Planetary atmosphere - Mars and Venus -

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Recently, research on extraterrestrial planets and protoplanetary disks has been rapidly increasing. Mars and Venus, lacking intrinsic magnetic fields, are valuable research targets for further understanding atmospheric environments, habitability of earth-type planets, and the influence of activity of the central star on planetary atmospheres.

On Mars, methane has been detected and research continues to investigate its originand destruction processes by oxidation reaction networks in the atmosphere and on the surface. For an Earth-type planet with an atmosphere mainly of CO_2, the CO_2 is photo-dissociated into CO and oxygen by UV radiation from the sun. Mars and Venus have small percentages of CO and oxygen, and how they are oxidized back into CO_2 has not yet been fully elucidated. This is known as the “CO_2 stability problem”. Also, in order to understand the evolutionary processes of the Martian atmosphere, detailed and systematic observations of the spatial and temporal fluctuations of H_2O and oxidants, including H_2O_2, O_3, O_2, etc., and their altitudinal distributions are important.

Venus experiences high-speed super-rotation winds at approximately the cloud altitude and day to night circulation at higher altitudes. Recently, for example, it has gradually become clear that the latter convection does not show a similar pattern in the morning and afternoon. In addition, the Akatsuki satellite (JAXA) has captured large-scale, bow-shaped patterns induced by atmospheric gravity waves. It is also important to investigate how the complex dynamics seen in the Venusian atmosphere drive material circulations and oxidation reaction networks including those with respect to minor species such as SO_x, HO_x, CO_x, chloride, aerosol, sulfuric acid, etc. Venus and Mars also provide important insights into how abiotically the biomarkers, O_2 and O_3, are formed in typical terrestrial planets with mainly CO_2 atmospheres.

In this talk, the observations of planetary atmospheres, explored via heterodyne spectroscopy with radio telescopes such as the Atacama Large Millimeter/submillimeter-wave Array (ALMA) interferometer, as well as measurements of various wavelengths with ground-based telescopes and satellites will be also discussed. Since the wavelengths of milli/submillimeter waves are comparatively long, they are less attenuated by absorption and scattering by aerosols/dust. In addition, the Doppler shift of the spectrum obtained with heterodyne spectroscopy provides important information about the velocity fields of the mesosphere and lower thermosphere. Also, regardless of the presence or absence of background light sources such as the sun heterodyne spectroscopy allows us to observe day and night-side atmospheres of planets.

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