

“Supermassive Black Holes” and “Time Domain” Joint Session

Invited talk

11/19/2019, 9:00 - 9:40

**Shigeru Yoshida**

(Chiba University)

Title: **Multi-messenger astronomy with high energy neutrinos**

Abstract: The high energy neutrino astronomy has been blooming. The realtime neutrino alert stream implemented by IceCube Neutrino Observatory has been launched and realized the rapid followup observations which led to the first identification of a likely source accelerating cosmic rays to at least energies beyond PeV. In this talk, we discuss the multi-messenger astronomy prompted by high energy neutrino detection and how it resolves one of the long standing mysteries in astrophysics - origin of the high energy cosmic rays.

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Contribution talk

11/19/2019, 9:40 - 10:00

**Haoning He**

(RIKEN)

Title: **Neutrinos from Choked Jets Accompanied by Type-II Supernovae**

Abstract: The origin of the IceCube neutrinos is still an open question. Upper limits from diffuse gamma-ray observations suggest that the neutrino sources are either distant or hidden from gamma-ray observations. It is possible that the neutrinos are produced in jets that are formed in core-collapsing massive stars and fail to break out, the so-called choked jets. We explain the IceCube observed diffuse neutrino flux as neutrinos from the jets choked in the hydrogen envelopes of red supergiant stars. Furthermore, we predict that a newly born jet-driven type-II supernova may be observed to be associated with a neutrino burst detected by IceCube. The future observations on a newly born type-II supernova following the IceCube events by Subaru HST and other telescope will help to constrain our model.

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Contribution talk

11/19/2019, 10:00 - 10:20

**Tomoki Morokuma**

(The University of Tokyo)

Title: **Subaru+Gemini follow-up for IceCube high-energy neutrinos**

Abstract: Origin of high-energy TeV-PeV neutrinos detected by the IceCube experiment is still unclear and more observational constraints are desired. For the 290 TeV event IceCube-170922A, an apparently bright blazar (BL Lac), TXS 0506+056 ( $\sim 15$  mag), turned out to be the likely counterpart and high signal-to-noise ratio data were taken over the full range of electromagnetic emission in addition to high-energy neutrino. On the other hand, another hypothesis, a peculiar supernova with failed jet, survives as a strong candidate of high-energy neutrino sources in general but almost no observational constraints have been obtained. We here show our trial to search for supernovae with Subaru/Hyper Suprime-Cam in the error region of IceCube-170922A in addition to our observations with 1m-class and Gemini telescopes for TXS 0506+056. We also discuss future prospects once 30m-class telescopes are available.

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Contribution talk

11/19/2019, 10:20 - 10:40

**Mitsuru Kokubo**

(Tohoku University)

**Title: Properties of variability-selected AGNs in the HSC SSP Transient Survey in COSMOS**

Abstract: Using time-domain dataset from the Subaru HSC SSP Transient Survey in COSMOS, we selected about 1000 AGNs purely based on the variability information. This variability-selected AGN sample contains low-luminosity (host-dominated) AGNs and red AGNs, which are missed by color selection techniques. Cross-matching with the Chandra X-ray COSMOS-Legacy Survey point source catalog reveals that a large fraction of the variability-selected AGNs is not detected in the X-ray band, indicating that our variability-based AGN search achieves higher sensitivity to faint AGNs than the deep X-ray AGN survey. In this talk I will discuss statistical properties of the variability-selected AGNs, and show some interesting objects with peculiar SEDs found in the variability-selected AGN catalog.

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Contribution talk

11/19/2019, 11:00 - 11:20

**Shintaro Koshida**

(Subaru PFS Instrument Research Specialist)

**Title: Searching for hot dust surrounding SMBH with HSC transient survey catalog**

Abstract: HSC transient survey is one of the deepest surveys of variable object based on the data observed in Subaru Strategic Program for HSC. The project built a database of variable object detected in the survey employing a differential photometry method. It provides more than 40,000 set of light curves of transient objects in wavelength from HSC-g to HSC-Y band. We applied a reverberation mapping method named JAVELIN (e.g. Zu et al. 2011) to the light curves of AGNs from the database and detected hot dust component in several objects varying with time lags from the accretion disc flux variations. The time lags follow the lag luminosity relation of the hot dust surrounding super massive black holes (e.g. Koshida et al. 2014). The hot dust detection with the large catalog of HSC survey expands the lag luminosity relation to further universe.

