**Session:** **[B5A-3] S3 : Stars, Exoplanets and Stellar Systems**

**Date:** August 22, 2014 (Friday)

**Time:** 09:00~10:30

**Room:** Room C (Room 104)

**Chair:** Wen-Ping Chen (National Central University)

**[B5A-3-1]** **09:00~09:15**

### [Invited] Characterising Transiting Exoplanet Systems

Daniel Bayliss (Australian National University , Australia)

Transiting planets are the key to exoplanet characterisation. The transit depth itself yields the planetary radius, and coupled with radial velocity follow-up, the true planetary mass and bulk density can be determined. A vast array of further follow-up techniques also allow in-depth characterisation of the planet. In this talk I will focus on characterising exoplanet atmospheres, temperatures, and spin-orbit alignments. Transmission spectroscopy allows us to determine the constituents of the planetary atmosphere. Such studies have detected atoms and molecules such as Na, water and methane in transiting planet atmospheres. Infra-red secondary eclipse photometry enables us to determine the temperatures of transiting planets. This in turn aids our understanding of the atmosphere of the exoplanet. Finally, the Rossiter-McLaughlin effect lets us measure the spin-orbit alignment of the star and the planet. Recent results have shown a number of transiting exoplanets are in misaligned orbits, which provide a challenge for planetary formation and migration theories.Precise characterisation relies on discovering transiting systems around bright stars. The new generations of ground and space surveys should provide these over the next five years (e.g. HATSouth, NGTS, Kepler K2, TESS). Extremely large telescopes, such as the GMT, will then be able to characterise these planets in unparalleled detail, leading to better understanding of exoplanet formation, migration, and composition.

**[B5A-3-2]** **09:15~09:30**

### [Invited] Circumbinary Planets

Liying Zhu (Chinese Academy of Sciences, China), Shengbang Qian, Wenping Liao, and Liang Liu

Most of the stars in the Galaxy are in binary systems, binaries should be the plausible hosting stars of planets. Searching for planetary companions to binaries especially evolved close binary stars (e.g., sdB-type eclipsing binaries, detached WD+dM binaries etc.) can provide insight into the formation and the ultimate fate of circumbinary planets, as well as can shed light on the late evolution of binary stars. In order to searching for the circumbinary planets around the evolved close binaries, we have monitored some evolved eclipsing binaries for several years. In this talk, I will review current observational results of circumbinary planets with different methods. Then, I will present some of our findings detected by the timing method, which has most successfully been applied to detect extrasolar planets around stars evolved beyond the first red giant branch. Finally, the fate of the orbiting circumbinary planets as well as their effects on the evolution of the host binaries will be discussed.

**[B5A-3-3]** **09:30~09:45**

### [Invited] High-Contrast Imaging of Exoplanets:Japanese Current and Future Plans

Taro Matsuo (Kyoto University, Japan)

High-contrast planet imaging observations provide us useful information on planetary atmosphere and surface environment that are complement with physical one such as mass, radius, and orbit. The Strategic Exploration of Exoplanets and Disks with Subaru (SEEDS) is a direct imaging survey for wide-orbit gas giants

and proto-planetary disks around about 500 stars as the first Subaru strategic program. Several new planets including one with unique T-dwarf type atmosphere as well as the unprecedented details of the disks have been successfully revealed in the SEEDS campaign.The next step is to detect and characterize Jovian planets at 1 to 10AU around nearby main-sequence stars. A new high-contrast instrument, called SEICA (Second-generation Exoplanet Instruments with Coronagraphic AO), for the Kyoto 4m segmented telescope is proposed as one of the next-generation Extreme Adaptive Optics. SEICA is aggressively optimized for high performance at a very small inner working angle with $10^{-6}$ detection contrast in 1-hour integration. Since this will be the first time to realize such an extreme high-contrast imaging on segmented telescopes, the SEICA project is an important step toward high contrast sciences on Extremely Large Telescopes (ELTs) – the regime in which rocky planets can be directly detected. We will begin the on-sky commissioning test in 2016 and the science observations in 2017. This talk introduces Japanese activities related to high-contrast planet imaging and then discusses possible international collaborations toward ELTs.

