Overview of The University of Tokyo Atacama Observatory Project and it's Prospects toward to Planetary Science

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Since astronomy is the study of various phenomena in the Universe, observations with wide wavelength range are essentially important. Especially infrared astronomy is very useful, however observations in the infrared wavelength (IR) are not easy because the infrared light is strongly absorbed by the Earth’s atmosphere. Then the University of Tokyo promotes the University of Tokyo Atacama Observatory (TAO) project. It is to construct a 6.5m IR-optimized telescope at the summit of Co. Chajnantor in the Atacama Desert, northern Chile. Thanks to the dry climate and the high altitude (5640m), in near IR range discrete atmospheric “windows” of J, H, K-bands coalesces into one continuous window at the TAO site. In addition a new window from 25 to 40 micron appears in the mid IR. Accessibility of these wavelengths is the most unique capability and the strongest advantage of the TAO telescope. To utilize the best observing environment, the TAO telescope has two state-of-art instruments called SWIMS and MIMIZUKU.

SWIMS (Simultaneous-color Wide-field Infrared Multi-object Spectrograph) is a NIR spectrograph capable of wide-field imaging and of multi-object-slit (MOS) spectroscopy. It has wide field-of-view of 9.6 arcmin diameter with 0.126 arcsec/pix with four 2k x 2k HAWAII-2RG arrays on short and long wavelength each other, and realizes simultaneous two wavelength-range (0.9-1.4 micron / 1.4-2.5 micron) imaging or MOS spectroscopy with wavelength resolution of $\lambda / \Delta \lambda \sim 1000$ in the full range of the NIR wavelength in one shot. SWIMS has many type of filters; 4 wide-band, 8 medium-band, and 10 narrow-band filters. Furthermore SWIMS has an integral field unit (IFU) capability. By combination of these filters or usage of IFU, we can adopt many scientific cases like galaxy evolution, cosmology, and searching rare objects.

As the TAO telescope is located at the high altitude, it is expected to have high performance in the MIR which is covered by MIMIZUKU (Mid-Infrared Multimode Imager for gaZing at the UnKnown Universe). The features of MIMIZUKU are (1) fully covering the mid-infrared wavelength from 2 to 38 micron by utilizing three kinds of detectors (HgCdTe, Si:As, and Si:Sb), (2) spatial resolution of 1 arcsec at 30micron, which is the highest resolution ever achieved, and (3) achieving accurate relative photometric observation using the newly developed "Field Stacker" unit. Covering the very wide wavelength range from 2 to 38 micron, MIMIZUKU takes advantage of the potential of TAO site as the world's best environment for infrared observations. Also, by putting the Field Stacker System, which is to combine two different field-of-view into one image, it will realize the measurement of high-accuracy temporal variation in the MIR. Thanks to its higher spatial resolution than satellite telescopes in this wavelength range, MIMIZUKU is a very powerful tool for studying planet formation and origin of materials.

Recently a lot of planets outside the Solar system (so called exoplanets) are detected and studied intensively. Investigations of the details of the exoplanets including orbit, size, composition, and their atmosphere are a key for understanding of formation of the (exo)planets. These planets are thought to be

formed in dust disks around young stars which called pre-main-sequence stars. Therefore the dust disks are important targets for observational astronomy as well as the exoplanets themselves. The dust disks do not shine in the optical wavelength, but are very bright in MIR. The capability of 30 micron imaging of TAO is expected to reveal the formation process of planets for the first time. Dust grains are one of major constituents of the Universe. They contain most of metal elements in the interstellar medium, and play important parts on physical and chemical processes in both interstellar and circumstellar environments. Studying the formation and the evolution process of the dust grains is also essentially important to understand the formation of planets.

Keywords: The University of Tokyo Atacama Observatory (TAO), Infrared Astronomy