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Contribution talk

11/19/2019, 11:20 - 11:40

**Shunsuke Onishi**

(The University of Tokyo, ISAS/JAXA)

**Title: The line-of-sight velocity variation of CO ro-vibrational lines in the ULIRG  
IRAS 08572+3915**

**Abstract:** According to the unified model of Active Galactic Nuclei (AGNs), supermassive black holes are surrounded by a geometrically thick structure named “molecular torus”, whose inclination angle makes a difference to AGN types (Antonucci et al. 1993). Gas forms a thin disk in a simple gravitationally-bound system. Hence, understanding the kinetic process to maintain the thickness of a torus is essential. However, its inner structure has not been directly observed due to its tiny size ( $\sim pc$ ). Then, we attempted to determine whether the velocity field in a torus is Keplerian or turbulent by observing the time variation of the line-of-sight velocity of CO ro-vibrational absorption lines ( $v=1-0$ ,  $\Delta J=\pm 1$ ,  $\lambda \sim 4.7 \mu m$ ) toward the ultra-luminous infrared galaxy IRAS 08572+3915.

We compared spectra obtained with Subaru Infrared Camera and Spectrograph (IRCS) in three epochs: 2004, 2010 ( $\Delta V \sim 60 \text{ km s}^{-1}$ ), and 2019 ( $\Delta V \sim 30 \text{ km s}^{-1}$ ). As a result, we found that some lines ( $v=1-0$ ,  $J_{\text{lower}}=4-8$ ) showed deceleration of  $\sim 40 \text{ km s}^{-1}$  from 2004 to 2010 and acceleration of  $\sim 40 \text{ km s}^{-1}$  from 2010 to 2019 even if we consider systematic errors of the wavelength calibration. This irregular velocity variation suggests that the velocity field in the molecular torus is not Keplerian but turbulent.

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Contribution talk

11/19/2019, 11:40 - 12:00

**Chien-Hsiu Lee**

(NOAO)

Title: **ANTARES: a community broker for ZTF and LSST**

Abstract: With the avalanche of alerts delivered by LSST and the limited resources for follow-up, we will need brokers to select intriguing alerts that warrant follow-ups in a timely manner. At NOAO and University of Arizona, we are developing the Arizona-NOAO Temporal Analysis and Response to Events System (ANTARES), to hunt for the rarest of the rare event in the time-domain. In this talk we will give an overview of the ANTARES system, how we use ZTF as a training set, and the way forwards to LSST.

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Contribution talk

11/19/2019, 12:00 - 12:20

**Toru Yamada**

(ISAS/JAXA)

**Title: Variability Search for Faint AGN using the HSC SSP-Survey Data: Variability properties of the low-luminosity AGN in the COSMOS field**

Abstract: We present the results of the multi-band deep variability survey for faint AGN in the COSMOS field using the data obtained for HSC-SSP Ultradeep Survey. It reaches to the depth  $i(AB) \sim 24$ , which is significantly deeper than previous variability search covering  $\sim \text{deg}^2$  area. We adopted the method using the fixed-aperture photometry and introduce the procedure to treat the photometry over the intervals with various different depth, which is inevitable for the facility not dedicated for time-domain observations. In this presentation, we focus on the most robust sample of the 500 variable objects, yet including the objects which are too faint to be detected in the deepest X-ray data of the Chandra Legacy Survey whose detection limit is  $\sim 5 \times 10^{-16} \text{ erg/s/cm}^2$ . The X-ray limit corresponds to  $L_x \sim 10^{42} \text{ erg/s}$  at  $z=1$ , or BH mass of  $10^7 M_{\text{sun}}$  for the Eddington ratio of 0.1. Thus our survey (even with the most robust sample) may include very low-mass BH. Our stacking analysis of the individually X-ray undetected sources shows that they are indeed AGN with lower luminosity, likely to be BH with  $\sim 10^6 M_{\text{sun}}$ . So our work presents the utility of the variability to detect and identify very low-mass BH which are very difficult to be detected by other methods.

We discuss the variability properties, i.e., dependence on wavelength and luminosity for these sources using the structure function analysis and also for the properties of the host galaxies.