that the data are in excellent agreement with LCDM predictions when the CLASH selection function based on X-ray morphological regularity and the projection effects are taken into account. We also derive an ensemble-averaged surface mass density profile of this subsample by stacking their individual profiles. The stacked lensing signal is well described by a family of density profiles predicted for cuspy dark-matter-dominated halos in gravitational equilibrium, namely, the Navarro–Frenk–White, Einasto, and DARKexp models, whereas the single power-law, cored isothermal and Burkert density profiles are disfavored by the data. We show that cuspy halo models that include the large-scale two-halo term provide improved agreement with the data. Finally, we develop and apply a new non-parametric method for extracting the ensemble mass profile and its logarithmic gradient. We will discuss the detectability of the splashback radius, a physical halo boundary, using cluster lensing observations.
Discovery of a Faint Quasar at $z \sim 6$: Implications on Cosmic Reionization in the Early Universe

Oral Talk

Yongjung Kim (SNU/Korea)

Recent studies suggest that faint active galactic nuclei may be responsible for the reionization of the universe. Confirmation of this scenario requires spectroscopic identification of faint quasars ($M_{1450} > -24$ mag) at $z > 6$, but only a very small number of such quasars have been spectroscopically identified so far. Here, we report the discovery of a faint quasar IMS J220417.92+011144.8 at $z \sim 6$ in a 12.5 deg$^2$ region of the SA22 field of the Infrared Medium-deep Survey (IMS). The spectrum of the quasar shows a sharp break at $\sim 8443\AA$, with emission lines redshifted to $z = 5.944 \pm 0.002$ and rest-frame ultraviolet continuum magnitude $M_{1450} = -23.59 \pm 0.10$ AB mag. The discovery of IMS J220417.92+011144.8 is consistent with the expected number of quasars at $z \sim 6$ estimated from quasar luminosity functions based on previous observations of spectroscopically identified low-luminosity quasars. This suggest that the number of $M_{1450} \sim -23$ mag quasars at $z \sim 6$ may not be high enough to fully account for the reionization of the universe. In addition, our study demonstrates that faint quasars in the early universe can be identified effectively with a moderately wide and deep near-infrared survey such as the IMS.
Improving Type Ia supernova cosmology

*Oral talk*

**Eric Hsiao (Florida State University/USA)**

The discovery from observations of Type Ia supernovae (SNe Ia) that the expansion of the Universe is currently accelerating has revolutionized physics. Either the Universe today is dominated by a mysterious “dark energy” that is counteracting gravity or we are witnessing the breakdown of General Relativity at the largest scales. Whichever of these explanations is correct, the consequences for fundamental physics are profound, and SNe Ia remain the most direct and promising probe for the nature of this phenomenon. Carnegie Supernova Project II aims to improve the precision of the next-generation SN Ia dark energy experiment with a two-pronged approach: 1) by preparing to shift future SN Ia experiments to the rest-frame near-infrared (NIR), and 2) by constraining SN Ia physics using NIR data for further improvements. I will describe the project and our progress to date.
H0LiCOW: $H_0$ Lenses in COSMOGRAIL’s Wellspring --
Analysis of the Time-Delay Lensed Quasar HE 0435–1223

Oral talk

Kenneth Wong (NAOJ/Japan)

Strong gravitational lenses with measured time delays between the multiple images allow a direct measurement of the so-called time-delay distance to the lens, and thus a measure of cosmological parameters, particularly the Hubble constant, $H_0$. An independent determination of $H_0$ is key to probing dark energy, neutrino physics, and the spatial curvature of the Universe. Our project, "H0 Lenses in COSMOGRAIL’s Wellspring" (H0LiCOW), aims to measure $H_0$ to $<3.8\%$ accuracy from five lens systems. We have acquired deep Hubble Space Telescope imaging to perform a blind analysis of HE 0435–1223, the third system in the H0LiCOW sample. With accurate time delay measurements from the COSmological MOonitoring of GRAvitational Lenses (COSMOGRAIL) project, a measurement of the velocity dispersion of the lens galaxy based on Keck/LRIS data, and a characterization of the mass distribution along the line of sight from a photometric and spectroscopic survey of the field, we constrain the time-delay distance to $\sim 8\%$ precision. Future analyses of the full sample of five H0LiCOW lenses will establish time-delay lenses as an independent and competitive probe of cosmology and set the stage for the hundreds of new time-delay lenses expected to be discovered in ongoing and future surveys.
Model-independent reconstruction of the expansion history and non-local measurement of $H_0$

*Oral talk*

*Benjamin L’Huillier (KASI/Korea)*

We used the luminosity distance from supernovae to reconstruct the expansion history of the Universe in a model-independent way, and combined with measurement of the measurement of the Hubble parameter $H(z)$ and the angular diameter distance $d_{A(z)}$ from the Baryon Oscillation Spectroscopic Survey DR11, and two different astrophysical measurements of $H_0$ to test the metric of the Universe and its flatness. Using the reconstructed expansion histories and $d_A$ and $H$, we then derive a measure of $H_0 r_d = 10075.23 \ \text{pm} \ 269.20 \ \text{km/s}$, where $r_d$ is the sound horizon at the drag epoch. Assuming $r_d = 147.10 \ \text{Mpc}$, we obtain $H_0 = 68.49 \ \text{\text{\text{pm}} } 1.83 \ \text{km/s/Mpc}$, compatible with the cosmological measurement from the Planck satellite.
HectoMAP and Horizon Run 4: A Cosmological Test with Large-scale Structures at Intermediate Redshifts

*Oral talk*

*Ho Seong Hwang (KIAS/Korea)*

HectoMAP is a dense redshift survey of red galaxies covering a 53 square degree strip of the northern sky, and Horizon Run 4 is one of the densest and largest cosmological simulations based on the standard Lambda cold dark matter model. We use HectoMAP and Horizon Run 4 to compare the physical properties of observed large-scale structures with simulated ones in the redshift range $0.22 < z < 0.44$. We find that the properties of the largest over- and under-dense structures in HectoMAP are well within the distributions for the largest structures drawn from 300 Horizon Run 4 mock surveys. Overall the size, richness and volume distributions of observed large-scale structures when the universe is ~10.3 Gyrs old are remarkably consistent with predictions of the standard Lambda cold dark matter model.
Studies of QSO host galaxies

Invited talk

Yiping Wang (NAOC/China)

Significant evidence exists for a connection between growth of massive black holes and their host galaxy formation in the nearby Universe. However, new findings of monster black holes formed less than a billion years after the big bang seem to challenge the current understanding of the growth path of massive black holes.

Therefore, studies of high-z quasars and their host galaxies towards the peak epoch of star-forming/AGN activities at $z \sim 3$ and beyond, would open an important avenue to look at the early growth phase of supermassive black holes and feedback from the AGN activities.

In this presentation, I will begin with a brief review of previous works on this subject, and describe our pilot observations and studies of high-z quasar host galaxies. Limits of current research and possible breakthroughs using galaxies. Limits of current research and possible breakthroughs using future large facilities will be discussed finally.
Low redshift Lyman–alpha blobs

Oral talk

Mischa Schirmer (Gemini Observatory/Chile)

Lyman–alpha blobs (LABs) are mysterious ionized clouds commonly found in the high redshift Universe at $z>1-2$. With luminosities of $10^{42-44}$ erg/s and sizes of several 10 kpc, they are amongst the most powerful Lyman–alpha emitters known. Many LABs exhibit severe ionization deficits, i.e. we do not know what causes their ionization. Amongst others, hidden star bursts and AGN, shock heating, and gravitational cooling have been proposed. I propose that AGN variability in combination with the delayed release of resonant Lyman–alpha photons naturally explain the ionization deficits seen. I will also present ample observational evidence that a handful of LABs may still exist in the low redshift Universe at $z=0.3$, 3-7 billion years later than previously thought.
Far-infrared emission from the host galaxies of quasars at z>6

Oral talk

Ekaterina Koptelova (NCU/Taiwan)

The huge amount of warm dust discovered in the host galaxies of bright z~6 quasars implies a vigorous star formation in early epochs. Probing the dust emission at these epochs is critical as it constrains the time scale of dust formation, the source of dust heating and black hole–bulge growth. We discuss the dust properties of the host galaxies of z~6 quasars and present our project on observations of their dust continuum emission with ALMA.
Multiple stellar populations in the halo and bulge of the Milky Way

Invited talk

Young-Wook Lee (Yonsei University/Korea)

The presence of multiple stellar populations is now well established in most globular clusters in the Milky Way. Here we show that the Oosterhoff period groups and the double red clump observed in the halo and bulge, respectively, are another manifestations of the same multiple population phenomenon observed in halo globular clusters. We will discuss the implications of this result on the formation of the halo and bulge of the Milky Way and on the stellar populations of early-type galaxies.
Star formation laws in galaxies near and far

Invited talk

Yu Gao (Purple Mountain Observatory/China)

One of the fundamental questions in modern astrophysics is to understand how star formation (SF) process works across all star-forming systems near and far. The relations between the gas and SF rate (SFR) in galaxies are termed as Schmidt or the Kennicutt–Schmidt (K–S) laws that are widely used in astrophysics. Many fundamental issues, however, remain largely unanswered. The global SF laws are reexamined in a large sample of 181 local star-forming galaxies with FIR luminosities (SFR) spanning almost five orders of magnitude. The ΣSFR is a steeper function of the total gas Σgas (molecular gas together with atomic gas) than that of molecular gas ΣH2. The high-dipole moment molecules such as HCN and CS trace much denser molecular gas than that of CO (the total molecular gas mass tracer). HCN linearly correlates with the far-infrared (FIR) emission for essential all star-forming systems near and far, CS observations in galaxies further demonstrate similarly tight correlations. The locally resolved FIR–HCN correlation, a local SF law in terms of dense molecular gas across the spiral disks is also established. Herschel SPIRE/FTS observations of high-J CO lines in ~170 galaxies reveal all linear correlations between the FIR and high-J CO. The surface density of dense molecular gas has the tightest and linear correlation with that of SFR. Such tight linear FIR–dense molecular gas correlations suggest that the SFR depends linearly upon the mass of dense molecular gas and the tiny dense cores in GMCs might be the basic units of massive SF in galaxies. This is drastically different from the traditionally established K–S laws that relate the total gas and SFR in galaxies since there are no unique slopes in these correlations. The immediate implication is on the modes of SF in galaxies because the dense cores are the sites of the active SF, and thus the basic units in contributing to the SF. The SFR depends essentially linearly upon the mass of dense molecular gas.
Infrared Medium–Deep Survey

