Methane and HDO/H2O in the Martian atmosphere studied by ultra-high spectral resolution

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The Mid-Infrared LAser Heterodyne Instrument (MILAHI), which operates onboard the dedicated Tohoku 60cm telescope (T60) at the summit of Mt. Haleakala, has been designed for investigating the trace gases (Methane, HDO/H2O, etc) in the terrestrial atmospheres, such as Mars and Venus. The limitation to detect such trace gases from the ground-based is mainly due to the difficulty of correcting the atmospheric absorptions in the Earth atmosphere. High spectral resolution of MILAHI (>10E6) enables to retrieve them without any ambiguity due to the reproduction of atmospheric spectra on Earth.
In this study, we focus on the detection of methane and HDO/H2O in the Martian atmosphere. As a local oscillator (LO), newly installed quantum cascade laser (QCL) nicely covers 7.7 micron wavelength for these molecules. It is the only IR heterodyne instrument that gives access to new spectral range as compared with previous instruments of this kind.
Because the facility/instrument is just becoming to be operational in these years, the first Mars campaign will be performed on Feb.-Mar. 2016, with large Doppler shift (~15 km/s) between Mars and Earth. Prediction of the radiative transfer model indicates that the determination with two- VSMOW precision could be obtained by 15-minute integration. Upper limit 100ppb of methane will also be determined by 32-hours integration.
Further continuous observations will help to constrain (i) the possibility of biological/geological activities in the current Martian atmosphere, and (ii) water cycle and its evolution on Mars.

Keywords: Methane, HDO/H2O, Heterodyne

