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SMILES-2 のための微量成分の感度解析
Sensitivity study of chemical species for SMILES-2

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Superconducting Submillimeter-Wave Limb-emission Sounder (SMILES) was the first instrument to use 4K cooled SIS (Superconductor-Insulator-Superconductor) detection system for the observation of the atmosphere in the frequency regions 625 GHz (Bands A and B) and 650 GHz (Band C) [1]. It has demonstrated its high sensitivity (System Temperature, Tsys ˜250K) for measuring stratospheric and mesospheric species, O3, HCl, ClO, HO2, HOCl, BrO, and O3 isotopes from Oct. 12, 2009 to Apr. 21, 2010 [2-5]. Since SMILES operation has terminated after only 6 months operation due to failure of sub-mm local oscillator (and later 4K cooler system), there exist strong scientific demand to develop successor of SMILES, the SMILES-2, which has optimized and enhanced frequency coverage to observe: (a) BrO and HOCl without interferences of stronger emission lines, (b) N2O, H2O, NO2, and CH3Cl not covered by the SMILES frequency regions, and (c) O2 line to measure temperature. This paper discusses possible SMILES-2 band selection considering limited instrument resources (number of SIS mixers and sub-mm local oscillator) and scientific requirements.

SMILES L2 system used strong O3 and HCl lines to retrieve temperature, which has sensitivity only up to 40-50 km. Temperature should be observed by SMILES-2 itself up to (or above) 100 km with a sensitivity of 1% (2-3K), since the temperature is the primary physical parameter to determine the dynamics and chemistry of the atmosphere and there is no global meteorological data set which is reliable above 60 km. SMILES-2 should have observation capability of H2O and N2O better than 5% precision, which are not observed by SMILES and are important tracers in the upper atmosphere. These are major sources of HOx and NOx. SMILES-2 should improve HOCl and BrO sensitivity by properly selecting observation frequency. SMILES BrO and HOCl observations have suffered severe interference from the near-by stronger lines. SMILES-2 should have original SMILES frequency coverage, and if possible it should add observation of other species retrieved in the Aura/MLS and Odin/SMR.

Instrument Altitude range: 10-120 km, 2.5 km vertical sampling. Frequency sampling: 4 GHz bandwidth, 500 kHz sampling interval, 1.3 MHz Gaussian (FWHM). Tsys = 150 K, Integration time $<$0.48 s.
(Band 1) 485-489 GHz: T, Wind, O2, H2O, O3, HO2, HNO3
(Band 2) 523-527 GHz: O3, 17OOO, 18OOO, O17OO, O18OO, BrO, NO2, H2CO, N2O, HO2
(Band 3) 612-616 GHz: HOCl, O3, HO2
(Band 4) 623-627 GHz: SMILES Bands A+B extended, O3, HCl, BrO, HNO3, HO2, N2O, HOCl, CH3CN, CH3Cl
(Band 5) 648-652 GHz: SMILES Band C extended, O3, 17OOO, O17OO, 18OOO, ClO, HO2, BrO, NO

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