SMILES-2 mission, planned spaceborne observation of the stratosphere, mesosphere and lower thermosphere

*Satoshi Ochiai[1], Philippe Baron[1], Yoshihisa Irimajiri[1], Yoshinori Uzawa[1], Toshiyuki Nishibori[2], Makoto Suzuki[2], Takeshi Manabe[3], Hiroyuki Maezawa[3], Akira Mizuno[4], Tomoo Nagahama[4], Masato Shiotani[5]

1. National Institute of Information and Communications Technology, 2. Japan Aerospace Exploration Agency, 3. Osaka Prefecture University, 4. Nagoya University, 5. Kyoto University

Spaceborne submillimeter-wave limb observation has a great advantage of measuring throughout the whole atmosphere from the stratosphere to the lower thermosphere with a single measurement technique. The variousness of atmospheric parameters to be observed, their precision, accuracy, and resolution are depends on the performance of submillimeter-wave receiver and antenna, which are the main components of submillimeter-wave limb sounding instrument, The SMILES-2 mission, which is a proposed spaceborne submillimeter-wave limb sounding mission proposed by our group, will be equipped with a highly-sensitive superconducting receiver and 1 m-class large aperture antennas. If the SMILES-2 mission is realized in full specifications, we expect the various observations to become possible. Temperature will be measured in a precision better than 1 K with a vertical resolution of 2-3 km in a height range between 15 and 80 km, in 5 K precision with 3-5 km vertical-resolution in a range between 80 and 120 km, and in 10 K precision with 10 km vertical-resolution in a range between 120 and 160 km. Wind will be measured in a precision better than 5 m/s with a vertical resolution of 2-3 km in a height range between 35 and 90 km, and in 10 m/s precision with 3-5 km resolution in a range between 90 and 160 km [Baron, 2015]. The frequency bands of the SMILES-2 receivers are selected to cover the emission lines from a variety of chemical species, which are important for the science in the stratosphere, mesosphere, and lower thermosphere. The species to be measured include O-atom, OH, O_2, O_3, H_2O, CO, NO, NO_2, N_2O, ClO, HCl, HOCl, OClO, BrO, HNO_3, CH_3CN, CH3Cl [Suzuki, 2015].
The SMILES-2 receiver is a superconducting receiver. The spaceborne superconducting receiver was demonstrated in the successful international-space-station-borne mission, SMILES, in 2009. Comparing with 2 band receiver of SMILES at 624-626 GHz and 649-650 GHz, the SMILES-2 receiver will have many frequency bands, that is 485-489 GHz, 523-527 GHz, 556-558 GHz, 575-577 GHz, 619-627 GHz, 649-657 GHz, 1.8 THz and 2.06 THz. For THz band to observe OH and O-atom, a newly developed HEB mixer will be used. The main reflector of the SMILES-2 antenna will have about 1 m, which is made of CFRP with a reflection surface of aluminum. It is planned to have two antennas. Two antennas will see two directions, ahead and behind aslant, to observe an atmosphere twice from different directions so that the horizontal direction of wind is retrieved.
The satellite platform for SMILES-2 is assumed to be the JAXA small-size science satellite, whose weight can be about 700 kg. The satellite orbit is currently assumed to be a height of 550 km and an inclination of 66 degree. The conceptional design of the mission is now studied by SMILES-2 working group. The conceptional design of SMILES-2 will be compiled in the next year or later. If the proposal is selected by JAXA/ISAS, the mission may be launched in 2023 or later.

Baron et al. (2015), Proc. SPIE, 9639, doi: 10.1117/12.2194741.
Suzuki et al. (2015), Proc. SPIE, 9639, doi: 10.1117/12.2194832.

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