R009-23
B 会場 ：11/7　 AM2 （10:45-12:30）
11:30〜11:45

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Birthplace of energetic ions around the Phobos’ orbit at midnight: Implications for future MSA observations onboard MMX

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Mars has experienced drastic climate changes over the past 4.6 Gyr due to a significant atmospheric escape. How much carbon dioxide (CO2), which is a major component of the Martian atmosphere, has escaped into space is important for understanding the climate change on Mars. The isotope ratio is particularly one of the key parameters in revealing the Martian atmospheric evolution. Jakosky et al. (2017) suggested that more than 1 bar of oxygen (O) was lost to space from measurements of argon isotope ratios based on observations by the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft, assuming that the all lost O primarily originated from CO2, but these estimations were not derived from direct observations of CO2. The evolution of O and carbon (C) isotope ratios between the surface and upper atmosphere is relevant to understanding the CO2 loss process, but there have been no observational constraints on these isotope ratios in the upper atmosphere. Note that Curiosity identified the isotope ratios of 16O/18O ˜476 and 12C/13C ˜85 near the surface (e.g., Mahaffy et al., 2013), and the Atmospheric Chemistry Suite onboard Trace Gas Orbiter (TGO) found the isotope ratio of 16O/18O ˜420 in the middle atmosphere below 60 km altitude (Alday et al., 2019). Japanese future sample return mission ”Martian Moons eXploration (MMX)” is a candidate for this observation.

One of the MMX mission is to determine the total amount of atmospheric escape that Mars has experienced in its history, based on the isotope ratios of the ions observed around Phobos. This study aims to classify the characteristics of ions around Phobos with a focus on their energies and velocities. We particularly investigate the birthplace of ions around the Phobos orbit on the midnight side, where the electromagnetic field environment is more complex, by means of test particle simulations. Simulations are performed with four cases of interplanetary magnetic field (IMF) clock angles. The difference in IMF clock angle has little effect on the birthplace of ions detected around the Phobos orbit on the midnight side. Ions with energies of a few keV are supplied from the magnetosheath, while those with energies greater than ˜10 keV are supplied by the solar wind. The ions coming from the magnetosheath have three sources that are (1) in the flank region of the induced magnetosphere, (2) around the terminator, and (3) on the dayside, which are determined by the electric field and potential in the magnetosheath. The dependence of ion birthplaces on IMF intensity is also studied, suggesting that a larger IMF produces higher energy ions in the magnetosheath and solar wind, resulting in closer ion birthplaces. This study would be useful for retrieval of the exospheric atmosphere from future MMX observations on the nightside under the complicated electromagnetic environment.