Session:	**[B5A-6] S6 : Observing Facilities and International Collaborations**
Date:	August 22, 2014 (Friday)
Time:	09:00~10:25
Room:	Room F (Room 108)
Chair:	Wonyong Han (Korea Astromony and Space Science Institute)

[B5A-6-1] **09:00~09:20**

[Invited] A Measurement of the Cosmic Microwave Background B-Mode Polarization with POLARBEAR

Yuji Chinone (High Energy Accelerator Research Organization, Japan)

POLARBEAR is a ground-based experiment located in the Atacama Desert of Northern Chile. The experiment is designed to measure the Cosmic Microwave Background (CMB) B-mode polarization at arcminute resolution with a beam size of 3.5 arcminutes. We started our science observations in early 2012 at 150 GHz with an array of 1,274 polarization sensitive antenna-couple Transition Edge Sensor (TES) bolometers. The CMB B-mode polarization on degree angular scales is a unique signature of primordial gravitational waves from cosmic inflation and B-modes on sub-degree scales are induced through the gravitational lensing by cosmological large-scale structure. We published the first CMB-only detection of the B-mode polarization on sub-degree scales induced by gravitational lensing in December followed by the first measurement of the B-mode power spectrum on those scales in March. I will describe the detector and hardware advances that made this possible, the results and their implications, and future plans for measuring inflationary B-modes and constraints on inflation, dark energy, and neutrino masses.

[B5A-6-2] **09:20~09:40**

[Invited] GroundBIRD: a Large Angular Observation of CMB Pol. from the Ground

S. Oguri (High Energy Accelerator Research Organization, Japan)

The cosmic microwave background radiation (CMB) is an important probe to understand the beginning of the universe. In particular, the odd-parity patterns of CMB polarization, *B*-modes, are one of the best probes to study the inflationary universe. Whereas BICEP2 experiment has claimed the first detection of it, there is a lot of attention whether the signals come from the inflation or not. One of the important subjects is proof of an ever-presence of primordial gravitational waves (PGW), which was generated by the inflation. Wide range measurements of *B*-mode's spectrum will probe it. We propose a novel experiment, GroundBIRD, which achieves satellite's observation from the ground. A super high-speed scan allows us to observe the CMB polarization in a large angular scale while mitigating effects of atmospheric fluctuation.
GroundBIRD is a compact radio telescope. One of the key features is very large scan range while mitigating systematic errors. In general, the range is limited by 1/*f* noise effect caused from detector's baseline fluctuation. Scan modulation, which is a CMB signal modulation by a periodic change of the line-of-sight direction, is a promising method to suppress it. In the past experiments, the left–right azimuthal scan is usually employed. Instead of the scan, we employ a high-speed rotation scan (20 rpm) without any deceleration. It allows us to expand the scan range (multipole, *l*) to $6 \le l \le 300$. Such a wide range spectrum measurement may allow us to reveal the ever-presence of PGW. Calibration of detectors is also important to mitigate the errors. We propose the continuous calibration strategy while measuring the CMB polarization. We combine sparse wires (wire grid) set on the ground shield over the telescope and the high-speed rotation. The wire grid with the interval of a few cm creates weak linearly-polarized signal. The rotation of the telescope modulates the polarization angle of the signal. It becomes a well-defined modulated source. Therefore, the signal is useful to calibrate the detectors as well as easy to separate it from the CMB signal. We employ microwave kinetic inductance detectors (MKIDs) as detectors. A fast time response of the MKIDs (it is about 10 times faster than conventional bolometers) is well-matched with the high-speed scan of GroundBIRD,

whereas its application is the first time for the CMB observation. There are other advantages for the MKIDs, e.g., a big potential for a multiplexed readout by frequency-domain. The detectors and their readout system are under developing by Japanese collaboration group: NAOJ, RIKEN, KEK, and Okayama Univ. We have already confirmed to detect polarization signals from a CMB simulator by MKIDs. We report the status of the development of instrumental components: a vacuum chamber, radiation shields, coolers, mirrors, structures in the cryostat, and a rotating table. In particular, we succeeded to make a cold condition at 230 mK on the rotating table, which is the first achievement in the world. We plan to have commissioning observation in Japan in late 2014–2015. After that we will move the telescope to a suitable place for the CMB observation.

[B5A-6-3] **09:40~09:55**

The Wendelstein 2m Telescope and it´s Instrumentation

Frank Grupp (Max Planck Institute für Extraterrestrische Physik, Germany), Florian Lang-Bardl, Claus Gössl, Ulrich Hopp, and Ralf Bender

The 2m Wendelstein telescope in the German Alps is currently in its commissioning phase. The modern Alt-Az-mounted telescope is hosting a contemporary suite of instruments. A visual light light wide field imager is covering a 0.7° diameter field utilizing a three lens filed corrector optimized for low ghost light brightness. In addition a three channel camera is imaging an uncorrected portion of 0.14° on the sky in two visual light and one near infrared channel. Beside these photometric instruments two spectrographs will be hosted at the telescope. The low to mid resolution 260channel multi object spectrograph VIRUS-W, and the highly stabilized R=70000 Échelle machine FOCES. The latter will be equipped with an astro frequency comb which, together with high end environmental and illumination stabilization will allow precise radial velocity spectroscopy down to the sub m/s regime. In the talk and paper we will introduce site and telescope, and then concentrate on the unique and technologically special features of the project such as low ghost intensity wide field imaging, high precision RV spectroscopy and the operational mode allowing a quick – semi automated – change of instruments and a flexible scheduling of observations. The latter allowing unique efficiency on a “small”, university owned, telescope.

[B5A-6-4] **09:55~10:10**

The 2m Telescope of the Thai National Observatory

Saran Poshyachinda (National Astronomical Research Institute of Thailand, Thailand)

Thai National Observatory (TNO) was inaugurated in January 2013. However, planning and preparation started more than a decade before that. A 2.4m folded dual Nasmith Ritchey-Chretian telescope, with state-of-the-art pointing and tracking capabilities, makes it possible for the Astronomical community in Thailand to join advanced research with the international counterparts. Located at the highest mountain in Thailand at 2450m above the mean sea level, the seeing conditions at the site provide astronomers with opportunities to observe over the long dry season, from October to May, in the northern part of the country.Instruments available at the time of this report are 4k x 4k camera, low resolution spectrograph, and fast read-out camera (ULTRASPEC). The latter is a collaboration between NARIT and the Universities of Sheffield and Warwick in the UK. A medium resolution Echelle spectrograph (MRES) is due for installation in October 2014. More instruments are planned for the near future

[B5A-6-5] **10:10~10:25**

U-SmART : Small Robotic Telescopes for Universities

Ranjan Gupta (The Inter-University Centre for Astronomy and Astrophysics, India), Harinder P. Singh, Shashi M. Kanbur, and Andreas Schrimpf

A group of universities have come together with the aim of designing and developing Small Aperture Robotic Telescopes (SmART) for use by students to observe variable stars and transient follow-ups. The group is deliberating on the components of the robotic system e.g. the telescope, the mount, the back-end camera, control software etc and their integration keeping in mind the scientific objectives. The prototype might then be replicated by all the participating universities to provide round the clock observations from sites spread evenly in longitude across the globe. Progress made so far is reported in this paper.