Oral talk

Myungshin Im (SNU/Korea)

We will present the highlights from the Infrared Medium–deep Survey (IMS), a NIR imaging survey over 120 deg$^2$ to the depth of 23 AB mag. The main aims of the survey are (i) to uncover and characterize high redshift quasars, (ii) to identify superclusters/clusters at high redshift and study galaxy evolution and cosmology, and (iii) to follow-up interesting transients such as gamma–ray burst, supernovae, and tidal disruption events. The highlights from the survey will include topics such as discovery of faint quasars at $z \sim 5$ to 6 and their implications to the cosmic re–ionization, and a supercluster at $z \sim 1$ as a means to constrain cosmological models.
Star–formation Properties and Large Scale Structures of High–redshift Galaxies

Oral talk

Seong–Kook Lee (SNU/Korea)

Understanding the effects of environment or large scale structure in which galaxies reside on their star formation properties is crucial in the appropriate understanding of galaxy evolution and structure formation. We present the results of our study based on the investigation of high–redshift galaxy clusters found in UDS. We found both of the stellar–mass and the redshift dependence on the environmental effects on the star–formation properties of galaxies in the redshift range of 0.5<z<2, while stellar mass plays more dominant role than the environment) in the cessation of star–formation in galaxies. We also observe a cluster–by–cluster variation in their star–formation properties even at similar epoch.
The Impact of Star–Formation Recipes on numerical Simulations of Dwarf Galaxy Evolution

Oral talk

Gerhard Hensler (University of Vienna/Austria)

The implementation of star formation (SF) in numerical simulations on galaxy scales and cosmological structures is still a matter of debate and multiple indispensable experiments. The reason for this are the sub–grid physics of SF and stellar feedback. A large variety of different methods have been developed and applied over the last decades. Nevertheless, it becomes clear that no universal but scale–dependent parametrizations have to be implied but need careful tests in which way parameter sets affect the models.

In order to examine this issue further, we perform N–body/SPH simulations of isolated dwarf galaxies for different SF recipes, one with the commonly used SF threshold prescription and one derived analytically under the assumption of SF self–regulation. Using the public version of Gadget–2 with self–implemented sub–resolution physics, we discuss differences between the SF recipes but also by variations of further free parameters on SF rates, gas dynamics, and galactic chemical evolution. Moreover, we compare models of this usually applied single–phase gas description with an advanced multi–phase chemo–dynamical particle code.

The main issues are: Arbitrarily implied parameters, like e.g. the cooling shut–off time, show strong effects on both different SF recipes; the system reacts very sensitively on the choice of the gravitational softening length, which also affects the SF; if the supernova efficiency is chosen too high, a dwarf galaxy can easily be disrupted; the chemical abundances are much better reproduced by a multi–phase gas treatment.
Morphology and Environment of Dwarf Galaxies

Oral talk

Hong Bae Ann (PNU/Korea)

We present the environment dependence of the morphological types of dwarf galaxies from SDSS DR7 using the visually classified morphological types. The present sample of dwarf galaxies is a representative dwarf sample of local galaxies with \( z < 0.01 \). There are two broad types of dwarf galaxies: dwarf elliptical-like galaxies and dI galaxies. The dwarf elliptical-like galaxies are divided into 5 sub-type (dE, dEbc, dSph, dEblue, naD dS0). The dEbc and dEblue galaxies are dwarf elliptical galaxies with blue core and global blue color, respectively. The dEblue galaxies resemble HII region-like BCDs but somewhat less blue colors. They comprise a significant fraction of the dwarf galaxies. There are some morphological differences between dE and dSph. The dSph galaxies are fainter and bluer with shallower surface brightness gradient than dE. However, there seems to be no appreciable difference in the environment of dE and dSph galaxies. Both types of dwarf galaxies are likely to be located in the denser regions while dEblue galaxies are predominated in the under-dense regions. The dEbc galaxies show some preference for the under-dense regions but they are frequently found in the dense regions. The dS0 galaxies are likely to be located in the environment similar to that of dE and dSph but slightly less preference for the densest regions.
The Virial Relation and Intrinsic Shape of Early-Type Galaxies

Oral talk

Sascha Trippe (SNU/Korea)

Early-type galaxies (ETGs) are supposed to follow the virial relation $M \sim \sigma^2 \cdot R_e$, with $M$ being the galaxy mass, $\sigma$ being the stellar velocity dispersion, and $R_e$ being the (2D) effective radius. I apply this relation to (a) the ATLAS3D sample and (b) the sample of Saglia et al. (2016). The two datasets reveal a statistically significant tilt of the empirical relation relative to the theoretical virial relation such that $M \sim (\sigma^2 \cdot R_e)^{0.92}$ with zero intrinsic scatter. This tilt disappears when replacing $R_e$ with the semi-major axis of the projected half-light ellipse, $a$. Accordingly, $a$, not $R_e$, is the correct proxy for the scale radius of ETGs. By geometry, this implies that early-type galaxies are axisymmetric and oblate in general, in agreement with published results from modeling based on kinematics and light distributions.
Disk Formation in the Early Phase of Star Formation

*Invited talk*

Chin-Fei Lee (ASIAA/Taiwan)

We have observed a few young protostellar systems with ALMA. In this talk, I will present our results about the disk formation in the early phase of star formation,
Transitional disks: structure, origin and evolution

Invited talk

Ewine van Dishoeck (Leiden Observatory/Netherlands)

Transitional disks with large inner dust cavities are thought to be the best laboratories for studying disk evolution during the planet-forming stage and for harboring just-formed planets. Little is known about the gas inside dust cavities, yet this gas significantly affects planet formation through gas-grain dynamics (dust trapping in pressure bumps) and planetary migration, whereas its chemistry determines the composition of gas-giant atmospheres. Recent ALMA observations of CO and its isotopologs are analyzed together with the dust in a number of transitional disks using sophisticated physical-chemical models. Gas cavities are found to be significantly smaller than those of the dust, providing constraints on the origin of the gaps and on the properties of any embedded young planets through comparison with hydro simulations. The origin of the highly asymmetric dust distributions seen in some (but not all) disks will be discussed.
ALMA Observations of Spiral Accretion Flows towards
Class 0 source VLA1623A with a Keplerian disk

Oral talk

Shih-Ping Lai (NTHU/Taiwan)

Studying the accretion flows toward Class 0 sources is an important step toward understanding how the protostars are assembled in the early stage of star formation. Here we investigate the accretion flows in an extremely young Class 0 protostar VLA1623A with a Keplerian disk likely just formed (Murillo et al., 2013). The accretion flows are commonly seen in the MHD numerical simulations (Li et al., 2014; Seifried et al., 2015); however, it is rarely observed in Class 0 sources. Here we report our discovery of \( \sim 5000 \) AU long accretion flows toward VLA1623 in C18O emission with ALMA observations. ‘Dendrogram’ algorithm (Goodman et al., 2009) are used to identify the accretion flows, and we find the three brightest ‘branches’ and their associated ‘leaves’ likely correspond to the spiral structure flowing toward the central young cluster. We further compare the PV diagrams of the three accretion flows to the CMU model (Ulrich 1976; Cassen & Moosman 1981) which describes the velocity structure of the gas accreting to the central protostar with constant angular momentum, and we find that our identified branch structures well match with the CMU model.
Inner warm disk of Class I ESO Hα279a revealed by NaI and CO overtone emission lines

Oral talk

A-Ran Lyo (KASI/Korea)

We present analysis of near-infrared, high-resolution spectroscopy towards the Class I YSO (Young Stellar Object) ESO Hα 279a (1.5MO) in the Serpens star forming region, at the distance of 429 pc. Employing the Immersion GRating INfrared Spectrometer (IGRINS, R ≈45,000), we detect emission lines originating from the accretion channel flow, jet, and inner disk. ESO Hα 279a is a unique YSO which has all of inner disk tracers of Ca I, Na I, H2, H2O and CO overtone emission lines in the K-band covering a wide temperature range of 100 ~ 5000 K. By modeling five bands of CO overtone emission lines, and the symmetric double-peaked line profile for Na I emission lines, we find that ESO Hα 279a has an actively accreting Keplerian disk. From our Keplerian disk model, we find that CO overtone emission lines are from the range between 0.22 AU and 3.00 AU, while Na gas disk is in the range of 0.04 ~ 0.78 AU. It reveals that Na gas traces the more inner part of the disk compared to that of CO gas. The derived inner radius of Na gas disk is close to the typical corotation radius, 0.03 ~ 0.08AU, and is also consistent with the minimum semi-major axis of exoplanets.
SEEDS direct imaging survey of exoplanet and disks, and next steps

Invited talk

Nobuhiko Kusakabe, Motohide Tamura (NAOJ, Universtiy of Tokyo/Japan)

The SEEDS survey of exoplanets and disks is the first Subaru Strategic Program, whose aim is to conduct a direct imaging survey for giant planets as well as protoplanetary/debris disks at a few to a few tens of AU region around 500 nearby solar-type or more massive young stars. Our team composed of ~120 members at maximum has successfully completed 120–night observations during 2009 and 2015. The targets are categorized into five categories spanning the ages of ~1 Myr to ~1 Gyr (YSOs, Moving Groups, Open Clusters, Nearby stars, Debris Disks). Some RV–planet targets with older ages are also observed. We have discovered a few exoplanets and candidates via direct imaging and uncovered detailed Solar–system–scale structures such as gaps and spirals in many protoplanetary disks. We highlight the main results from this survey on both planets/companions and disks, and then introduce the next–generation instruments for exoplanet studies for Subaru.
The "TOP–SCOPE": Follow–up observations of Planck cold clumps with ground–based telescopes.

