

[EE] Evening Poster | P (Space and Planetary Sciences) | P-CG Complex & General

[P-CG21]Future missions and instrumentation for space and planetary science

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Not only national space agencies but some universities and even companies in the world are now leading a number of space science and exploration missions and also energetically initiating new research activities for satellite and rocket developments and international collaborations in these days because the Earth observations from the space and the space explorations could be achieved much easier than a few decades ago. The deployment to the space, which itself is not purely a scientific purpose but one of methods for better sciences, is vigorously motivating the technical innovation and the educational development. For successful space missions, it is also crucial to research and develop aim-oriented on-board instruments, and the fundamental research and development of observational instrumentation with future perspectives could totally lead space missions in some case. Detailed investigation and evaluation on various on-board instruments are needed during their proposals, selections, and fabrications in order to promote the missions, and inevitably we have to make multi-sided arrangements and evolution at every process and aspect of any type of space missions, independently of their mission sizes. In this session, we focus on these comprehensive research activities in the space missions, including the mission integrations and the individual instrumental developments, and we also call many presentations showing the uniqueness and renovation regarding the mission strategy and methodology, and the status and latest results in the related state-of-the-art researches and developments, which would provide all of researchers and developers with invaluable opportunities for active discussion, information sharing, and collaboration toward the realization of more missions for more fruitful space sciences and explorations in nearer future.

[PCG21-P01]Development of compact mid-infrared heterodyne spectroscopy by hollow optical waveguide

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We have developed the mid-infrared (MIR) heterodyne spectrometer which can achieve the highest spectral resolution of $\sim 3.0 \times 10^7$ which enables us to obtain temperature, wind velocity, and abundance of trace gas in planetary atmosphere (e.g. Sonnabend et al., 2012; Sornig et al., 2013; Stangier et al., 2015). We are operating this instrument installed to Tohoku university 60 cm telescope on Mt. Haleakala. This instrument is relatively large size and requests severe control for the alignment of superposition between two beams from source and one local oscillator with many mirrors and lenses. On the other hand, Rodin et al. (2015) proposed M-DLS which was planned to install the channel of near-infrared heterodyne spectroscopy developed for ESA ExoMars lander mission for atmospheric measurement. It achieved compact size and enabled us to control optical alignment easy and flexibly by optical glass fibers. Furthermore, it can switch multiple local oscillators quickly to observe at the multiple wavelengths by fiber coupler. For the utilization to our MIR heterodyne spectrometer, we are starting to evaluate the Ag-coated hollow optical fibers with higher

transmission than the polycrystalline fibers in the wavelength 4-18 μm (Katagiri et al., 2017).

MIR heterodyne spectrometer requires the single-mode transmission for the mixture of two beams and enough low loss rate of 0.5 dB/m for the weak source light. The hollow optical fibers was confirmed to achieved single-mode transmission with the core diameter of 1.0 mm by quantum cascade laser of 7 μm with incident F-number of ~ 70 and that the loss rate was less than 0.5 dB/m with the fiber core diameter of 0.7 mm by CO_2 laser.

Optical glass fibers can be coupled by the fused fiber coupler which two fibers are twisted, heated, stretched, and fused to exchange the energy between cores by evanescent light. Although the hollow optical fibers cannot be used this coupler method because of no core material, we developed the Ag-coated rectangular hollow waveguide coupler which can mix MIR beams by mode couple. It can be utilized to the mixing part of the heterodyne spectrometer, which enables us to simplify the optical design of the current MIR heterodyne spectrometer and to observe with multiple local oscillators. We simulated two gauss beam was coupled with the rectangular hollow waveguide coupler by length of 15 cm.

We will evaluate the quality for heterodyne signal of source light and laser transmitted by the hollow optical fibers and will develop to the rectangular hollow waveguide coupler for beam mixture. We plan to show the plot of new compact MIR heterodyne spectrometer.