Scientific capabilities and measurement sensitivities of the IR heterodyne spectroscopy

H. Nakagawa[1], H. Sagawa[2], S. Aoki[3], K. Takami[1], Y. Kasaba[1], and I. Murata[1].

(1) Tohoku Univ., (2) Kyoto Sangyo Univ., (3) IAPS/INAF, Italy

A new IR heterodyne instrument is developed for continuous monitoring of planetary atmosphere using dedicated telescope at Mt. Haleakala, Hawaii. Here we introduce the scientific capabilities and measurement sensitivities of the IR heterodyne spectroscopy.

Ultra-high resolution spectroscopic measurement ($R>10^6$) is one of the most powerful tool to explore the planetary atmospheres with several key capabilities: (1) fully resolved molecular features to address the atmospheric temperature profiles, abundance profiles of the atmospheric compositions and their isotopes, (2) direct measurement of the mesospheric wind and temperature with high precision, (3) sensitive detection of minor trace gases, and (4) its small beam size capabilities to allow global mapping. The dedicated use of the telescope provides nearly-continuous operation, for understanding the variable nature and evolutions of the planetary atmospheres. The instrument is set on the Coude focus of the Tohoku 60cm-telescope at Mt. Haleakala to demonstrate the feasibility.

The scientific capabilities and measurement sensitivities of the MILAHI are specifically investigated by the radiative transfer model: Advanced Model for Atmospheric TeraHertz Radiation Analysis and SimUlation (AMATERASU) that is being developed in the framework of the NICT (Baron et al., 2008). Good temperature retrieval is achieved from surface to 30km on Mars with better than 10K precision and 10km vertical resolution, and from 70km to 80km on Venus with better than 5K precision and 2km vertical resolution. Wind retrieval is achieved from 80km to 90km with 40m/s uncertainty and 10km vertical resolution. The local wind and temperature is directly derived from the CO_2 non-LTE emission at the middle atmospheres with 11m/s in velocity and 12K in temperature accuracies. Detection of trace gases is performed without any ambiguity by migrating with terrestrial absorptions.