*Oral talk*

*Tie Liu (KASI/Korea)*

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.
Evidence for dynamically important magnetic fields on massive star–formation in RCW57A

Oral talk

Eswaraiah Chakali (NTHU/Taiwan)

While the low mass star–formation has been understood considerably well, the processes governing massive star–formation have not been well understood. Especially, the role of B–fields relative to turbulence and gravity has been remain poorly constrained. Using near–infrared polarimetry towards a massive star–forming region RCW57A, we have evidenced morphological correlations among the filament, bipolar bubble and magnetic fields. These results shed light on the implications towards the understanding on formation and fragmentation of filament into massive clumps, to cores, and subsequently to stars. The cores embedded in dense filament of RCW57A are associated with water/methanol maser sources, and are predicted to be forming massive Class 0/I protostars. In this talk I will present our findings towards understanding the influence of magnetic fields not only in the star and cluster formation, but also on feedback process such as regulation of both outflows and expanding ionization fronts to form conspicuously spectacular bipolar bubbles.
BISTRO: B–fields In STar–forming Region Observations

Oral talk

Woojin Kwon (KASI/Korea)

We introduce a magnetic field survey of the Gould Belt clouds using the James Clerk Maxwell Telescope (JCMT) POL-2: B–fields In STar–forming Region Observations (BISTRO). POL-2 with SCUBA-2 on JCMT is a unique facility, as it is the only facility world–wide that can map the magnetic field within cold dense cores and filaments on scales of ~1000 AU in nearby star–forming regions, such as Taurus and Ophiuchus. It can provide a link between the B–field measured on arcminute scales by Planck and BLASTPOL and measurements made on arcsec scales by interferometers such as CARMA, SMA, and ALMA. BISTRO was awarded 224 hours toward 16 fields for the next 3 years and started to take data in the 2016A semester.
Magnetic field structure and investigation of radiation driven implosion in BRCs

Oral talk

Archana Soam (KASI/Korea)

Bright-rimmed clouds (BRC) are formed at the periphery of H II regions as the radiation from the central star interacts with dense gas. The ionization and resulting compression of the clouds may lead to cloud disruption causing secondary star formation depending on the stellar and gas parameters. We used R-band optical polarimetry to probe the plane-of-the-sky magnetic field in the two near-by BRCs IC\,59 and IC\,63. The both nebulae are illuminated by the B0,5 IVe star $\gamma$ Cas, but located close to parallel and perpendicular to the star, relative to the local magnetic field, allowing us to probe the importance of magnetic field pressure in the evolution of BRCs. Along with this, we are carrying out a survey of molecular line in nearby BRCs using TRAO facility in KASI. This study will help in understanding the kinematics of these clouds. In addition to the aim of studying 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 present the magnetic field structure in two BRCs and will show some preliminary results of our molecular line studies towards some of the BRCs using TRAO.
Disruption of Molecular Clouds by Expansion of HII Regions

Oral talk

Jeong-Gyu Kim (SNU/Korea)

Expanding H II regions around young massive stars are believed to have important impacts on the dynamical evolution of their parent molecular clouds by expelling residual gas and quenching star formation. We present results of three-dimensional simulations of star formation in turbulent molecular clouds with the effects of photoionization and radiation pressure included. We use the Athena code with adaptive ray tracing to describe propagation of radiation from multiple point sources. We find that for typical giant molecular clouds in the Milky Way, photoionization is efficient in driving outward gas motions with net star formation efficiency of ~10%. For more dense and massive clouds, on the other hand, radiation pressure is more important for removing gas with higher efficiency, consistent with the predictions of recent analytic models.
Studies of the Sun with Hinode and Numerical Simulations

Invited talk

Takaaki Yokoyama (University of Tokyo/Japan)

The ten years of the Hinode observations have changed our view of the solar atmosphere, especially of the chromosphere. Dynamic aspects of the chromosphere, such as waves, instabilities, jets, rapid brightenings, were revealed by the high resolution and high cadence movies taken by the Solar Optical Telescope on the spacecraft. Along with the observations, the numerical simulations for such phenomena have been advanced incorporating not only the magnetohydrodynamics but also the effects of the radiative transfer, and the non-isotropic thermal conduction etc. This talk is for reviewing the recent progress in solar physics with Hinode and numerical simulations. The future prospect beyond Hinode by our proposing SOLAR-C project will also covered.
Three-minute Chromospheric Oscillations in Sunspots

Invited talk

Jongchul Chae (SNU/Korea)

We consider the physics of three-minute oscillations in sunspots. Three-minute oscillations prevail in the solar chromosphere, whereas in the photosphere the famous five-minute oscillations dominate. The five-oscillations represent standing acoustic waves trapped in the interior of the sun, but the three-minute oscillations are acoustic waves dispersively propagating in a gravitationally stratified medium. We provide a theoretical explanation why three-minute oscillations become the fundamental oscillations in the chromosphere, and how the three-minute oscillations nonlinearly develop during the upward propagation.

We also provide our recent observational findings of wave generation and shock merging relevant to three-minute oscillations from the observations done with the Fast Imaging Solar Spectrograph of the 1.6 meter New Telescope at Big Bear Solar Observatory.
Space reconstruction of the morphology and kinematics of axisymmetric radio sources

Oral talk

Diep Pham Ngoc (VNSC/Vietnam)

The unprecedented quality of the observations available from the Atacama Large Millimetre/sub-millimetre Array (ALMA) calls for analysis methods making the best of them. Reconstructing in space the morphology and kinematics of radio sources is an underdetermined problem that requires imposing additional constraints for its solution. The hypothesis of rotational invariance, which is a good approximation to, or at least a good reference for the description of the gas envelopes of many evolved stars and protostars, is particularly efficient in this role. In a first part, a systematic use of simulated observations allows for identifying the main problems and for constructing quantities aimed at solving them. In particular the evaluation of the orientation of the star axis in space and the differentiation between expansion along the star axis and rotation about it are given special attention. The use of polar rather than Cartesian sky coordinates to display the results of the analysis is shown to often better match the morphology and kinematics of actual stars. The radial dependence of the gas density and temperature and the possible presence of velocity gradients are briefly considered. In a second part, these results are applied to a few stars taken as examples with the aim of evaluating their usefulness when applied to concrete cases. A third part takes stock of what precedes and formulates some guidelines for modelling the radio emission of axisymmetric radio sources, limited however to the mathematics and geometry of the problem, physics considerations being generally ignored.
Probing the Accretion Induced Collapse of White Dwarfs in Binary Millisecond Pulsars

*Oral talk*

Ali Taani (Al Balqa Applied University/Jordan)

The Recycling process is usually considered as a standard model to produce Millisecond Pulsars (MSPs), I discuss another possible channel involving the Accretion Induced Collapse (AIC) of a white dwarf (WD) in binaries. As accreting binaries lead to orbit circularization due to tidal coupling during the accretion phase, Low–Mass X–Ray Binaries (LMXBs) are considered to be the progenitors of MSPs with very short orbital periods (Porb < 2 d) and highly circular orbits (e < 0.1). This paper investigate the progenitors of MSPs with a distribution of long orbital periods, to show the link between WD binaries and long orbits for some binary MSPs. For this task, I present a model that attempts to turn binary MSPs into wide binaries with high eccentricities, through the asymmetric kick imparted to the pulsar during the AIC process, since the AIC process in a close binary will impart a sizeable kick velocity expected to exceed (∼ 50 – 150km/s) to the thus formed NS. This can result due to the effect of shock wave, binding energy plus the mass loss (0.2M☉). I indicate specific pulsar systems where the results of this work are relevant to AIC–candidate. If the system survives, the resulting system typically has an eccentric orbit (e > 0.1) with a long orbital period (Porb > 2 d). Or it may disrupt the system and create a single MSP. Finally, the AIC in turn play a key role in understanding the formation of NSs in globular clusters (since WD populations are very large in these clusters, that AIC could potentially be the dominant NS forming mechanism in such clusters) and in LMXBs (which may later evolve into MSPs through the usual recycling process).
Solar signatures in ice cores

Invited talk

Yuko Motizuki (RIKEN, Saitama University/Japan)

Solar UV radiation and solar protons arising from solar activity cause changes in the chemical composition of the stratosphere, which extends from about 10 – 50 km above the earth’s surface. The effects of solar activity on the stratosphere are recorded in the chemical composition of ice cores. Those effects in the ice cores obtained from the Dome Fuji (DF) station in Antarctica are measurably more significant than the effects in every other ice core studied in the two hemispheres, as reported elsewhere (Fourré et al., 2006). It is also important to note that changes in 18O and 16O isotope concentrations in ice cores are an established proxy for temperature changes on the surface of the earth (Masson-Delmotte et al., 2008). Traversi et al. (2012) analyzed the nitrate ion (NO3−) concentrations in a Talos Dome (Antarctica) ice core, and showed, but only statistically, that the signatures of 11–year and 70 – 100 year Gleissberg solar cycles were identifiable in the parts of the ice core that corresponded with the period from 1713 – 1913 AD with variability of 10 – 25%. Every solar cycle, however, was not resolved because of meteorological noise in the data. In this presentation, we report that the annually–resolved NO3− concentrations in the ice cores we obtained from the DF station are a better proxy of past solar activity than the NO3− concentrations reported for the Talos Dome ice core. The results of analyses of oxygen isotopes in ice cores will also be discussed. A direct relationship between past solar activity and the oxygen isotope temperature proxy, in DF ice cores, is revealed for the first time.
Molecules in S–type AGB stars

Oral talk

Xiaohu Li (ASIAA, NAOC/Taiwan)

The composition of S-type Asymptotic Giant Branch (AGB) stars, which have C/O ratios of approximately one and the circumstellar envelopes (CSBs) possessing the dual chemical features of both C-rich (C/O >1) and O-rich (C/O <1) stars, is less-known. In this talk I will present the latest simulation results on the most detectable species presenting in the CSEs of S–type stars. This is based on the significant progress from recent Herschel/HIFI observations plus the improvement in accurately studying the chemical influence of N2 (and CO) photodissociation in a 3D radiation field,
Circumstellar Spirals/Shells/Arcs: the Messages from Evolved Stars

*Oral talk*

Hyosun Kim (ASIAA/Taiwan)

Evolved stars are the birth places of the chemical elements, and their extensive mass loss provides an important source of gas and dust to the interstellar medium. An understanding of the late stellar evolution and the nature of the mass loss process is important input for studies of the chemical evolution of a galaxy and the formation of next generations of stars. Of particular interest, here, is that the outflowing matter is highly structured shaped in the form of arcs, shells, and spirals. Ever since the first discovery of a circumstellar spiral pattern of a heavily mass-losing evolved star, a paradigm whereby such patterns are induced by the orbital motions of the (postulated) central binary stars was emphasized. In addition, many ring-like patterns observed for longer than a few decades can be explained by the same spiral-shell pattern, but viewed at different angles. Recent high-resolution high-sensitivity molecular line maps from the ALMA and other sub-mm/mm interferometers facilitate new detections of circumstellar spiral-like patterns, and therefore the spirals/shells/arcs have led to a resurgence of interests. In this presentation, I will describe the impact of binaries on the evolution of the late stages of stellar evolution. In particular, I suggest that the coexistence of bipolar (or multipolar) structures and shell-like patterns can both be understood within the framework of unified model.
Crystalline silicates in external galaxies

*Oral talk*

*Ciska Kemper (ASIAA/Taiwan)*

Observational evidence has long supported that most of the interstellar silicates in galaxies are amorphous, meaning that while the basic silicate tetrahedra are present to give rise to the 9.7 and 18 μm Si–O stretching and O–Si–O bending modes, the lattice shows defects, and the chemical composition may be non-stoichiometric. While crystalline silicates may form around evolved stars at temperatures sufficiently high to allow for annealing, it is thought that the harsh interstellar environment quickly amorphizes any crystalline silicates, most likely through bombardment by the heavy ions in cosmic rays (Demyk et al., 2001; Jäger et al., 2003; Brucato et al., 2004; Bringa et al., 2007; Szenes et al., 2010), and a firm upper limit of 2% on the crystalline fraction of silicates was derived based on the absence of substructure in the 9.7 μm feature (Kemper et al., 2004; Kemper et al., 2005).

