"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Invited talk
11/19/2019, 9:00 - 9:40

Misato Fukagawa
(NAOJ)

Title: **Star Formation Science with Subaru**

Abstract: This review will cover a wide variety of topics on star formation investigated with the Subaru Telescope, from the initial mass function to the characterization of young stellar objects such as about age measurements, multiplicity, jets, and circumstellar disks. The prospects in optical and infrared will also be discussed based on the recent progress with ALMA.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 9:40 - 10:00

Hervé Bouy
(University of Bordeaux, France)

Title: **Combining 20 years of Subaru data to search for young brown dwarfs and planetary mass objects**

Abstract: Despite the tremendous progress achieved over the past decade, the study of stellar formation is far from complete. We have not yet measured the minimum mass for star formation, nor the shape of the IMF down to the least massive free-floating planets, or know how universal this shape is. Although clusters are the building blocks of galaxies, little is known about their early dynamical evolution and dispersal into the field. The COSMIC-DANCE project aims at answering these fundamental questions and revealing the shape of the IMF down to the fragmentation limit and with a precision and completeness surpassing current surveys. To achive these goals, we compare deep archival Subaru SuprimeCam images obtained over the past 20 years with newer HSC images. Combined with wide-field images from other world-class facilities, we derive proper motions for tens of millions of sources with an accuracy comparable to Gaia but 4 to 5 mag deeper. Feeding these proper motions and the multi-wavelength photometry to innovative hyper-dimensional data mining techniques, we securely identify all cluster members and derive the ultimate census over the entire mass spectrum and down to the fragmentation limit.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 10:00 - 10:20

Per Calissendorff
(Stockholm University)

Title: **Spectral characterization of newly detected young substellar binaries**

Abstract: Multiplicity studies of stars and brown dwarfs have shown a decrease in multiplicity frequency as a function of primary mass and spectral type, stretching down all the way to the substellar mass-regime. However, at the very bottom of the stellar and substellar initial mass function, multiplicity is not very well-constrained. By associating low-mass brown dwarfs to young moving groups we may constrain their ages, which otherwise prove difficult to do. We are thus at a point where we can compare the multiplicity rates for both older and younger samples of substellar brown dwarfs. We present the results from observations of 14 young low-mass brown dwarfs using the VLT/SINFONI IFS with LGS-AO, detecting 3 new binary systems. These results indicate for higher multiplicity frequencies for younger populations of brown dwarfs, and that older systems may have undergone dynamical interactions disrupting primordial binaries. We discover some of these companions to be of planetary-mass, and that they have small separations, translating to orbital periods of just a few decades. Dynamical masses can hence be obtained within just a few years of astrometric monitoring, making these systems excellent benchmarks for calibrating evolutionary models in an otherwise scarcely probed mass-regime.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 10:20 - 10:40

Jinshi Sai
(The University of Tokyo/NAOJ)

Title: **ALMA Observations of the Late-Phase Protostar L1489 IRS: Warped or Misaligned Disk Structure**

Abstract: Formation process of protoplanetary disks is still unclear even though disks are essential, key objects for star and planet formation. To understand how disks form and evolve, it is necessary to reveal geometrical and kinematical structures of disks around protostars during disk formation phase. We present observational results of the Class I protostar L1489 IRS at high spatial resolutions of <50 au using ALMA. Our observations in the C18O J=2-1 line have revealed that the disk having Kepler rotation extends up to r~600 au with gaps at r~150-300 au. Interestingly, the disk plane changes its position angle at the gap positions by ~15 degree. Comparing these observational results with kinematic disk models, it is found that the disk around L1489 IRS can be explained as a warped disk or two misaligned inner and outer disks. Theoretical simulations suggest that such change of the disk position angle could be formed by accretion from a misaligned envelope surrounding the disk.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 10:50 - 11:10

Yasunori Hori
(Astrobiology Center)

