

Observation capability and the results of ground tests of JEM/SMILES

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Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) will be launched in September 2009 via Japanese rocket, H-IIB/HTV. SMILES will be aboard Japanese Experiment Module of the international space station (ISS) and then start observation of Earth's atmosphere. SMILES observes limb emission from the atmosphere in submillimeter wave band, ie. 624.32 - 626.32 GHz and 649.12 - 650.32 GHz. Height profiles of stratospheric and mesospheric chemical components such as, O₃, HCl, ClO, HOCl, HO₂, HNO₃, CH₃CN, and BrO can be retrieved from the SMILES limb spectra.

At the moment of this presentation, the proto-flight model of SMILES will have been transported to Tanegashima launch site and be under preparation for the launch via HTV. The ground tests of SMILES hardware were performed in 2008. The tests include initial electrical performance tests, thermal vacuum environment tests, mechanical environment tests, and final electrical performance tests. In the initial and final electrical performance tests and thermal vacuum environment tests, we measured several observation capability parameters with the final configuration of SMILES. As a result of the tests, we confirmed that the single-sideband system temperature at the front of antenna conformed the SMILES specification and showed 530 K and less, which was several times better than that of US Aura/MLS. We also measured thermal instability and gain linearity of the SMILES receiver, all of which are conforming the specifications. In the previous year the other observation capability parameters have been also measured in the tests of submillimeter receiver that is a subsystem of SMILES. We believe every measurements which are possible to be measured on the ground were completed with them. We have now got entire sets of system parameters that are necessary to calibrate the real observation data which is expected to be acquired from the latter half of this year.

The observed data by SMILES will be downlinked through the medium rate data link of ISS, and then processed into Level 1B data in a facility located at JAXA, Tsukuba. The Level 1B data is calibrated brightness temperature spectra of atmospheric limb emissions. The brightness temperature will be scaled between two temperatures of internal black body and deep space background emission. In addition to that scaling, the brightness temperature is calibrated with the knowledge of the ground tests and so on, for example, receiver non-linearity, receiver gain drift due to temperature change, incident power from far sidelobe of antenna beam pattern, and Joule loss of mirrors in the antenna system. The calibration is important for reducing scaling error of input data to retrieval processing of stratospheric chemical species. And in case of retrieval of water vapor and ice clouds density in the upper troposphere the calibration in Level 1B processing becomes much more important, because the information needed for such retrieval comes from the absolute brightness temperature instead of spectral structure and directly depends on the calibration accuracy of Level 1B processing including its offset error. The SMILES mission team are evaluating the results of the ground tests and preparing the Level 1B algorithm with it for the best calibrated data.

In this paper, we report the result of the system tests in 2008 and estimated calibration errors in Level 1B data, then summarize the observation capability of SMILES.