

R009-15

Zoom meeting D : 11/1 PM1 (13:45-15:30)

14:30~14:45

高コントラスト望遠鏡 PLANETS の開発状況と惑星・衛星近傍の希薄ガス発光の検出可能性

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Current status of the development of high-contrast telescope PLANETS and detection feasibility of scientific targets

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We are carrying out a 1.8-m aperture off-axis telescope project PLANETS (Polarized Light from Atmospheres of Nearby ExtraTerrestrial Systems). In this presentation, we give the detection feasibility of scientific targets, such as volcanic and plume activities on Jovian satellites Io and Europa, and escaping gases surrounding Mars, taking advantages of high-contrast performance of the PLANETS telescope. The high-contrast performance of PLANETS telescope optics is provided by low-scattering off-axis mirror system, adaptive-optics (AO), and stable atmospheric conditions of an observatory site at a high-altitude. In particular, the off-axis system brings us no cross-shaped diffraction pattern caused by the secondary mirror support in the optical path, and thus the scattering light of PLANETS is estimated to be more than 10 times better than that of a normal large telescope.

A major scientific target is to detect faint emissions of gasses erupted from Jovian satellites Io and Europa. These emissions are so faint (10^{-3} to 10^{-6} to the brightness of planetary or satellite body) close to the main disk (less than a few arcsec). We will elucidate the spatial and time variations of Io volcanoes and its influence on Jupiter's magnetosphere by monitoring volcanic activities on Io's surface with infrared AO imaging at 1-4 μm , and neutral emissions (O 630 nm and Na 589 nm) distributed in the atmosphere surrounding Io, plasma torus emission in the inner magnetosphere (S+ 672 nm, S++ 631nm, O+ 733nm, O++ 501nm), and Jupiter infrared aurora emission (H3+ 3.4 μm , 3.9 μm). We also observe visible emission (O 630 nm and 558 nm) caused by the dissociation of water molecules suddenly released by Europa's water ejection activity, and clarify the relationship between tidal action and eruption activity, and between surface topography and eruption location.

Another major scientific target is the escaping gases surrounding planets. We are examining the detection possibility of Martian ionospheric gases and ion tail using the PLANETS telescope. The target is solar resonance emissions of N2+ at 391.4 nm/427.8 nm and CO+ at 505 nm. From the quantitative estimation with number density obtained with MAVEN (Benna+, 2015), the N2+ emission intensity is seems to be greater than detection limit and the time variation may be able to detect during a CME event.

The telescope optics has a Gregorian focus with a FOV of 6 arcsec(F/13). The main mirror is Clearceram Z-HS with a diameter of 1850 mm and thickness of 100 mm. So far, the glass blank of main mirror was made in 2010, the rough grinding was carried out by Harris/Excelis in 2012. In December 2019, the mirror was shipped from Hawaii to Japan for the final polishing. We glued 36 metal adapters on the backside of mirror to connect the mirror support. We adopted the mirror support with warping harness which is similar to that of TMT and the Seimei telescope. We made the elemental test of the whiffletree system, and confirmed that the performance for stress input is as expected by the structure model with a finite element method (FEM), and the repeatability (hysteresis) for stress change is in the acceptable range. We are now carrying out final polishing using a dragging three probe method with a robot-arm system at LogistLab and will complete it within a year. We expect to obtain the accuracy of main mirror better than 20 RMS nm by the final polishing. In addition, we will fabricate the telescope mount and structures using the proto-type mount Seimei telescope. We will assemble the whole PLANETS telescope system, and achieve the first light and technical demonstration, particularly on the high-contrast and low-scattering capability, in Japan within a few years. Further, we already have the construction permit at the summit of Haleakala (CDUP) from the State of Hawaii, and we plan to install PLANETS there as soon as we get the funding for the observatory construction.