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MESSENGER Observations of Reconnection in Mercury's Magnetotail Under Strong IMF Forcing

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The nature of reconnection in magnetospheres may differ between various planets, because of the differences in upstream solar wind conditions and internal planetary environments. Mercury has an Earth-like magnetosphere, but with a relative small scale size [1,2,3]. Like Earth, reconnection occurs at the dayside magnetopause [4] and the nightside tail current sheet [5,6,7]. Due to the strong solar wind forcing in the inner heliosphere and the relatively weak planetary magnetic field, the reconnection at Mercury is expected to be more efficiency, and play a much more important role in driving magnetosphere.

The MESSENGER spacecraft typically crossed Mercury's magnetotail current sheet relatively close to the planet, that is, less than 2.5 R_M (planet radius; 2,440 km). Previous case studies suggest that tail reconnection can be occur or even continuous very close to the planet [5,6,7]. Here, Magnetometer measurements are used to detect active reconnection events by identifying the quadrupole Hall magnetic field signatures that form about X-lines. Statistical analyses of the 51 active reconnection events detected in this manner indicate that they occur most frequently on the duskside and typically at a mean altitude greater than 1.5 R_M. In contrast, the dawnside events occur at altitudes of ~1 R_M. In addition, a higher recurrence rate of flux ropes formed in the Hall region was observed on the dawnside. Applying the Kan-Lee solar wind-magnetosphere coupling function confirmed that these near-tail reconnection events at Mercury are observed under strong forcing by the interplanetary magnetic field [8].

We further propose that nightside reconnection-driven magnetosphere-planet interaction may also exhibit dawn-dusk asymmetry under strong IMF forcing and may affect the near-planet space environment (Figure 1). The upcoming multi-instrument, dual spacecraft observations from Bepi-Colombo mission will take our understanding of reconnection at Mercury to the next level.

References

[1] J. Zhong, *et al.*, J. Geophy. Res. Space Physics, 120, 7658-7671 (2015)
[2] J. Zhong, *et al.*, Geophys. Res. Lett., 42, 10,135-10,139 (2015)
[3] J. Zhong, *et al.*, Astrophys. J., 892, 2 (2020)
[4] J. Zhong, *et al.*, Astrophys. J. Let., 893, L18 (2020)
[5] J. Zhong, *et al.*, Astrophys. J. Let., 860, L20 (2018)
[6] J. Zhong, *et al.*, Astrophys. J. Let., 893, L11 (2020)
[7] J. Zhong, *et al.*, Astrophys. J. Let., 886, L32 (2019)
[8] J. Zhong, *et al.*, J. Geophy. Res. Space Physics, 128, e2022JA031134 (2023)

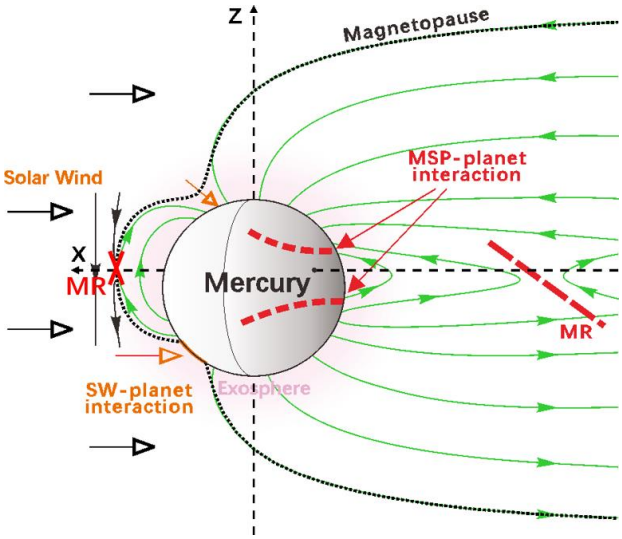

Figure 1. Dawn-dusk asymmetry in Mercury's near-tail reconnection