

R009-04

A 会場 : 11/24 PM1 (13:45-15:45)

14:30~14:45:00

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Study of Na source regions in the Mercury's magnetosphere based on systematic global MHD simulations

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One of important characteristics of Mercury is the absence of a collisional thick atmosphere, and it exhibits a weak global intrinsic magnetic field [e.g., Anderson et al., Science, 2011]. Consequently, the magnetosphere of Mercury is formed by the interaction between the solar wind and the planetary magnetic field. As demonstrated in the works of Yagi et al. [JGR, 2010; 2017] and Zurbuchen et al. [Science, 2011], sodium ions originating from the solid planet constitute a significant plasma source. Given that Mercury revolves around the Sun at a radial distance of 0.31-0.47 AU, the solar wind density (~50 1/cc on average) and interplanetary magnetic field (IMF) strength (~35 nT) at the Mercury's orbit are considerably larger than those at Earth. Previous studies have indicated that the configuration of the Mercury's magnetosphere depends on the solar wind conditions and the surface conductivity of the solid planet [e.g., Seki et al., JGR, 2013]. Changes in configuration can cause variations in the location of the cusp in the magnetosphere. The cusp is the source region of exospheric N, which is produced by sputtering from the surface of Mercury [e.g., Raines et al., JGR, 2022]. On the one hand, ground-based telescopes have been utilized to observe the exospheric Na distribution. These observations indicate that the spatial distribution of Na emission is subject to variation over time and can be categorized into eight distinct types. A comparison of in-situ IMF observations by MAG/MESSENGER reveals that Na emission patterns depend on IMF [Mangano et al., PSS, 2015]. However, the mechanisms that cause the IMF dependence remain to be fully elucidated. Consequently, the investigation of the solar wind and IMF effects on the cusp location is important to comprehend the planetary ion source in the Mercury's magnetosphere.

The objective of this study is to investigate how the cusp location changes with solar wind and IMF conditions based on global MHD simulations.. The CIP-based divB-free MHD model, which solves the vector potential instead of the magnetic flux [Yagi et al., JGR, 2017], is utilized for the simulations. A systematic simulation is conducted (24 cases) under Parker spiral IMF configurations with some Bz components added, for three solar wind dynamic pressure conditions. The results indicate that the locations of the high-pressure region in dayside (cusp-like region) systematically change with the IMF Bz and solar wind dynamic pressure under background Parker spiral IMF conditions. The simulation results are categorized into eight types of spatial distributions that were proposed by Mangano et al. [PSS, 2015]. The results indicate that 2P patterns, including 2PN and 2PS, are the dominant patterns. Different By polarity causes opposite longitudinal twist of the cusp location. As the solar wind dynamic pressure increases, the appearance of WP or EP patterns is particularly evident, especially during periods of negative Bz conditions. The results of the study indicate that exospheric Na distribution can systematically change in response to variations in the solar wind conditions.