Traditionally, silicates in the interstellar medium of external galaxies were also assumed to be completely amorphous. The first detection of crystalline silicates in external galaxies was reported by Spoon et al. (2006) in 12 out of a sample of 77 starbursting Ultraluminous Infrared Galaxies (ULIRGs), with Roussel et al. (2006) adding a 13th galaxy, NGC 1377, to this sample. More recently, Willett et al. (2011) analysed mid-infrared spectra of 51 OH megamas er galaxies, finding that 19 of them show one or more of the crystalline silicate features between 11 and 28 μm in absorption, while Stierwalt et al. (2014) report the detection of crystalline silicates in 6% of the objects in a sample of 244 LIRG nuclei. The most spectacular detection is done by Aller et al. (2012), who report interstellar silicates with a crystallinity of ~95% in a foreground absorbing galaxy towards a quasar background source. The only other study quantifying the crystalline fraction is the aforementioned work by Spoon et al. (2006), who report a crystalline fraction of 6–13% in their interstellar silicates (when detected), using the definition for crystallinity by Kemper et al. (2004). A very simple model of the production of crystalline silicate dust by evolved stars, at a level of 10–20% of the total silicate dust production by these stars, is able to explain the observed crystallinities at about 30 Myr after the start of a starburst (Kemper et al., 2011). In general, the model can be used to estimate the transition time and interstellar conditions, such as cosmic ray fluence, based on observational constraints on the crystalline fraction.

However, the small number of known interstellar crystalline silicate fractions in star–forming galaxies limits the usefulness of such a model. We have devised a method to measure the crystalline fraction of silicates in a large number of galaxies quickly and easily. For this purpose, we are performing radiative transfer models of starburst galaxies, with varying crystalline fractions of their interstellar silicates using the SKIRT radiative transfer code (Camps & Baes 2015), and identified a method to determine the crystallinity of silicates in starburst galaxies directly from (archival) infrared spectroscopy.
Diffuse Interstellar Bands from SDSS DR7 normal galaxies

Oral talk

Bo Zhang (NOAC/China)

Over the ~100 years since the first discovered Diffuse Interstellar Bands (DIBs), various molecules have been proposed as the carriers of DIBs. However, before Campbell et al. (2015) identified the carrier of DIB 9577 and 9632, except ~400 DIBs were discovered, we know little about the composition of DIB carriers, where they come from, how they form, and how they response to the change of environment.

The cumulation of observations toward the Galactic stars provides chances to improve our knowledge of DIBs, while the analysis of DIBs in extra-galaxies were fragmentary. Utilizing ~100,000 spectra of normal galaxies from SDSS DR7, we measured integrated Equivalent Width (EW) of three of the strongest DIBs in the optical region, i.e., DIB 5780 5797 and 6284, after the removal of stellar features, and constructed the largest set of DIB measurements toward extra-galaxies so far.

The galaxies show clear bi-modal distribution in EW(DIB)–Av diagram. Using Dn(4000) as the indicator of mean age of the stellar populations, we find that young galaxies show strong DIB features and large extinctions while the old galaxies concentrate around the original point. Surprisingly the EW(DIB)/Av ratio does not change significantly with Dn(4000), and the EW(DIB)–Av measurements are quite consistent with the Milky Way results.
Recent Results of KaVA AGN Science WG

*Oral talk*

**Bong Won Sohn (KASI/Korea)**

KaVA stands for KVN and VERA Array which is a Korean–Japanese joint VLBI facility. Here we briefly present the imaging capabilities of KaVA array which actually achieves more than three times better dynamic range than that achieved by VERA or KVN alone. The KaVA images clearly show detailed structures of extended radio jets in AGNs. With the improved imaging capabilities, we proposed the KaVA AGN Large Program. We launched the intensive monitoring observations of two super-massive black holes, Sgr A* and M87. The main scientific goals of the program are (i) testing magnetically-driven–jet paradigm by mapping velocity fields of the M87 jet and (ii) obtaining tight constraints on physical properties of radio emitting region in Sgr A*. 
Structural Transition in the NGC 6251 Jet: An interplay with the Supermassive Black Hole and Its Host Galaxy

*Oral talk*

Chih-Yin Tseng (ASIAA/Taiwan)

The structure of the NGC 6251 jet at the milliarcsecond scale is investigated utilizing the images taken with the European VLBI Network and the Very Long Baseline Array. We report a detection of a jet structural transition from a parabolic to a conical shape at a distance of $(1.2) \times 10^5$ times the Schwarzschild radius from the central engine, which is close to the sphere of gravitational influence (SGI) of the supermassive black hole (SMBH). We also examine the jet pressure profiles with the synchrotron minimum energy assumption to discuss the origin of the structural transition. The NGC 6251 jet, together with the M87 jet, suggests a fundamental process of the jet structural transition in active galactic nuclei (AGN). A collimated AGN jet (by the external gas pressure) is subject to a free expansion beyond the SGI of the SMBH, which interplays with the SMBH and its host galaxy.
Radio Activity of BL Lacertae During Gamma-ray Outbursts

Oral talk

Daewon Kim (SNU/Korea)

We present our observational results of BL Lacertae(BLLAC) obtained by Korean VLBI Network(KVN) at 22, 43, 86, and 129 GHz simultaneously to study a connection between gamma-ray outbursts and radio activity. The observation was performed for 38 months (Jan, 2013 ~ Mar, 2016) which includes two gamma-ray flaring in BLLAC. During the entire epochs, the radio emission of BLLAC shows a smooth, exponential decay. We have found a VLBI core at the center of map, and one quasi-stationary jet component which is moving component on the south of the core. Overall, our observational results do not show any significant connection between the gamma-ray outbursts and radio activity in BLLAC.
Multi–frequency AGN Survey with the KVN (MASK)

Oral talk

Taehyun Jung (KASI/Korea)

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, which aims to densify an existing a VLBI catalog of extragalactic radio sources at 22/43/86/129GHz is proposed as a KVN legacy program. We selected 1220 sources of AGNs that include existing VLBI sources and new fringe–detected sources using the KVN at K–band (22GHz). Among them, 138 sources were observed in the first run and we achieved excellent results on the VLBI detection of them.
Influence of Magnetic Fields on Molecular Cloud Evolution and Turbulence

Oral talk

(The Chinese University of Hong Kong /Hong Kong)

We present recent observational evidence that magnetic fields in the interstellar medium (ISM) are dynamically important during formation and fragmentation of molecular clouds. The fields are found to be well-ordered and preserve their orientation on scales from 100 pc to below 0.1 pc, so that they can guide gravitational contraction and channel sub-Alfvenic turbulence. Furthermore, we have studied the influence of magnetic fields and gravity on ISM turbulence using numerical simulations, and we show that the disappearance of turbulence anisotropy in high-density regions is not necessarily due to super-Alfvenic conditions, but can be attributed to gravity.
Three-dimensional Shock Structure of Orion KL Outflow with IGRINS

Oral talk

Heeyoung Oh (KASI, SNU/Korea)

We report study of the three-dimensional (3D) outflow structure of a 15" x 13" area around H2 peak 1 in Orion KL with slit-scan observations (13 slits) using the Immersion Grating Infrared Spectrograph (IGRINS). We identified 31 distinct outflow fingers from channel maps of H2 1-0 S(1) 2.122 micron emission line. The line profile at each finger shows multiple-velocity peaks with strong low-velocity component around systemic velocity at $V_{\text{LSR}} = +8$ km/s and high velocity at $|V_{\text{LSR}}| = 45-135$ km/s, indicating the typical bow-shock. The radial velocity gradients of $\sim$ 4 km/s/arcsec agree well with large-scale proper motions, which indicate "Hubble Flow". The extinction variation (Delta $A_v > 10$ mag) in blueshifted and redshifted fingers indicates high internal extinction. The inclination angles of fingers are $57 - 74$ degree, which are estimated from full width zero intensity (FWZI) of bow-shock profiles and radial velocity. The radial velocity gradients and the 3D distributions of fingers together support the hypothesis of simultaneous, radial explosion of the Orion KL outflow.
Molecular bubbles unveiling the progenitors of supernova remnants

Oral talk

Ping Zhou (Nanjing University/China)

The past decades have shown us that many supernova remnants (SNRs) are surrounded with molecular shells or bubbles. The shells or bubbles were regarded as wind blown structures created by the massive progenitor stars, thus providing unique boundary conditions to constrain the wind activities of the massive progenitor stars. While the progenitors of SNRs are notoriously hard to determine, molecular bubbles give a valuable way to estimate the masses of core-collapse SNRs.

Molecular bubbles also help us to unveil the progenitor of Type-Ia supernova, which has been a highly debated topic. To address the origin of the famous Type Ia SNR Tycho, SN 1572, we have carried out a 12CO J=2−1 mapping and a 3-mm line survey toward the remnant using the IRAM 30 m telescope. We prove the physical interaction between Tycho and a molecular cloud, and find the expansion (v~4.5 km/s) of the molecular bubble. The most plausible origin for the expanding bubble is the fast outflow (with velocity of hundreds km s⁻¹) driven from the vicinity of a white dwarf as it accreted matter from a non-degenerate companion star. This is the first unambiguous detection of an expanding bubble driven by the progenitor of a Type-Ia SNR, which constitutes evidence for a single-degenerate progenitor for this SN Ia.
A Supernova Remnant Candidate in the UWIFE Survey

Oral talk

Yesol Kim (SNU/Korea)

We report the discovery of a new supernova remnant (SNR) candidate identified in the narrow-band [Fe II] 1.644 um line imaging survey, UWIFE (UKIRT Wide-field Infrared Survey for Fe). UWIFE survey covers the Galactic plane first quadrant (7° < l < 62°, b|l < 1.5°), and, by visual inspection, we identified about 300 extended Ionized Fe objects (IFOs). The majority of IFOs have SNRs, young stellar objects, HII regions, and planetary nebulae as their counterpart. However, about 12% of IFOs are not associated with any known celestial objects, and the SNR candidate, IFO J183740.829–061452.41 (hereafter IFO J183740) is one of those.