Title: **Are Planets Rare in Open Clusters?**

Abstract: In clustered environments, stellar encounters can liberate planets from their host stars via close encounters. The detection probability of planets suggests that the planet population in open clusters resembles that in the field. Only a few dozen planet-hosting stars, however, have been discovered in open clusters. We explore the survival rates of planets against stellar encounters in open clusters similar to the Pleiades, Hyades, and Praesepe and embedded clusters. We performed a series of N-body simulations of star clusters, modeling the three open clusters and embedded clusters. We find that less than 1.5 % of close-in planets within 1 AU and at most 7 % of planets with 1-10 AU are ejected by stellar encounters in clustered environments after the dynamical evolution of star clusters. We expect no significant difference between the frequency of short-period planets in open clusters and that in the field. Besides, our simulations imply that most of planets (within 10au) around FGKM-type stars are likely to survive against stellar encounters in open clusters. If a planet population from 0.01-100 AU in an open cluster initially follows the observed planet distribution in the field, the production rate of free-floating planet per star is 0.0096-0.18, where we have assumed that all the stars initially have one giant planet with a mass of 1-13 Mjup in a circular orbit. These values are compatible with the observed fraction of free-floating planets, 0.25 per main-sequence star.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 11:10 - 11:30

Hiroyuki Ishikawa
(SOKENDAI)

Title: **Detailed Chemical Analysis of M Dwarfs by High-Dispersion Near-Infrared Spectroscopy with IRD**

Abstract: It is crucial to know the chemical composition of the host stars to understand the formation of and the composition of terrestrial planets. Detection of such planets around M dwarfs are rapidly increasing. We are developing the chemical abundance analysis scheme based on the high dispersion near-infrared spectroscopy. Data is obtained from IRD on the 8.2-m Subaru Telescope here on Hawaii and the similar instrument on the 3.5-m Calar Alto telescope in Spain; both offers high dispersion spectroscopy with wide wavelength coverage. In this presentation, we report the chemical analysis of 8 species – Fe, Na, Mg, Al, K, Ca, Ti, and Cr – on M dwarfs. For M dwarfs in binary systems with FGK primaries, we compared our results and the values in the literature about the primaries. The results agree within the error margin, which is still larger than expected though. We think it is because the depth of the absorption lines is sensitive not only to the absorbers but also to the electrons ejected by the ionization of other elements such as Na. We will apply this analysis method on all the data coming from the IRD SSP to understand the distribution of chemical abundances of nearby M dwarfs.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"

Invited talk

11/19/2019, 13:20 - 14:00

Mitsuhiko Honda

(Okayama University of Science)

Title: **Evolution of solids and planet formation revealed by Subaru**

Abstract: Solids (e.g. silicates, ice) in the protoplanetary disk are the ingredients of planets and play a major role on the planet formation. Subaru Telescope has been operating several unique instruments and revealed the evolution of the solids in the disk for 20 years. In this talk, I will review the achievements done by Subaru telescope, and discuss the future prospects of this science topic with Subaru and TMT.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 14:00 - 14:20

Garima Singh
(Observatoire de Paris)

Title: **Discovery of an azimuthal density gradient in a gas-rich debris disk possibly related to a massive collision**

Abstract: The gas-rich debris disk of HD 141569 (Herbig Ae/Be star at 116 pc), discovered in 1999 with the HST in near-IR and later in visible revealed multiple rings and outer spirals extended as far out as 410 AU. More recently the exoplanet imager SPHERE has been able to resolve several non-uniform concentric rings inside the inner cavity (<100 AU)[1]. A North-South asymmetry was discovered in the brightest ringlets at 40 AU, which is aligned with the disk projected major axis. This asymmetry cannot be explained by the dust light scattering properties. Furthermore the post-processing techniques used for scattered light observations in total intensity impact the shape and local photometry of extended objects[2]. With the newly acquired polarimetric data using the dual polarimetric imaging mode of SPHERE/IRDIS, we discovered that the Lorentzian azimuthal distribution of the intensity reported in the innermost ring is significantly different in total intensity and polarized intensity. In this talk, I will present the hypothesis based on the massive collisions[3] between planet embryos that explain how both images can be described as a combination of a phase function and an azimuthal dust density variation which takes a Lorentzian profile peaking to the south-west of the ring.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 14:20 - 14:40