**[B5A-3-4]** **09:45~10:00**

### [Invited] Free Floating Planets and Initial Masss Functions

Yumiko Oasa (Saitama University, Japan)

One of the most important issues in astrophysics is to precisely determine the initial mass function (IMF).
How abundant very low-mass objects such as brown dwarfs and extrasolar planets and whether the formation process and statistical properties differs among various environments are questions to be explored, yet remained unclear. We are executing near-infrared observations of various star-forming regions to search for very low-mass objects and to constrain their frequency, nature, and formation. Our photometric and spectroscopic observations with Subaru reveal significant populations of very low-luminosity YSOs with cool temperatures, some of which appear to be similar to giant planets without hosting stars, i.e. isolated planetary mass objects ("free-floating planets"). Comparison of the IMFs within the same cluster and various clusters implies that there is not any cutoff in IMF at low-mass end and very low-mass IMFs would be dependent on the forming environment. In this talk, I would like to review observational results of free-floating planets and their IMFs as well as a perspective for their future observations with GLAO, TMT and WISH.

**[B5A-3-5]** **10:00~10:15**

### Developing a Multispectral Source Finder for Direct Imaging of Exoplanets

Inseok Song (The University of Georgia, USA) and Jinhee Lee

Since the first exoplanet discovery at 1995, about 2000 exoplanets have been discovered. Radial velocity and transit methods have provided major contribution to the recognition of the ubiquity of the exoplanets in the Universe. Despite of their big contribution, these methods provide limited information about the exoplanets. The progress of technologies realizes direct imaging of the exoplanet and allows us to obtain more information about the exoplanets directly.
The major difficulty to obtain images of the exoplanets is caused by high brightness contrast between the host star and the planet. Stellar coronagraph and extreme AO (adaptive optics) are used to reduce stellar light, but still there is a significant residual starlight – speckle pattern. This quasi-static speckle pattern is the main reason to make the exoplanet imaging difficult. Therefore, a post-processing method to distinguish the speckle from the target images is an important task to detect the exoplanets. The most current post-processing methods are based on empirical modeling to construct a stellar PSF, which could lead self-subtraction.
In the framework of the GPI (Gemini Planet Imager, PI: B. Macintosh) project, we are developing a multispectral source finder for an AO-corrected coronagraphic imaging system. This post-processing tool is using an analytical coronagraphic PSF model based on Bayesian approach. The analytical PSF model is not correlated to the image itself unlike the other methods, so this approach could separate the speckle and the planet explicitly. With guaranteed 890 hours of Gemini time, GPI is obtaining multispectral images of young stellar systems. Here we present the performance of our tool to GPI images.

**[B5A-3-6]** **10:15~10:30**

### The MINERVA Project: Small Exoplanets from Small Telescopes

Rob Wittenmyer (University of New South Wales, Australia), John Johnson, Jason Wright, and Nate McCrady

The Kepler mission has shown that small planets are extremely common. It is likely that nearly every star in the sky hosts at least one rocky planet. We just need to look hard enough - but this requires vast amounts of telescope time. The way forward is to own the telescope. MINERVA (MINiature Exoplanet Radial Velocity Array) is a dedicated exoplanet observatory with the primary goal of discovering rocky, Earth-like planets orbiting in the habitable zone of bright, nearby stars. We have joined with Harvard, Caltech, Penn State, and Montana to build the 4-telescope MINERVA array, to be sited at Mt Hopkins in Arizona, USA. Full science operations will begin by 2015 January with all four telescopes and a stabilised spectrograph capable of high-precision Doppler velocity measurements. We will observe the 80 nearest, brightest, Sun-like stars every night for at least five years. Detailed simulations of the target list and survey strategy lead us to expect 12±3 new low-mass planets, with 3±1 in the habitable zone.