IFO J183740 is a 6′-long, faint, arc–like filament with small–scale irregular structures. It seems to be a part of a circular loop, however the rest of the loop is not seen in [Fe II]. It is found to coincide with a well–defined radio continuum arc. The radio arc has a complicated structure and IFO J183740 coincides with the bright inner part of the arc. Hydrogen recombination lines have been detected toward the arc from low–resolution surveys, so it has been known as an HII region (G25.8+0.2) with a kinematic distance of 6.5 kpc. But the inside of this radio arc is filled with soft X–rays, while, just outside the arc to the north, there is hard X–ray nebulosity which central young pulsar. Therefore, the nature of the arc–like structure based on radio and [Fe II] emission is uncertain.

In this presentation, we report the results of spectroscopic follow–up study of IFO J183740 using IGRINS (Immersion Grating Infrared Spectrograph) which is high spectral resolution (R~40,000) spectrograph covering H and K–bands simultaneously. We found that the [Fe II] filaments are spatially and kinematically distinct from the HII structure. The intensity ratios of [Fe II] to Bry lines imply that the HII structures are photoionized while the [Fe II] filaments are shock–ionized, which supports the SNR origin for IFO J183740. We discuss the association of IFO J183740 with other sources in the vicinity.
Special Session: Women in Astronomy
Roles of Women Astronomers In IAU

Oral talk

Ewine van Dishoeck (Leiden Observatory/Netherlands)

The International Astronomical Union (IAU) is the organization of professional astronomers worldwide with some 12,000 members spread over 100 countries. It was founded in 1919 and its mission is to promote and safeguard the science of astronomy in all its aspects through international cooperation. Its individual members are astronomers at the Ph.D. level and beyond, and active in professional research and education in astronomy. The IAU sponsors nine high profile international scientific symposia each year, as well as regional IAU meetings, schools for young astronomers, and the General Assembly every three years (to be held in Korea in 2021). Among the other tasks of the IAU are the definition of fundamental astronomical and physical constants; unambiguous astronomical nomenclature; promotion of educational activities in astronomy; naming of celestial bodies; and informal discussions on the possibilities for future international large-scale facilities. Since 2010, the IAU has created the Office of Astronomy for Development (OAD), a joint venture with the South African National Research Foundation as well as with the IAU Office for Astronomy Outreach (OAO), a joint venture with the National Astronomical Observatory of Japan. Regional offices have been created in other countries as well, including in East Asia.

This talk will provide an overview of the activities of women in the IAU. Although disappointingly only 17% of IAU members are women, they have played increasingly visible roles in the IAU over the past decades, from the organization of symposia, focus meetings and women in astronomy events to being presidents, vice presidents, and general secretaries of the Executive Committee. Planned activities to increase the participation of women in the IAU will be outlined and further suggestions are welcomed.
Women Astronomers in Taiwan

Oral talk

You-Hua Chu (ASIAA/Taiwan)

In the past 25 years, astronomy in Taiwan has grown tremendously. As this rapid growth is in modern era, the presence of female astronomers is not significantly affected by the old society. I will report the advances in women scientists’ rights in Taiwan, and suggest ways to retain female scientists in the field.
Women Astronomers in Japan

Oral talk

Yuko Motizuki (RIKEN, Saitama University/Japan)

The present status of women astronomers in Japan is reviewed: Problems are identified. Various approaches to the resolution of the problems are then discussed in the context of the Japanese academic evaluation system, taking into account current trends in the attitudes of Japanese women researchers.
Women Astronomers in China

Oral talk

Yiping Wang (NAOC/China)

I will talk about the role of women astronomers in China based on the statistics, as well as the significant contribution they have made to the development of the Chinese astronomy. The challenges and triumphs of a few key women astronomers in China will be introduced, especially to the young students.
Women Astronomers in Korea

Oral talk

Hyesung Kang (PNU/Korea)

Women Astronomers have been an important part of the development of modern astronomy and will continue to play essential and pioneering roles in the advancement of astronomy in the 21st century. In the Korean Astronomical Society (KAS), about 13% of full members and 35% of student members are female. Since the fraction of female membership is expected to grow in the future, research achievements by women astronomers will be crucial in the success of the KAS and the prosperity of astronomy as science in Korea. In April, 2016, Women-in-Astronomy Division was established within the Korean Astronomical Society with the aims to facilitate interactions among women astronomers and to establish strategies and actions that can help women to attain true equality as research
Women Astronomers in Mongolia

Oral talk

Tsolmon Renchin (National University of Mongolia/Mongolia)

Mongolia has ancient astronomy education. Historically we had astronomical education for nomads. Mongolian women played important role for education. Mongolian women scientist made initiative to build Mongolian observatory and contributed to establishing it. Today’s science departments and institutions in Mongolia has a more higher percentage of women. But there is a very few women astronomers in Mongolia nowadays. For example there is only two or three women astronomers are teaching astronomy in Mongolian Universities. It is important for us to experience and learn lessons and share best practices from international communities on managing and mentoring a successful and diverse scientific professionals in region. This meeting allow us to collaborate and cooperate with women from different region in astronomy field.
Women in Korean Young Astronomers’ Meeting

Oral talk

Joowon Lee (Kyung Hee University/Korea)

Since Korean young astronomers meeting (KYAM) was founded in 1993, KYAM has encouraged the interactions between graduate students and represented the Korean young astronomers in international meetings. Many female members have important roles in KYAM. Here, I introduce what they have contributed to KYAM and the results of a survey targeting the KYAM female members.
Part 5. Historical Astronomy, Astronomy Education and Public Outreach
An analysis of the syllabi of astronomy in Japanese universities

Oral talk

Shigeyuki Karino (KSU/Japan)

Recently, universities in Japan are required to ensure a quality of educations. Hence, each academic society in Japan now intends to determine the guidelines to be taught in the university education. In this study, preparatory for this, we try to grasp and analyze the current situation. At this time, we have already investigated curricula and syllabi offered in more than 150 universities in Japan. Then, we have checked topics taught in lectures of astronomy in Japanese universities. In this presentation, we would like to show the result and share the current problems in astronomical educations. Our final purpose is to propose a standard curriculum of astronomy which can be used all over the world, based on the broadest agreement. For this purpose, we need to have global discussions with a lot of actively working lectures.
Transformable Reflecting Telescope Kit for Astronomical Education

Oral talk

Soojong Pak (KHU/Korea)

We invented TRT Kit (Transformable Reflecting Telescope Kit) for various astronomical education purposes. This kit has a basic opto-mechanical structure with a primary mirror module and an exchangeable secondary module. Students can easily assemble Newtonian, Cassegrain, and Gregorian telescopes by simply replacing the secondary mirrors. In this presentation, we present the design structure of the TRT Kit and possible applications.
Bioastronomy teaching at the U. of Chile (1979–2015)

Oral talk

Luis Campusano (University of Chile/Chile)

Astrobiology was first introduced in the curriculum of a chilean university in the 1980’s, at the School of Engineering and Science of the University of Chile. "Life in the Universe Through Science" has been offered since 2006 as a general course on science to students of all disciplines of the Universidad de Chile. An introductory course in Astrobiology saw light in 2009 at the Faculty of Physical and Mathematical Sciences (FCFM), addressed to more advanced and analytically literate students, and thus possibly preparing future manpower that will develop this science in Chile. The lecturers are a mix of astronomers, geophysicists, geologists, biologists and technologists. We analyze our experience with this course offered in two flavors, its perspectives and significance, and their role to familiarize the university community and the general public to this new science, and also their role to generate new science vocations and research initiatives.
Public outreach activities using Mobile Planetarium

Oral talk

Tsolmon Renchin (NUM/Mongolia)

One of is astronomical activities in rural areas is using Mobile planetarium. NAOJ (National Astronomical Observatory in Japan) donated mobile planetarium to Mongolia in July, 2014. Before having the planetarium we used traditional Mongolian Ger home with round roof. Since we have now first educational mobile planetarium in Mongolia our School children could visit this planetarium. It allows public to improve understanding of science and encourage public engagement in the sciences. The mobile planetarium stimulates an interest in astronomy among the general public in Mongolia. Furthermore, this educational planetarium is used as an astronomical center that is widely open to serve the requirement of interested scientists, teachers, students, pupils and people all over the country. Also this training was linked with Mongolian and international Galileo Teacher Trainings. Mobile planetarium can be used in remote areas where is no internet and astronomy education in Mongolia.
2. Poster Abstracts
Part 1. Regional Activities
Astronomy in Hong Kong

Poster

H-b. Li, M.C. Chu, T.G.F. Li, F. Otto, P.K. Leung, K.H. Yuen, Y.P. Zhang,
(The Chinese University of Hong Kong /Hong Kong)

In this contribution, we introduce some of the astronomical research carried out in Hong Kong. At the Chinese University of Hong Kong (CUHK), Prof. Li Hua-bai’s Star Formation Group uses both observational and numerical methods to study the interaction between gravity, magnetic fields, and turbulence. Besides using the CSO, JCMT, ASTE, and ALMA telescopes, we are designing and building the ASTE polarimeter, which will be the first of this kind of instrument built in Asia. To help understand and interpret the observational data, our numerical group is developing new simulation and analysis codes, which are running on our department’s HPC clusters with 1800 CPU cores (expected to be tripled in the coming years). Prof. CHU Ming Chung’s group covers a broad range of subjects in cosmology and high-energy astrophysics, including the Cosmic Microwave Background, Dark Matter, and Neutrino astrophysics. Prof. LI Tjonnie heads the gravitational-wave group at CUHK. Due to his efforts, CUHK is joining the LIGO collaboration,
Part 2. Current and Future Facilities
The scientific impact of the new ALMA Band 1 receiver

Poster

Ciska Kemper (ASIAA/Taiwan)

