Sub millimeter-wave/THz sounder toward the observations of Martian atmosphere

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Spectroscopic remote sensing in the sub-millimeter (sub-mm) wavelengths is a powerful tool for the Martian meteorological study in terms of measuring the atmospheric temperature profile, chemical compositions, and the wind velocity.

In the sub-mm wavelengths, spectral resolving power (lambda/Delta-lambda) higher than 10^6 is usually realized by the heterodyne technique. This high resolving power enables us not only to obtain the vertical distributions of the observed molecule and the temperature profile (retrieval) but also to measure the wind velocity directly via the Doppler shift. The full potential of the high dispersion sub-mm spectroscopy will be brought out under the limb and nadir sounding from Martian orbit. The non-disturbance of the terrestrial atmosphere (water vapor) gives access to observing the horizontal and vertical distribution of the water vapor on Mars. Additionally, the limb sounding is the best approach to gain a longer line of sight, which allows us to detect the atmospheric species even with very low abundances such as O_2, O_3, photochemical catalysts like HO_2 and H_2O_2, or isotopes like ^{18}OO, ^{17}OO, ^{13}CO, $C^{17}O$, $C^{18}O$, HDO, $H_2{}^{18}O$.

Besides its high resolving power, the sub-mm observation has advantage of the capability of sensing both the dayside and nightside of Mars unlike the UV/visible/NIR wavelengths which can be used only in the dayside observations. Due to the relatively long observing wavelengths, it is considered that neither distributions of the dust nor the ice clouds can interrupt the sub-mm observations. These provide us with global and stable monitoring of the Martian atmosphere in a wide vertical range from surface up to ˜100 km.

With such characteristics, the sub-mm sounder can be suited for answering the fundamental issues on Martian meteorology; for instance water cycle, photochemistry, and atmospheric circulations.

We present recent status of the study of the Martian sub-mm limb and nadir sounder. The standard receiver system will be Schottky receiver system with Mars ambient temperature. 4K cooled SIS mixer system and receivers in the sub-mm (THz) region are also under the review for much further technology advance. The scientific target, sensitivity, instrumental design, will be discussed.