

In-orbit Performance and Current Status of the SMILES Mission

K. Kikuchi^{1*}, S. Mizobuchi¹, T. Nishibori¹, R. Sato¹, Y. Irimajiri², S. Ochiai², F. Ohtsubo³, K. Mizukoshi³,
H. Ozeki⁴, T. Manabe⁵, and M. Shiotani⁶

1 Japan Aerospace Exploration Agency, Ibaraki, Japan

2 National Institute of Information and Communications Technology, Tokyo, Japan

3 Advanced Engineering Services Co. Ltd., Ibaraki, Japan

4 Toho University, Chiba, Japan

5 Osaka Prefecture University, Osaka, Japan

6 Kyoto University, Kyoto, Japan

* Contact: kikuchi.kenichi@jaxa.jp, phone +81-50-3362-5580

Abstract—In this presentation, we will describe in-orbit performance and current status of the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES). Unfortunately the SMILES has stopped atmospheric observation since April 2010 owing to some instrumental failures, but intensive activities for data analysis are still in progress.

The SMILES was launched and attached to the International Space Station (ISS) in September 2009. The SMILES had been conducting atmospheric observations since 12 October 2009 with the aid of a 4 K mechanical cooler and Superconductor-Insulator-Superconductor (SIS) mixers for submillimeter limb-emission sounding in the frequency bands of 624.32-626.32 GHz and 649.12-650.32 GHz. On the basis of the observed spectra, the data processing has been retrieving vertical profiles for the atmospheric minor constituents in the middle atmosphere, such as O₃ with isotopes, HCl, ClO, HO₂, BrO, and HNO₃. Results from the SMILES have demonstrated its high potential to observe atmospheric minor constituents in the middle atmosphere.

A notable feature of the SMILES is a high sensitivity of the submillimeter receiver thanks to the SIS technology. The SMILES receiver shows a system noise temperature of <380 K for single sideband operation. The output fluctuation of each spectral channel by radiometric noise is around 0.4 K for each spectrum that acquired every 0.5 s. The measured performance in orbit is consistent with the results of prelaunch tests on the ground and satisfies the specifications.

The SMILES has had troubles in critical subsystems: failure of Gunn diode used in the local oscillator occurred on 21 April 2010, and degradation of cooling power of the Joule-Thomson cryocooler found in June 2010. Although the SMILES terminated observation operation, analysis of the data obtained for a half year is still ongoing. In-orbit calibration and additional ground test results will be implemented in the ground data processing system.