The Atacama Large Millimeter/Submillimeter Array (ALMA) Band 1 receiver is a recently approved ALMA development project led by East-Asia, that will provide access to the 35-51 GHz frequency window and takes full advantage of ALMA’s high angular resolution. The international consortium led by PI institute ASIAA includes NAOJ, NRAO, HIA and the Universidad de Chile. With Band 1, significant progress on the level one science goals identified by the ALMA project can be expected. Specifically, with Band 1, we will detect molecular the most distant molecular reservoir, by using the lowest rotational transitions of CO, the most abundant molecule after H2, which, at redshifts z~1-10 appear in the Band 1 frequency range. Furthermore, with Band 1, the maximum wavelength at which thermal emission from dust grains can be observed increases from 3 mm to 7 mm. Since the size of the emitting grains constrains the wavelength of the emission, a population of larger grains will now be observable, allowing for studies of grain growth in planet-forming environments. We will briefly discuss other interesting science cases for Band 1, and we also provide a comparison in performance with the Jansky Very Large Array (JVLA).
The East–Asian VLBI Network

Poster

Kiyoka Wajima (KASI/Korea)

A new VLBI array in East Asia, the East–Asian VLBI Network (EAVN), is being planned under mutual cooperation between each institute of EACOA. EAVN consists of VLBI arrays which are operated by each East Asian country with the total of 20 radio telescopes, the maximum baseline length of 5,000 km, and the observing frequency of 6.7, 8, 22, and 43 GHz. We have already started bilateral VLBI collaboration between Korea and Japan with the KVN and VERA Array (KaVA) at 22 and 43 GHz. On the basis of this activity, a small task force was organized in 2013 to conduct test observations with EAVN and to clarify the problems for future regular operation of EAVN. We are continuously carrying out snapshot VLBI test observations since 2013 at 8 and 22 GHz, resulting in successful detection of fringes for both Galactic water maser sources and bright AGNs. In order to confirm array capabilities and image qualities we have started imaging test observations with EAVN from the end of 2015 at 8, 22, and 43 GHz. EAVN will be operational from the second half of 2017. I will give a talk on the overview, current activities and future plan of EAVN, including results of test observations, future array extension, and scientific goals.
The Japanese VLBI Network

Poster

Kenta Fujisawa (Yamaguchi University/Japan)

The Japanese VLBI Network (JVN) consist of more than ten radio telescopes in Japan and is operated by the JVN collaboration of universities. In this poster, we will present some recent results of scientific research, development, and organization reconstruction of JVN. One of the long-term purposes of JVN is to construct the East Asian VLBI Network (EAVN).
From SMA to w–SMA

Poster

Naomi Hirano (ASIAA/Taiwan)

The Submillimeter Array (SMA) has provided forefront capabilities for high spatial and spectral resolution observations at submillimeter wavelengths from its excellent site on Mauna Kea, Hawaii since 2004. The SMA has continuously enhanced its capability. It is now equipped with two receivers in the 1.3 mm band (Rx230/Rx240) and two in the 0.85 mm band (Rx345/Rx400). The total bandwidth available is 8+8 GHz in the single receiver mode, and is 6+6 GHz in the dual band or polarization mode. To maintain a leading role in the ALMA era, the SMA project is now planning to upgrade its receivers, IF signal transport and correlator system. The new wideband SMA – the wSMA – will provide the instantaneous coverage of 56 GHz. In this presentation, I will introduce the latest status of the SMA, upgrade plan to the w–SMA, and the possible science cases with the w–SMA.
K–GMT Science Program: Stepping Stone to Korean GMT Observatory in 2020’s

Poster

Narae Hwang (KASI/Korea)

K–GMT Science Program, operated by Center for Large Telescopes (CfLAT) in Korea Astronomy and Space Science Institute (KASI), has been implemented to promote scientific researches of the Korean Astronomical Society by providing access to competitive observational facilities abroad. Through the program, Korean community members are making use of various instruments on MMT and Gemini Observatory as well as IGRINS, “Immersion GRating INfrared Spectrometer” mounted at 2.7m HJS Telescope of McDonald Observatory and 4.3m Discovery Channel Telescope of Lowell Observatory. We will present the current status and some early results made from K–GMT Science Program, and share our vision to develop the program to kick–start “Korean GMT Observatory” operation in 2020’s.
Carbon Fiber Mirror

Poster

Young-Soo Kim (KASI/Korea)

Carbon fiber is stiff and light-weight, which has many applications in our life. The property of low thermal expansion adds suitability for telescope mirrors. In this presentation, processes of producing carbon fiber mirrors have been investigated and presented.
DOTIFS: a new optical multi–Integral Field Unit spectrograph for the 3,6m Devasthal optical telescope

Poster

Haeun Chung (SNU/Korea)

Devasthal Optical Telescope Integral Field Spectrograph (DOTIFS) is a new optical multi–Integral Field Unit (multi–IFU) spectroscopic instrument being built by Inter–University Centre for Astronomy and Astrophysics (IUCAA). It is planned to be mounted on the 3,6m Devasthal Optical Telescope at Devasthal peak, Uttarakhand, India, which is operated by the Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, India, Korea Institute for Advanced Study (KIAS) and Seoul National University (SNU) are involved in this project as international collaborators.

DOTIFS is designed for 2–dimensional spatially resolved spectroscopy in the entire visible range with medium spectral resolution with multi–object capability. It has 16 IFUs deployable over 8’ focal plane. Each IFU has 8.7” x 7.4” field of view sampled with a 12x12 hexagonal aperture microlens array. Light coming from the 2,304 spaxels through optical fibers are dispersed by 8 identical spectrographs over a 370 to 740nm wavelength range simultaneously with R=1200–2400 in a single exposure. We will give an overview of the instrument and report current status of the development. The instrument is expected to see its first light in 2018.
The University of Tokyo Atacama Observatory (TAO)
Project: Current Status

Poster

Kohno Kotaro (University of Tokyo/Japan), on behalf of TAO project

The University of Tokyo Atacama Observatory (TAO) is a project to operate a 6.5-meter telescope optimized for infrared observations at the summit of Co, Chajnantor, 5,640 m altitude. The high altitude and low water vapor (0.5 mm in 25% percentile) of the site provide wide wavelength coverage from 0.3 to 38 micron including continuous window from 0.9 to 2.5 micron and new windows at wavelength longer than 25 micron. The construction of the telescope is now underway.

Most part of the telescope mount is fabricated and the pre-assembly for commissioning has been carried out in Japan. The primary, secondary, and tertiary mirrors and their cells have been also fabricated. Construction of the base facility at San Pedro de Atacama was completed in 2014, and has been operated for the activities in Atacama. Both of the two instruments, SWIMS and MIMIZUKU, are at their final stages of development. They are now planned to be transported to the Subaru telescope at Hawaii for the test observations in 2016, and after adjustments, will be transported to Chile. The telescope is now scheduled to see the first light at the end of FY2017.
TWINKLE – A Low Earth Orbit Visible and Infrared Exoplanet Spectroscopy Observatory

Poster

Marcell Tessenyi\textsuperscript{1, 2}, Giorgio Savini\textsuperscript{1, 2}, Giovanna Tinetti\textsuperscript{1, 2}, Jonathan Tennyson\textsuperscript{1, 2}, Mekhi Dhesi\textsuperscript{2}, Max Joshua\textsuperscript{2}  
(Physics and Astronomy, UCL/U.K.\textsuperscript{1}, Blue Skies Space Ltd./U.K.\textsuperscript{2})

Twinkle is a space mission designed for visible and near-IR spectroscopic observations of extrasolar planets. Twinkle’s highly stable instrument will allow the photometric and spectroscopic observation of a wide range of planetary classes around different types of stars, with a focus on bright sources close to the ecliptic. The planets will be observed through transit and eclipse photometry and spectroscopy, as well as phase curves, eclipse mapping and multiple narrow-band time-series. The targets observed by Twinkle will be composed of known exoplanets mainly discovered by existing and upcoming ground surveys in our galaxy and will also feature new discoveries by space observatories (K2, GAIA, Cheops, TESS).

Twinkle is a small satellite with a payload designed to perform high-quality astrophysical observations while adapting to the design of an existing Low Earth Orbit commercial satellite platform. The SSTL-300 bus, to be launched into a low-Earth sun-synchronous polar orbit by 2019, will carry a half-meter class telescope with two instruments (visible and near-IR spectrographs – between 0.4 and 4.5\textmu m – with resolving power R~300 at the lower end of the wavelength scale) using mostly flight proven spacecraft systems designed by Surrey Satellite Technology Ltd and a combination of high TRL instrumentation and a few lower TRL elements built by a consortium of UK institutes.

The Twinkle design will enable the observation of the chemical composition and weather of at least 100 exoplanets in the Milky Way, including super-Earths (rocky planets 1–10 times the mass of Earth), Neptunes, sub-Neptunes and gas giants like Jupiter. It will also allow the follow-up photometric observations of 1000+ exoplanets in the visible and infrared, as well as observations of Solar system objects, bright stars and disks.
High redshift galaxy clusters and superclusters

Poster

Minhee Hyun (SNU/Korea)

Galaxy overdensities such as galaxy clusters and superclusters are the largest gravitationally bound systems in the Universe. Since they contain many different levels of local densities, they are excellent places to test galaxy evolution models in connection to the environments. The environment studies of galaxies at $z \sim 1$ are important because the environmental quenching seems to be an important mechanism to reduce star formation activities in galaxies at $z < 1$. However, there have been not many studies about high redshift galaxy clusters at $z \sim 1$ because of the lack of wide and deep multi-wavelength data. We have used the multi-wavelength data from the UKIDSS DXS (J and K band), the SWIRE (4 IRAC bands), and the PAN-STARRS (g, r, i, z, Y bands) in the ELAIS-N1 field. We identified galaxy cluster candidates at $0.2 < z < 1.6$ using the multi-wavelength data. We found several superclusters where cluster candidates are concentrated on few tens of Mpc scale. Interestingly, Some of supercluster candidates have high blue galaxy fractions, which is unusual in galaxy clusters at high redshift. We will give a talk about high redshift galaxy cluster and supercluster candidates in ELAIS-N1 field and galaxy properties in various environments including dense clusters, filaments, and fields.
Photometric Reverberation Mapping with Medium Bands Installed on SQUEAN

*Poster*

**Yoon Chan Taak (SNU/Korea)**

Photometric reverberation mapping is an effective alternative to time consuming spectroscopy. It usually employs narrow bands to track the luminosity variations of broad emission lines, such as Balmer lines, and broadbands for the continuum variability. Here, we present a possible alternative, using medium bands, with 50nm widths, that are currently being used on the SED Camera for QUasars in EArlly uNiverse (SQUEAN) installed on the 2.1m Otto Struve Telescope at McDonald Observatory. Two targets with recent variability and/or short expected time lags were selected, and observed in the medium band containing Hα/β, and the two adjacent bands for continuum subtraction afterwards. Analysis shows that for one of the objects, SDSS J0350+0037, the pure Hα emission line flux has a S/N ~ 12, so that variabilities up to ~ 8% are detectable with 15 minute exposures per filter. Light curves will be presented as well.
Infrared Variability and Time Lags for Periodic Quasars

