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Simulation of the Charged Particle Environment of Mercury

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A number of modeling studies are pursued to investigate the ionized environment of Mercury in preparation of the MESSENGER and Bepi Colombo missions. The existence of a small intrinsic magnetic field at Mercury as revealed by Mariner-10 observations indeed leads to a miniature magnetosphere that resembles the terrestrial one, which raises numerous questions regarding the interaction with the solar wind, the large-scale magnetospheric structure and dynamics or the coupling with the planetary surface and exosphere. We will review some features of the charged particle transport in the hermean environment as derived from different modeling approaches (test particle, MHD, hybrid). