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Millimeter Wave Band Monitoring of Venusian and Martian Middle Atmosphere with SPART Telescope

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To understand the influences of the activities of the central star on the middle atmospheres of the surrounding terrestrial planets, we have performed millimeter-wave-band monitoring of the atmospheres of Venus and Mars by using a 10-m radio telescope called SPART (solar planetary atmosphere research telescope). The telescope employs highly sensitive superconducting SIS mixer receivers in the 100- and 200-GHz bands for the front-end and a commercially available FFT spectrometer (1-GHz bandwidth and 67-kHz resolution) for the back-end. Millimeter-wave-band heterodyne sensing is a powerful technique that can be utilized to trace the abundance and vertical distribution of minor constituents in a planetary middle atmosphere.

In 2011, we began observations of the middle atmospheres of Venus and Mars in the 100-GHz band. In 2012, the telescope had problems with the azimuth gear, motor, and synchro-to-digital converter unit, which resulted in a pause in telescope operation. In 2013, we repaired these problems and resumed the substantive operation test. We are currently restarting double-band full remote monitoring of the spectral lines of minor constituents such as ^{12}CO J=2-1 at 230 GHz, ^{13}CO J=2-1 at 220 GHz, and ^{12}CO J=1-0 at 115 GHz toward Venus and Mars. This season, the apparent diameter of Venus is greater than the beam size at the 200-GHz band (35 arcsec.). We adopted position switching and on-the-fly modes for 100- and 200-GHz-band observations, respectively. The latter two-dimensional mapping allows us to cover the entire disk of Venus. The retrieved CO abundance variation is compared with the data of high-energy particles, X-rays, solar wind velocity/density, and other measured parameters. The data are associated with flare, coronal mass ejection, and solar proton events.

In this conference, the current status of the SPART project and the millimeter-wave-band monitoring will be presented.

Keywords: planet, solar activity, radio telescope, heterodyne spectroscopy, middle atmosphere, remote sensing