Poster

Hyunsung Jun (JPL, Caltech/USA)

The optical light curve of the quasar PG 1302-102 at z=0.278 shows a 5.2 year periodic signal, detectable over 20 years. The most plausible mechanisms involve a binary supermassive black hole system with a sub-pc separation, where they will likely merge within ~10^-5 years due to gravitational wave emission alone. Here, we report the infrared time lags for PG 1302-102 from WISE and Akari missions. We confirm that the periodic behavior reported in the optical light curve is reproduced at infrared, with best-fit 3.4 and 4.6 micron time lags of (2219 ± 153, 2408 ± 148) days for a near face-on orientation of the torus, or (4103 ± 153, 4292 ± 148) days for an inclined system with relativistic Doppler boosting in effect. The periodicity in the infrared light curves and the time lag to the optical support that a source within the accretion disk is responsible for the optical variability of PG 1302-102, echoed at the farther out dusty regions ~pc away. We further present ongoing work to constrain the infrared variability and time lags for all the identified periodic quasars and relate the quantities to physical origins.
Properties of Spectrally-defined Red QSOs at $z = 0.3–1.2$

*Poster*

Anli Tsai (National Central University/Taiwan)

We investigated the properties of a sample of red QSOs using optical, radio, and infrared data. These QSOs were selected from the SDSS DR7 quasar catalog. We only chose sources with sky coverage of the VLA FIRST survey, and searched for sources which have WISE counterparts. We defined typical QSOs and red QSOs based on the flux ratio of the rest frame 4000A to 3000A continuum emission. Under this criterion, we can only select QSOs with redshifts between 0.3 and 1.2. In addition, we defined radio-loud QSOs (RLQs) and radio-quiet QSOs (RQQs) based on their radio-to-optical ratios. We found that the red QSOs have stronger infrared emission than the typical QSOs have, especially for the RLQs.

We also found that the red QSOs have a higher fraction to be RLQs than the typical QSOs have, especially for luminous or high redshift red QSOs. Besides, the RLQs have a higher fraction to be red than the QSOs have. There might be a connection between the excess infrared emission and the radio activity of the QSOs. On the other hand, the red QSOs at high redshifts are less popular than the red QSOs at low redshifts, yet the typical QSOs show inverse population distribution along redshifts. Besides, at high redshifts, the luminosity distribution of the typical QSOs and the red QSOs seem to have similar pattern. However, at low redshifts, the red QSOs show different luminosity distribution with the typical QSOs. All these suggest that there might be more than one type of red QSOs.
Star Forming Elliptical Galaxies

*Poster*

*Chorng-Yuan Hwang (Graduate Institute of Astronomy, NCU/Taiwan)*

We investigated the star formation activities for a sample of nearby elliptical galaxies. We selected morphologically-identified elliptical galaxies from Galaxy Zoo and estimated their star formation rates using the mid-infrared data from WISE. We found that there are about 4.4% of nearby elliptical galaxies having high specific star formation rates, which are comparable with the specific star formation rates of normal spiral galaxies. We investigated the star formation history of these star forming elliptical galaxies and found that they have continuous star formation activities, which are not caused by recent burst events. These results suggest that there are some unknown mechanisms in the elliptical galaxies to maintain the continuous star formation activities in these elliptical galaxies.
What makes red quasars red?: Intrinsically red vs. dusty red

Poster

Dohyeong Kim (SNU/Korea)

Red quasars have been suspected as an intermediate population between merger–driven star–forming galaxies and unobscured quasars. In this scenario, the red colors of red quasars are expected to come from the dust extinction by dust and gas in their host galaxies. However, several studies have proposed different explanations for the red colors of red quasars, which are (i) a moderate viewing angle between type 1 and 2 quasars, (ii) an unusual covering factor of the dust torus, and (iii) an anomalous synchrotron emission. In order to find out why red quasars are red, we compare several properties of red quasars to those of normal type 1 quasars by using the optical and NIR spectra of 11 red quasars at z~0.3 and 0.7. The Pb/Hb luminosity ratios of the red quasars are 10 times higher than those of normal type 1 quasars, and which high luminosity ratios cannot be explained by the unusual physical condition. Moreover, the covering factor of the dust torus of the red quasars are similar to those of normal type 1 quasars. These results imply the red colors of red quasars come from the dust extinction. In order to investigate the source of the dust extinction, we measure the Eddington ratios of the red quasars using Paschen lines, and which is significantly higher than those of normal type 1 quasars. This result indicates the dust extinctions of red quasars do not originate from the moderate viewing angle. The results from our study point to a picture in which red quasars are the intermediate population between the merger–driven star–forming galaxies and unobscured quasars.
Tidal disruption event, Swift J1644+57: host galaxy properties and black hole mass

Poster

Yongmin Yoon (SNU/Korea)

We investigate the host galaxy of tidal disruption event, Swift J1644+57 and derive the mass of the supermassive black hole which is responsible for this event. We decompose the surface brightness profile of the host galaxy based on high-resolution HST WFC3 images. We found that the host galaxy of Swift J1644+57 is a bulge-dominated galaxy with Sersic index of 3.43. We analyze long-term NIR light curves, which reveal the pure host galaxy fluxes 500 days after the burst. By fitting spectral energy distribution (SED), we estimate the stellar mass of the host galaxy to be logM=9.14. Finally, we estimate the mass of the central supermassive black hole to be logM=6.7 from several scale relations of black hole mass.
Exploring the transverse structure of M87 jet with KaVA Large Program

Poster

Hyunwook Ro (Yonsei University, KASI/Korea)

In this talk I will present early results of the biweekly monitoring program of M87 using KaVA (KVN and VERA Array) at 22 and 43 GHz. This project is one of the key science program of KaVA led by KaVA AGN working group. The main purpose of the monitoring program is to test the magnetically–driven jet paradigm. Currently, we observed 9 epochs from February to June 2016. In this talk, I will present the intensity maps of first 9 epochs, and discuss structural change over the observations. Particularly, I will discuss about transverse structure of the M87 jet by fitting transversely sliced jet with several Gaussian components. Also, I will present the spectral index maps between 22 and 43GHz and discuss the spectral index properties of the M87 jet.
4C+21.35 Kinematics with KaVA observation

Poster

Taeseok Lee (SNU/Korea)

We present the kinematics of a flat spectrum radio quasar (FSRQ), 4C+21.35 observed with KaVA(KVN and VERA joint array) at 22 and 43 GHz from 2014 to 2016. Throughout seven epochs within one and half years, we could track one component near the core moving outward at apparent speed of eleven times the speed of light at 22GHz. We have also found one new component coming out of the core at 22GHz in the two epochs early 2016. Our results show that KaVA is comparable to world’s most powerful VLBI. With more data obtained recently, we hope to track the jet components further and find physical relations, if any.
PAGaN II: The Evolution of AGN jets on Sub–Parsec Scales

Poster

Junghwan Oh (SNU/Korea)

We report first results from KVN and VERA Array (KaVA) VLBI observations obtained in the frame of our Plasma–physics of Active Galactic Nuclei (PAGaN) project. We observed eight selected AGN at 22 and 43 GHz in single polarization (LCP) between March 2014 and April 2015. Each source was observed for 6 to 8 hours per observing run to maximize the uv coverage. We obtained a total of 15 deep high–resolution images permitting the identification of individual circular Gaussian jet components and three spectral index maps of BL Lac, 3C111 and 3C345 from simultaneous dual–frequency observations. The spectral index maps show trends in agreement with general expectations –– flat core and steep jets –– while the actual value of the spectral index for jets shows indications for a dependence on AGN type. The apparent speed of jet components in BL Lac and 3C111 were analyzed, and we detected superluminal proper motions with a maximum apparent speed of 5.3c for 3C111 at 43 GHz. This result constrains the lower limit of the intrinsic component velocity to ~0.98c and the upper limit of the angle between jet and line of sight to ~20 degree. Jet components show systematically larger diameters d at larger core distances r, following the global relation d~0.3r, albeit within substantial scatter.
STUDIES: SCUBA–2 Ultra Deep Imaging EAO Survey

Poster

Wei-Hao Wang (ASIAA/Taiwan)

STUDIES is one of the new JCMT Large Programs started from 2016. In three years, STUDIES will use 330 hr of the best submillimeter weather on Maunakea to produce an ultradeep 450 um image of the COSMOS-CANDELS region. We will reach an rms sensitivity of < 1 mJy over an area of ~100 sq–arcmin, and < 0.6 mJy in the central D = 3’ region. The survey takes advantage of the higher angular resolution of SCUBA–2 at 450 um, to overcome the confusion limit of single–dish surveys. Our imaging will lead to the deepest far–IR selection of high–redshift galaxies, approximately 10x deeper than those from confusion limited Herschel 250–500 um images. It will enable the selections of all L_IR > 10^{12} Lsun galaxies at z < 4, and the majority of L_IR > 10^{11} Lsun galaxies at z < 2. By combining with the rich multi–wavelength data in the COSMOS, our survey will lead to a more complete census of star formation and AGNs that are obscured and unobscured by dust. Here I will outline the design, the science goals, and the current status of the survey.
Near-infrared Spectroscopy of early afterglow of Ultra-Long GRB 111209A

Poster

Sang-Yun Lee (SNU/Korea)

We observed Ultra-Long GRB 111209A using NASA’s 3m IRTF. The observation started at around T0+40 min, (T0 = 07:12:08 UT, Swift’s BAT) The NIR SEDs show power law distribution with no black body component. According to the fireball model, these power law distribution indicate afterglow’s synchrotron emission with spectral index beta ~ 1.2. Also the data capture the same moment when optical flare exists in TAROT-R band data. However, the time resolution was not enough to fully distinguish the flare, Therefore more careful discussion is needed for the flare.
Constraining the shielded wind scenario in PG 2112+059

Poster

Cristian Saez (KASI/Korea)