Riouhei Nakatani
(RIKEN)

Title: **Radiation Hydrodynamics Simulations of Photoevaporating Protoplanetary Disks: Implications to Metallicity Dependence of Disk Lifetimes**

Abstract: While protoplanetary disks are considered to have lifetimes of several million yr in the solar neighborhood, recent observations suggest that the disk lifetimes are shorter in a low-metallicity environment (Yasui et al. 2009, 2010). We perform a suite of radiation hydrodynamics simulations of photoevaporating disks with various metallicities to study their long-term evolution and the metallicity dependence of mass-loss rates. Our simulations follow hydrodynamics, radiative transfer, and nonequilibrium chemistry in a self-consistent manner. We also consistently calculate dust-grain temperatures by solving the radiative transfer of the stellar irradiation and grain (re-)emission. As photo-heating sources for the gas, we take account of far-ultraviolet (FUV), extreme-ultraviolet (EUV), and X-ray, which prior works have suggested important to drive photoevaporation but either of their relative importance or their interplaying effects is not well resolved.
In the fiducial case with solar metallicity, including the X-ray effects does not significantly increase the photoevaporation rate when compared to the case with ultra-violet (UV) radiation only. At sub-solar metallicities in the range of $Z \gtrsim 10^{-1.5}$ Zsun, the photoevaporation rate increases as metallicity decrease owing to the reduced opacity of the disk medium. The result is consistent with the observational trend that disk lifetimes are shorter in low metallicity environments. In contrast, the photoevaporation rate decreases at even lower metallicities of $Z \lesssim 10^{-1.5}$ Zsun, because dust-gas collisional cooling remains efficient compared to far UV photoelectric heating whose efficiency depends on metallicity. The net cooling in the interior of the disk suppresses the photoevaporation. However, adding X-ray radiation significantly increases the photoevaporation rate, especially at $Z \sim 10^{-2}$ Zsun. Although the X-ray radiation itself does not drive strong photoevaporative flows, X-rays penetrate deep into the neutral region in the disk, increase the ionization degree there, and reduce positive charges of grains. Consequently, the effect of photoelectric heating by far UV radiation is strengthened by the X-rays and enhances the disk photoevaporation.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 14:40 - 15:00

Takayuki Muto
(Kogakuin University)

Title: **Multi-wavelength High Resolution Observations of Protoplanetary Disks**

Abstract: High resolution observations of protoplanetary disks have found various structures such as rings, gaps and spirals. The near infrared polarization imaging observations are sensitive to small dust grains at the surface of the disk while sub-mm observations reveal the structures of large grains and molecular gas at the midplane. The combination of near infrared and sub-mm observations is therefore a key to understand the structures of protoplanetary disks. The SEEDS project observed several tens of disks using HiCIAO/AO188 on board Subaru and now ALMA has observed more than 100 disks at the spatial resolution of <=0.2 asec and several tens of disks at <=0.1 asec at sub-mm wavelengths. We present several case studies of disk imaging observations at different wavelengths to understand the distribution of dust particles. We also present the prospects on direct imaging observations of an accreting young planet using sub-mm and near infrared high resolution observations. If time allows, we present recent progress of our archival survey to reveal the statistical properties of disk structures. Finally, we discuss prospects towards future high contrast imaging observations with TMT and/or extended ALMA.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Invited talk
11/19/2019, 15:30 - 16:10

Tyler Groff
(NASA Goddard Space Flight Center)

