

MAVEN Observations of Crustal Field Effects on Magnetotail Twisting at Mars

Gina A. DiBraccio (1), Norberto Romanelli (1,2), Janet G. Luhmann (3), Yingjuan Ma (4), Jared R. Espley (1), Jacob R. Gruesbeck (1), Shaosui Xu (3), John E. P. Connerney (1,5), and Gangkai Poh (1,2)
(1) NASA Goddard Space Flight Center, Greenbelt, USA, (2) University of Maryland, Baltimore County, USA, (3) Space Sciences Laboratory, University of California, Berkeley, USA, (4) Department of Earth, Planetary and Space Sciences, UCLA, Los Angeles, USA, (5) Space Research Corporation, Annapolis, MD, USA (gina.a.dibraccio@nasa.gov)

Abstract

Observations from the Mars Atmosphere and Volatile Evolution (MAVEN) mission have revealed that the Martian magnetotail possesses a twisted configuration, dependent on the dawn-dusk component of the interplanetary magnetic field (IMF). Tail twisting has also been reported at intrinsic magnetospheres such as Earth; however, the main driver of this twist at Mars is still undetermined. These observations shift the paradigm of the magnetotail structure at Mars, which was once thought to possess two, symmetric tail lobes, formed solely by the draped IMF [1]. The availability of continuous, comprehensive observations provided by MAVEN enable statistical analyses to understand both the structure and dynamics of the Martian magnetotail [2,3,4].

Here, we augment the original investigation by DiBraccio et al. [2018] in order to assess whether the orientation of the crustal magnetic fields play a role in the degree of tail twisting at Mars. More than four years of MAVEN magnetic field data [5,6], spanning from October 2014 through December 2018, are analyzed. We require that MAVEN measured both the upstream solar wind and magnetic tail over a single orbit in order to be included in this study, resulting in the selection of >2200 orbits. These orbits are sorted based on the IMF dawn-dusk component along with the local time (LT) orientation of the strongest crustal magnetic fields (located at ~180°E longitude). Crustal field LT are separated between midnight, dawn, noon, and dusk orientations. Initial statistical results demonstrate that the tail remains twisted to a large degree, regardless of crustal field orientation. This analysis is extended to determine whether seasonal effects, and therefore the degree to which crustal fields experience solar wind forcing, play a role in the tail twisting. Additionally,

data-model comparisons provide further global contextualization by utilizing field-line tracings to determine whether the tail field topology changes as a function of crustal field orientation or season.

References

- [1] DiBraccio, G. A., et al. (2018), The twisted configuration of the Martian magnetotail: MAVEN observations. *Geophys. Res. Lett.*, 45, 4559–4568. <https://doi.org/10.1029/2018GL077251>.
- [2] DiBraccio, G.A., J.R. Espley, J.R. Gruesbeck, J.E.P. Connerney, et al. (2015). Magnetotail dynamics at Mars: Initial MAVEN observations. *Geophys. Res. Lett.*, 42, 8828–8837, doi:10.1002/2015GL065248.
- [3] DiBraccio, G. A., J. Dann, J.R. Espley, et al., (2017). MAVEN observations of tail current sheet flapping at Mars. *J. Geophys. Res.: Space Physics*, 122(4), 4308–4324. doi:10.1002/2016JA023488.
- [4] Ma, Y., C.T. Russell, G. Toth, G., et al. (2018). Reconnection in the Martian Magnetotail: Hall-MHD With Embedded Particle-in-Cell Simulations. *J. Geophys. Res.: Space Physics*, 123(5), 3742–3763. doi:10.1029/2017JA024729.
- [4] Connerney, J.E.P., J.R. Espley, J.R., P. Lawton, et al. (2015). The MAVEN magnetic field investigation. *Space Sci. Rev.*, 195, 257–291, doi:10.1007/s11214-015-0169-4.
- [5] Connerney, J.E.P., J.R. Espley, G.A. DiBraccio, et al. (2015). First results of the MAVEN magnetic field investigation. *Geophys. Res. Lett.*, 42, 8819–8827, doi:10.1002/2015GL065366.