The physical scenario describing the origin of quasar winds remains largely unsettled due to our failure to account for X-ray weak BAL quasars. We approach this problem by studying the relation between the inner part of the outflow which is likely to be shielding the X-ray emission and the UV winds characterized by broad absorption lines (BALs). In particular, we aim to probe the wind-shield connection in the highly X-ray variable BAL quasar PG 2112+059, which has exhibited periods of X-ray weakness and X-ray normality in the past. A set of two 20 ks Chandra observations and two contemporaneous HST observations, performed in Dec 2014 and Sept 2015, combined with a nearly simultaneous archival Chandra-HST observation from 2002, afford us a unique opportunity to study the connection between the shield (which is thought to be responsible for the X-ray absorption) and the ionization state of the wind (observed as UV BAL features; e.g., C iv and O vi lines) over various timescales.
Part 4. Sciences--- 2. Star Formation and Exoplanets
The relationship between the young star clusters and the molecular clouds

Poster

Hongjun Ma (Purple Mountain Observatory/China)

We report the FCRAO mapping observations of HCN (1–0), CS (2–1), HNC (1–0) and HCO+ (1–0) in ten high-mass star-forming cores associated with water masers. We find that these four tracers trace similar area in these massive dense cores, and in most cases, the emissions of HCN and HCO+ are stronger than HNC and CS. We also use the line ratios of HCO+/HCN, HNC/HCN and HNC/HCO+ as the diagnostics to explore the environment of these high-mass star-forming regions, and find that most of the cores agree with the model that a photo-dominated regions dominate the radiation field, except for W44, for which the radiation field is similar to a X-ray-dominated region. Extending the larger optical environments, they were found to be associated with embedded and/or open star clusters. For the two giant molecular cloud cores (S231 and W3 OH) associated with several embedded clusters, we have made efforts to shed some light on the theoretical models of the formation and evolution of star cluster.
HIFI SPECTROSCOPY OF H2O SUBMM LINES IN NUCLEI OF ACTIVELY STAR FORMING GALAXIES

Poster

Lijie Liu (Purple Mountain Observatory/China)

We present initial results of a systematic survey for multiply H2O transitions in nuclei of nine nearby actively star forming galaxies, by utilizing the velocity–resolved spectroscopy of Herschel/HIFI instrument. Our results reveal that the line shape of different water transitions can not be assumed to be similar – unlike the line profiles from multiple transitions of other molecules. The ground–state and low–lying transitions tend to show a line profile with emission and absorption blended together, while absorption–free middle–lying lines often display similar line shapes that match the line profiles of CO. The HIFI observation of H2 O lines together with extra SPIRE/PACS H2O data from literature are analyzed with an updated version of 3D, non–LTE code — ’3D’, which takes account of the interaction between dust and molecular gas. The models for the water excitation are combined with information on the dust continuum (the IR field) and the CO line spectral energy distribution to determine the physical structure of the ISM in our samples galaxies. Our model reveals that the middle–lying H2O emissions come from a warm dense component (with Tdust $\sim 40 - 60$ K, n(H) $\sim 1 \times 10^5 - 10^6$ cm$^{-3}$ ), which contributes most of dust SED and middle/high–J CO emissions (with CO SLED peak at Jup = 8 - 10). The ground–state and low–lying lines arise from a extended region (ER) with cold dust (Tdust $\sim 20 - 30$ K) and less dense gas (n(H) $\sim 1 \times 104 - 105$ cm$^{-3}$), where a large part of dust sub–mm continuum and low/middle–J CO emissions are generated from. The different line shapes seen in the low–excitation lines is due to geometrical origin: absorption features are detected where the ER locates in front of the warm component while emissions are detected in the rest part of ER. For the ultra luminous IR galaxies in our sample (Arp 220 and Mrk 231), another compact (Rs $\leq 100$ pc), hot (Tdust /Tk $\sim 100 - 180$ K) and dense (n(H) $\geq 1 \times 106$ ) component is required to explain the strong detection (both in emission and absorption) in high–lying H2 O transitions. The hot component has a significant effect on the IR emissions in the MIR regime and CO SLED at levels with Jup $\geq 10$. The gas phase abundance of water varies from $1 \times 10^{-9} /10^{-8}$ in the cold extended region, to $1 \times 10^{-8} /10^{-7}$ in the warm component and jumps to $1 \times 10^{-6} /10^{-5}$ in the hot component.
The signs of planets in resolved near-infrared image of protoplanetary disks: LkCa 15 and GM Aur

Poster

Daehyeon Oh (National Meteorological Satellite Center, NAOJ/Japan)

We present high-contrast H-band polarized intensity images of the transitional disks around the young solar-like stars, LkCa 15 and GM Aur. By utilizing Subaru/HiCIAO for polarimetric differential imaging, the angular resolution and the inner working angle reach 0.″07 and 0.″05 < r < 0.″1, respectively. From LkCa 15, we obtained a clearly resolved gap (width 27 au) at ≈48 au from the central star. This gap is consistent with images reported in previous studies. We also confirmed the existence of a bright inner disk with a misaligned position angle of 130 ± 40 with respect to that of the outer disk, i.e., the inner disk is possibly warped. From GM Aur, we clearly resolved a large inner hole, with a measured radius of 18±2 au, which is smaller than that of a submillimeter interferometric image. Those characteristic structures may provide the properties of protoplanets, such as their masses or separations, hidden in the optically thick disks.
Atmospheric Compositions of the Galilean moons Io and Callisto

Poster

Ming-Chi Chung (Department of Earth Sciences, National Taiwan Normal University/Taiwan)

According to the Grand Tack (GT) model, Jupiter is believed to have migrated very close to the Sun. Hence atmospheres of the four Galilean moons were largely destroyed during the GT due to non-thermal XUV-driven atmospheric escape. However, scarce atmospheres remain existent on Galilean moons today. It is thus important to study the chemical compositions of these atmospheres in order to understand their origins. In particular, by probing atmospheric trace components evaporated from the surface, we may infer the likely chemical compositions of the subsurface oceans suspected to exist on the outer three Galilean moons Europa, Ganymede and Callisto. Thanks to the high sensitivity and spatial resolution of ALMA (Atacama Large Millimeter/submillimeter Array), we are now able to resolve the discs of Galilean moons directly with ALMA. As first steps, we use the available archival ALMA data to study the atmospheric compositions of Io and Callisto, the innermost and outermost Galilean moons, respectively, orbiting around Jupiter. Because of its closeness to Jupiter, Io is the most geologically active body in our solar system. Io’s surface appears mainly in yellow, black, white and orange colors caused by sulfide compounds ejected from volcanic eruptions. Sulfide compounds from volcanic plumes are also present in Io’s atmosphere. Callisto is about 1,880,000 km away from Jupiter, hence it is least affected tidally by Jupiter among four Galilean moons. Unlike Io, Callisto’s atmosphere is thought to be formed mainly due to sublimation of icy volatiles on the surface. In this meeting, we will present preliminary results from our high spectral resolution ALMA study. Two strong SO2 lines, a 34S02 line, and a KCl line are detected on Io tentatively. Nevertheless, no clear signature of the existence of molecular gas is present in Callisto’s atmosphere unfortunately.
Part 4. Sciences --- 4. Diffuse Interstellar Medium
Supernova Remnants in the UWIFE and UWISH2 Surveys

Poster

Yong-Hyun Lee (SNU/Korea)

We have searched for near-infrared [Fe II] (1.644 \textmu m) and H2 1–0 S(1) (2.122 \textmu m) emission features associated with Galactic supernova remnants (SNRs) using the narrow-band imaging surveys UWIFE/UWISH2 (UKIRT Widefield Infrared Survey for [Fe II]/H2). Both surveys cover about 180 square degrees of the first Galactic quadrant (7° < l < 62°; -1.5° < b < +1.5°), and a total of 79 SNRs are falling in the survey area among the currently known 294 Galactic SNRs. The images show diffuse structures as deep as the surface brightness limit of 1E-19 W/m²/arcsec² which is comparable with a 5σ detection limit of point sources of 18 mag. In order to inspect the narrow-band features, we subtracted H– and K–band continuum images obtained from the UKIDSS GPS (UKIRT Infrared Deep Sky Survey of the Galactic Plane) from the [Fe II] and H2 narrow-band images, respectively. By this time, we have found 19 [Fe II]– and 18 H2–emitting SNRs, and these are likely to increase in future as we inspect the images in more detail. Some of the SNRs show bright, complex, and interesting structures that have never been reported in previous studies. Since [Fe II] and H2 lines trace dense atomic and molecular gases associated with SNR shocks, our results can help us understand the environment and evolution of individual SNRs.

Among the SNRs showing both [Fe II] and H2 emission lines, some SNRs show the "[Fe II]–H2 reversal" phenomenon, i.e., the H2 emission features are detected outside the [Fe II] emission boundary. This is opposite to the standard picture: If the shocks are driven by the same blast wave, we expect the H2 filaments to be closer to the explosion center than the [Fe II] filaments. In this presentation, we show several examples of such SNRs detected in our study, and present high resolution (R ~ 40,000) H– and K–band spectra of H2 emission features obtained by using IGRINS (Immersion Grating Infrared Spectrograph).
Near-infrared MOS observations of RCW 103

Poster

Ho-Gyu Lee (KASI/Korea)

We present near-infrared multi-object spectroscopy (MOS) observations of Galactic supernova remnant (SNR) RCW 103. The bright [Fe II]–emitting SNR RCW103 is selected from our near-infrared [Fe II] 1.64 um narrow band imaging observations of SNRs in southern sky using AAT telescope. In addition to near-infrared spectra of the bright southeastern shell of RCW 103, we obtain the MOS spectra of [Fe II]–emitting clumps inside RCW103. The center of the [Fe II] shell is different from that of X-ray shell, where the central compact object 1E 161348–5055 is located. The observed clumps move up to hundreds kilometers in radial direction. A possible explanation is that they are shocked dense materials lost by stellar wind at the final stage of the evolution of the progenitor star, while the hot X-ray gas traces the SNR shock after stellar explosion.
Special Session: Women in Astronomy
Women in Astronomy for Mongolia

Poster

Tsolmon Renchin¹, Gerelmaa Dolamdorj², Altangerel Balgan³

(National University of Mongolia/Mongolia¹,²,³)

Today’s science departments and institutions in Mongolia has a higher percentage of women, but there is very few women astronomers in Mongolia. For example, there is only two or three women astronomers are teaching astronomy in Mongolian Universities. We need to develop an advanced degree courses in our universities and focus on successful practices in Astronomy. It is important for us to experience and share best practices from international communities on managing and mentoring successful and diverse scientific professionals. This meeting allows us to collaborate and cooperate with women from different region in astronomy field.