Title: **Exoplanet Imaging with CHARIS and Future Synergies with WFIRST CGI**

Abstract: The principal science goal of directly imaging exoplanets is spectroscopy. At Subaru, the SCExAO instrument uses the CHARIS integral field spectrograph (IFS) to take spectra of young, self-luminous companions and disks in the near-infrared. CHARIS provides both R70 and R20 spectral resolutions across the J, H, and K bands. Of the two, R20 is the primary observing mode, which provides both excellent spectral coverage of the companions and a larger bandpass for advanced speckle subtraction techniques. Looking to the future, the WFIRST CoronaGraph Instrument (CGI) is a technology demonstration for future missions whose spectroscopic techniques are rooted in what has been demonstrated at ground observatories. CGI will reach very high contrast in broadband light with advanced wavefront control and coronagraphy techniques, paving the way for characterizing Earth-like planets. The spectral resolution of CGI spectroscopic modes is R50 with 15% bandpasses from 600 to 970nm. The calibration, speckle subtraction, and spectral extraction methods for CGI spectroscopy has a strong heritage from techniques developed for SCExAO+CHARIS. We discuss such synergies between CHARIS and CGI characterization capabilities from both a science and engineering perspective, including the new Wollaston polarization upgrade to CHARIS.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 16:10 - 16:30

Julien Lozi
(Subaru Telescope)

Title: **New NIR spectro-polarimetric modes for the SCExAO instrument**

Abstract: The Subaru Coronagraphic Extreme Adaptive Optics (SCExAO) instrument is a high-contrast imaging system installed at Subaru. It is equipped with a fast visible dual-camera polarimetric module, VAMPIRES, already producing valuable observations of protoplanetary disks and dust shells. We present two new polarimetric modules that were recently implemented,. using the NIR light from y- to K-band and Wollaston prisms. The fast polarization module, similarly to VAMPIRES, uses a fast IR camera that can run at kilohertz frame rates, and a Ferroelectric Liquid Crystal (FLC) device modulating the polarization in a synchronized way with the acquisition. This allows to freeze atmospheric speckles and to calibrate more precisely the degree of polarization of the target, as already demonstrated by VAMPIRES. For the second module, we perform spectro-polarimetric measurements at a slower rate, using the CHARIS Integral Field Spectrograph (IFS). The field-of-view is reduced by a factor 2 in one direction to 2x1 arcsec, to accommodate for the imaging of both polarizations on the same detector without sacrificing the spectral resolution of the instrument. This is the first demonstration of a high-contrast spectro-polarimeter using an IFS. We present on-sky results of the new polarimetric capabilities taken during the commissioning phase, on strongly polarized targets.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/19/2019, 16:30 - 16:50

Thayne Currie
(NASA-Ames/Subaru)

Title: **Spectral Characterization of Directly-Imaged Planets with the Subaru Telescope**

Abstract: The Subaru Telescope has played a critical role in not just the discovery of directly imaged planets around other stars but also their spectral/atmospheric characterization. Early data taken with AO188 helped establish key trends in young jovian exoplanet atmospheres, in particular their clouds and chemistry. Now, SCExAO coupled with the CHARIS integral field spectrograph delivers not just far sharper images but simultaneous JHK spectra diagnostic of the planets' temperatures, gravities, and chemistry. SCExAO/CHARIS also clarifies the nature of controversial objects. In the next decade SCExAO should provide the first detections and characterizations of mature exoplanets in reflected light, paving the way for characterizing an exo-Earth with TMT.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/22/2019, 9:00 - 9:20

Mayuko Mori
(University of Tokyo)

Title: **Transmission Spectroscopy of the Atmosphere of TRAPPIST-1g using Subaru/MOIRCS and Gemini/GMOS-N**

Abstract: Uncovering the composition of planetary atmospheres is important for understanding their formation and evolution. From previous studies using Hubble Space Telescope (de Wit et al. 2018, Wakeford et al. 2019), the TRAPPIST-1 planets seem not to have clear H2/He-dominated atmospheres. However for TRAPPIST-1g, the largest planet in the system, the result was not very clear in the observed wavelength (1.1-1.7um).

