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ミリ波 10mSPART 電波望遠鏡による太陽系地球型惑星の中層大気モニタリング
Millimeter-Wave Band Monitoring Observations of the Terrestrial Planets in the Solar System with 10-m SPART Telescope

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For understanding the influence of the activities of central stars on the middle and lower atmospheres of terrestrial planets in the solar system and of exoplanets, we have been performing monitoring observations of millimeter-waveband spectral lines of carbon monoxide (^{12}CO: J=1-0 230.538 GHz, J=2-1 115.2712018 GHz; ^{13}CO: J=2-1 230.3986765 GHz) in the middle atmospheres of Mars and Venus with a 10-m telescope, Solar Planetary Atmosphere Research Telescope (SPART), since it was launched in 2011. SPART employs highly sensitive 100- and 200-GHz double-band superconducting SIS heterodyne detectors and a 1-GHz-band digital fast-Fourier-transform spectrometer with a frequency resolution of 67 kHz. The heterodyne spectroscopy with high frequency resolution is a powerful tool to trace the weak and narrow spectral lines of minor constituents in the middle atmosphere of planets.

The results obtained with SPART suggest that the disk-averaged mixing ratio of carbon monoxide derived at an altitude of approximately 80 km in Venus has steadily decreased since 2012. The X- and M-class solar events that reached Venus also seem to have decreased from 2012 to 2014. To study the electron production rate induced by solar energetic particles incident at different altitudes of the planetary middle atmospheres, we also developed an analytical model, using which ionization losses are numerically calculated on the basis of the Bethe?Bloch formula. The ionization of carbon dioxide induced by solar-energetic-particle events is considered to increase the production rate of CO. With a basic model under conditions of typically great solar-proton events with incident-proton energies of less than 1 GeV, it was found that the ionization rate reaches its maximum at an altitude of 80?90 km in the Venusian atmosphere. These results suggest that the decrease in CO in the Venusian middle atmosphere may be deeply related to the solar activities.

In this conference, we will present these results and the status of the SPART project.