

Space Studies of the Upper Atmospheres of the Earth and Planets including Reference Atmospheres (C)
Planetary Upper Atmospheres, Ionospheres and Magnetospheres (C3.2)

MAGNETOSPHERE OF MERCURY : OBSERVATIONS AND INSIGHTS FROM MESSENGER

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MESSENGER Team

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The MESSENGER spacecraft executed three flyby encounters with Mercury in 2008 and 2009, was inserted into orbit about Mercury on 18 March 2011, and has returned a wealth of data on the magnetic field, plasma, and energetic particle environment of Mercury. These observations reveal a profoundly dynamic and active solar wind interaction. In addition to establishing the average structures of the bow shock, magnetopause, northern cusp, and tail plasma sheet, MESSENGER measurements document magnetopause boundary processes (reconnection and surface waves), global convection and dynamics (tail loading and unloading, magnetic flux transport, and Birkeland currents), surface precipitation of particles (protons and electrons), particle heating and acceleration, and wave generation processes (ions and electrons). Mercury's solar wind interaction presents new challenges to our understanding of the physics of magnetospheres. The offset of the planetary moment relative to the geographic equator creates a larger hemispheric asymmetry relative to magnetospheric dimensions than at any other planet. The prevalence, magnitude, and repetition rates of flux transfer events at the magnetopause as well as plasmoids in the magnetotail indicate that, unlike at Earth, episodic convection

may dominate over steady-state convection. The magnetopause reconnection rate is not only an order of magnitude greater than at Earth, but reconnection occurs over a much broader range of interplanetary magnetic field orientations than at Earth. Finally, the planetary body itself plays a significant role in Mercury's magnetosphere. Birkeland currents close through the planet, induction at the planetary core-mantle boundary modifies the magnetospheric response to solar wind pressure excursions, the surface in darkness exhibits sporadic X-ray fluorescence consistent with precipitation of 10 to 100 keV electrons, magnetospheric plasmas precipitate directly onto the planetary surface and contribute to sputtering, and planetary ions are often present with sufficient densities and energies to substantially modify the plasma pressures and hence magnetospheric dynamics.