We observed a transit of TRAPPIST-1g at wavelengths of 1.3-2.3 um using the MOIRCS spectrograph. This wavelength range is useful to constrain atmosphere models because it covers strong methane absorption lines around 2.3 um. Simultaneously with MOIRCS observation, we obtained Gemini/GMOS-N photometry in r-band, to look for signatures of Rayleigh scattering.

We were able to detect the transit with both instruments. The derived transit depth is ~0.77% in r-band, consistent with previous study at longer wavelengths. This indicates low levels of haze in the TRAPPIST-1g atmosphere, but still we need more observation. For the MOIRCS data, the uncertainty of derived transit depths is too big to constrain any atmosphere models.

In this presentation, I will share the data analyses techniques and the possibility of transmission spectroscopy of future targets using MOIRCS.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/22/2019, 9:20 - 9:40

John Livingston
(University of Tokyo)

Title: **Spitzer observations of the young planet V1298 Tau b**

Abstract: At 24 Myr, V1298 Tau b is the youngest known Jupiter-size transiting planet. However, with only three transits in the initial K2 discovery data, the ephemeris was poorly constrained. Furthermore, the star is fast-rotating and active, so spot-crossing events pose an obstacle precise transit modeling. We observed a transit with the Spitzer Space Telescope in order to mitigate this problem, as spot contrasts on the stellar surface are greatly diminished in the infrared. The Spitzer transit improves the ephemeris precision by an order of magnitude. Furthermore, by measuring a more precise planet radius, the planet will be more useful for studies hoping to constrain the physics of planet formation and evolution.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/22/2019, 9:40 - 10:00

Noriharu Watanabe
(SOKENDAI (Graduate University for Advanced Studies))

Title: **Doppler Tomographic Analysis for Planetary Orbital Precession of WASP-33b**

Abstract: Johnson et al. (2015), henceforth as J+15, found that the transit chord of WASP-33b, which has a 1.2-day-period retrograde circular orbit around a rapidly rotating and pulsating A-type star, changed slightly from 2008 to 2014. They detected its orbital precession due to its flattened host star. However, only two observational epochs, 2008 and 2014, were used in J+15.

To confirm and measure more precisely the precession, we used observational data of WASP-33 which was obtained using the High Dispersion Spectrograph (HDS) in 2011, as well as the data sets of 2008 and 2014 in J+15. After using a method of Doppler tomography, we got the planetary shadow showing a retrograde orbit and a component from stellar pulsations. Then we extracted only the planetary shadow by Fourier filtering.

To measure sky-projected orbital obliquity and impact parameter of each epoch, we adopted an MCMC analysis for the three filtered data with our planetary shadow model. After applying equations of a long-term orbital precession from Iorio (2016) to fit our values, we found that our measured parameters did not follow the model. This disagreement may imply that WASP-33b's precession has an unclear short variation or we have underestimated these errors.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/22/2019, 10:00 - 10:20

Taichi Uyama
(NASA Exoplanet Science Institute, Caltech/IPAC)

Title: **Characterizing a directly-imaged planet Kappa And b with SCExAO**

Abstract: Kappa And b was discovered in the SEEDS survey and follow-up observations have been conducted for its characterizations. We present the latest Kappa And b observations with Subaru/SCExAO+HiCIAO HY-bands imaging and Subaru/SCExAOI+CHARIS JHK-bands low-resolution spectroscopy. By combining our results with previous studies we investigated Kappa And b's spectrum and performed orbital fitting, which suggests that Kappa And b is likely an L0-L1 object and has an eccentric orbit. Our results promote following observations for with TMT for further discussions of formation/evolution scenarios of Kappa And b.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution talk
11/22/2019, 10:20 - 10:40

Ruben Asensio-Torres
(Stockholm University / Max Planck Institute for Astronomy)

