5.089 Feasibility study of possible O2 abundances in the Martian atmosphere: line spectra simulations for Mars terahertz sensor missions.

Early Career Scientist

Presenting Author:
Takayoshi YAMADA, National Institute of Information and Communications Technology, Tokyo, Japan, yamada.t.bd@m.titech.ac.jp

Co-Authors:
Takeshi Kuroda, National Institute of Information and Communications Technology, Tokyo, Japan
Richard LARSSON, Max Planck Institute for Solar System Research, Göttingen, Germany
Naohiro YOSHIDA, Tokyo Institute of Technology, Tokyo, Japan
Yasuko KASAI, National Institute of Information and Communications Technology, Tokyo, Japan

Abstract:

Terahertz observations with a series of future micro-satellite missions to Mars, named TERa-hertz EXplorer (TEREX), are planned. The first mission lander, TEREX-1, is planned to be launched in 2022 and measure the molecular oxygen (O_2) and water vapor (H_2O) in Martian atmosphere. The frequency windows of its terahertz instrument are 474.65 – 475.65 and 486.65 – 487.65 GHz with 100 kHz frequency resolution.

The importance of O_2 on the atmospheric chemistry of Mars had been overlooked historically, because it has been thought to exist horizontally and vertically constant (~1400 ppmv) and impossible to observe from ground-based telescopes due to the deep absorption of the terrestrial O_2. However, the recent sub-millimeter spectroscopic observation using the Herschel Space Observatory suggested the possibility of higher concentration of O_2 near the Martian surface, which has not reproduced by current Mars global climate model (MGCM). It means that current MGCMs may lack the processes which cause the increase of the O_2 abundance near the surface, e.g. unusual chemical reactions inside local dust storms and/or other surface activities including biological and geological ones.

We present following two results: 1. spectra simulations of the TEREX-1 observations which include O_2, O_3, H_2O, and H_2O_2 transitions with possible vertical profiles, and 2. test experiments of O_2 distributions using our MGCM (DRAMATIC) with water cycle and a chemical module. The terahertz instrument would be suitable for the first specific observational investigations of O_2 distributions and its formation/loss processes on Mars because the abundance of O_2 is chemically related to the existences of O_3, H_2O, HO_2, H_2O_2, CO and methane (CH_4). We discuss the potential scientific interests for the future terahertz observations from Mars landers/orbiters.