A new mm-wave spectroscopic radiometer for the measurements of stratospheric and mesospheric water vapor isotopomers

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Stratospheric and mesospheric water vapor plays an important role in ozone chemistry especially above $\sim$40km, and is a very efficient greenhouse gas affecting surface climate and radiation balance in the middle atmosphere. However, past measurements of the stratospheric and mesospheric water vapor are quite limited in either spatial or temporal coverage. A millimeter-wave spectroscopic radiometer is one of the most suitable tools for ground-based measurements of vertical profiles of water vapor mixing ratio in the middle atmosphere. We started a project to observe the stratospheric and mesospheric water vapor in Atacama highland (Alt. 4,800m), Chile in September 2004. We installed a mm-wave radiometer equipped with a superconductive (SIS) mixer receiver and 1GHz-bandwidth acousto-optical spectrometer. Atacama highland is one of the best places in the world to observe 183GHz water vapor spectra because of very small tropospheric opacity at this frequency. We succeeded in detecting water vapor emission line in December 2005, and it indicates a feasibility of steady monitoring stratospheric and mesospheric water vapor at 183GHz in Atacama. For the next step, we plan simultaneous observations of two distinct water vapor isotopomers, e.g., H2O, H218O, and HDO in Atacama, and develop a new dual frequency mm-wave radiometer in the laboratory for this purpose. Two SIS mixer receivers are cooled down to 4K in a common single cryostat, but the optics that feed the sky signal into the receivers are completely separated and independently controlled by Linux observation program.

We present the current status of the radiometer system in Atacama and the development of the dual frequency radiometer in the laboratory.