Title: **First results from BEAST: The B-star Exoplanet Abundance Study**

Abstract: "Direct imaging surveys have proven that substellar companions on wide orbits are rare, but seem to be more common with increasing host stellar mass. However, the more massive B-type stars (>3MSun) have not been studied to the same level of scrutiny as AFGKM types, and it is not clear whether this trend holds for the most massive stars or there is an overturn, as suggested by the indirect methods at short separations. To address this issue, the B-star Exoplanet Abundance Study (BEAST) survey has started with the goal of detecting giant planets, brown dwarfs and disks around 83 B-type stars in Scorpius Centaurus with SPHERE. Here, we describe the layout of the survey and the current results of the observations. We also present the first companion yielded by BEAST, the discovery of a ~20 Mjup circumbinary brown dwarf in Upper Scorpius. We will discuss the spectral properties of this object and the importance of common proper motion when claiming physical association."

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Invited talk
11/22/2019, 10:50 - 11:30

Masahiro Ikoma
(University of Tokyo)

Title: **Progress in and prospects for understanding of planet formation**

Abstract: Considerable progress in understanding of planet formation has been made in the last two decades, thanks to continuous progress in exoplanet observation. Last year a new satellite for transiting exoplanet survey (TESS) was launched, opening a new era of characterization of atmospheres of close-in exoplanets. On one hand, development of direct imaging technique is enabling to detect and observe distant, young exoplanets including accreting gas giants. Here I review such progress that exoplanet observations have brought about in understanding of planet formation. Then I discuss what observational constraints are expected from the Subaru Telescope for further understanding of the origins and diversity of exoplanets.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Invited talk
11/22/2019, 11:30 - 12:10

Olivier Guyon
(Subaru Telescope)

Title: **Imaging Giant Exoplanets with SCExAO and Habitable Planets on TMT**

Abstract: Subaru Telescope has provided powerful exoplanet imaging capabilities with AO-fed high contrast imaging instrumentation. Its current extreme-AO instrument, the Subaru Coronagraphic Extreme Adaptive Optics (SCExAO) system, feeds several optical and near-IR instrument modules, including the CHARIS near-IR integral field spectrograph and the VAMPIRES visible imager/polarimeter. SCExAO users are making major contributions in exoplanet science with observations of disks and young giant planets.
Major upcoming upgrades in Subaru adaptive optics instrumentation, along with new SCExAO instrumentation deployment, will further augment contrast performance and provide additional modes including high resolution spectroscopy and near-IR polarization differential imaging. The SCExAO platform is also a prototype for imaging and spectroscopy of habitable planets around nearby M-type stars with the Thirty Meter Telescope. The scientific and technical evolution path toward this ambitious goal is poised to make Subaru Telescope a world-leading exoplanet observation facility over the next decade.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution poster
Poster ID: P30

Yasunori Hori
(Astrobiology Center)

Title: **Do the TRAPPIST-1 Planets Have Primordial or Secondary Atmospheres?**

Abstract: Recently, seven Earth-sized planets orbiting an ultra cool red dwarf TRAPPIST-1 were reported, three of which dwell in the habitable zone. Low densities of the TRAPPIST-1 planets may conceal volatile content, e.g., water and atmospheres. In fact, atmospheric spectroscopy of the TRAPPIST-1 planets suggests that six of them may have atmospheres. We have investigated whether the TRAPPIST-1 planets acquired substantial amounts of primordial atmospheres from the ambient disk gas and can retain some of them under a hostile environment such as stellar intense irradiations. In this talk, we discuss expected atmospheric properties of the TRAPPIST-1 planets, which are closely related to their habitability, in the context of formation histories.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution poster
Poster ID: P31

Masashi Omiya
(Astrobiology Center (ABC/NINS))

Title: **Precise radial velocity survey of late-M dwarfs in IRD-SSP : Observation status**

Abstract: In IRD-SSP, we are carrying out a precise radial velocity (RV) survey of late-M dwarf stars to search for Earth-like planets around late-M dwarfs using the IRD and the Subaru telescope since S19A. Goals of our survey are to detect Earth-like planets in the habitable zone and understand property of planetary systems around low-mass stars.

