火星電磁圏科学の可能性

寺田 直樹 [1]
[1] NICT/JST

The plasma environment of Mars

Naoki Terada[1]
[1] NICT/JST

Recent observations by Mars Global Surveyor (MGS) and Mars Express (MEX) revealed that the plasma environment of Mars is more complex and more intriguing than ever thought. While MGS found banded magnetic field patterns at various locations of the Martian surface, MEX identified auroral-type emissions on the nightside, which are highly correlated with the position of the highest magnetic field intensities identified by MGS, suggesting the role of the structures in driving high-energy electrons. The banded magnetic field patterns are seen as evidence of moving crustal plates (plate tectonics) and/or changing magnetic fields, which were both died long time ago. Together with the Martian chronology and precise magnetic field observations via Electron Reflectometer (ER) aboard MGS, the magnetic field intensity of early Mars was suggested to have fluctuated, implying the presence of the 'second dynamo episode'. There findings indicate that Mar was once more Earth-like in its solar wind interaction - atmosphere protected by magnetic field -, but has gradually (not monotonically) changed to its present form - direct atmosphere interaction - as time progresses. MEX also identified that heavy ions escaping from the Martian atmosphere consist of not only O+ and O2+ but also CO2+. This finding suggests that the dense (˜bars of) greenhouse gas that Mars had once possessed has been stripped off via the solar wind interaction over billions of years. On the other hand, recent statistical analysis of MEX/ASPERA measurements may cast a doubt on this view since the escape rate of heavy ions amounts only 3.8×10^{23} s^{-1} during the solar minimum period. However, recent results from simulation modeling of the escape processes would mediate the discrepancy.

These findings make the plasma environment of Mars complex but tempting. In this presentation, I will present the current understanding of the near-Mars plasma environment with a particular emphasis placed on its evolution. Recent progress of simulation and modeling studies will be also presented.