In the first phase of the survey observation, we aim to select good targets suitable for very precise RV measurements with IRD from our ~150 sample stars pre-selected using stellar parameters in literatures and our low-resolution spectroscopy. Many late-M dwarfs are active and rapidly rotating, and then such properties of the stars disturb precise RV measurements with precisions of ~2m/s to be needed to detect Earth-mass planets around low mass stars. The stars with double lines caused by close companions are also excluded in the screening observation.

So far, we have observed more than 40 pre-sample stars several times until May 2019 and will observe the 60 stars for the RV measurements in IRD-SSP survey from S19B intensively. In this poster, we report the current observation status of the IRD-SSP survey.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution poster
Poster ID: P32

Mayuko Ozawa
(Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo)

Title: **N-body simulations of accretion of ice giant cores in mean motion resonances with gas giants**

Abstract: Recent exoplanet surveys have detected more Neptune-size planets beyond the snow line than planet formation theories predict. However, even for such planets in the Solar System, namely Uranus and Neptune, the planetary accretion processes remain uncertain. Standard in-situ growth of the cores of Uranus and Neptune via planetesimal accretion is theoretically too slow to be completed before gas disk dispersal. In this study, as a possible rapid growth process, we consider the accretion of planetesimals trapped in mean motion resonances (MMRs) with inner giant planets such as Jupiter and Saturn. If MMRs could accelerate planetary accretion, the timescale problem of the cores of Uranus and Neptune could be alleviated. The previous study that studied the core accretion of Saturn in MMRs considered only a 2-dimensional system. In this study, we have performed high-resolution N-body simulations of planetary accretion in a 3-dimensional system to investigate the effect of MMRs on planetary accretion.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution poster
Poster ID: P33

Yuhei Takagi
(Subaru Telescope)

Title: **High-resolution optical and near-infrared spectroscopy of FU Ori type star V960 Mon**

Abstract: We present the result of the high-resolution optical and near-infrared spectroscopy of FU Ori type star V960 Mon. Spectroscopic variation of an FU Orionis type star will provide valuable information of its physical nature and the disk evolution. From our previous results of two-years mid-resolution optical spectroscopic monitoring of V960 Mon since its outburst on Nov. 2014, we found that the equivalent width of neutral atomic lines increased, while those of ionized line decreased. This equivalent width change corresponds to a decrease in effective temperature and an increase in surface gravity. To investigate the cause of this change, we obtained the high-resolution optical and near-infrared spectra. While line profiles of the neutral lines were broad during the early phase of the outburst, those in the spectrum taken in Jan. 2018 show triple-peaked profile. The central structure of the absorption line is likely to be which indicate that the spectrum of the central star is appearing as the V960 Mon luminosity fades. The H-alpha line, Ca triplet, NaD, and K lines also show profile change, corresponding to the evolution of the outflow and accretion. We discuss the relationship between the profile change and the evolution of FU Ori star.

"Past 20 Years and Future of Subaru's Role in Observations of Exoplanets and Disks"
Contribution poster
Poster ID: P34

Taichi Uyama
(NExScI, Caltech/IPAC)

Title: **Search for Hα from Accreting Protoplanets with SCExAO+VAMPIRES**

Abstract: The Visible Aperture Masking Polarimetric Interferometer for Resolving Exoplanetary Signatures (VAMPIRES) has newly started operation with Subaru/SCExAO. This instrument enables variety of imaging modes of polarization differential imaging (PDI), aperture masking, and spectral differential imaging with a Hα filter (SDI). The main purpose of the instrument is high– resolution imaging of circumstellar disks but the Hα SDI mode can provide another aspect of high –contrast imaging; accretion signatures. As reported accreting protoplanet candidates around LkCa 15 or PDS 70 hydrogen emissions from protoplanets will directly benefit discussion of planet formation mechanisms. We introduce Hα high– contrast imaging observation and reduction schematics in the presentation.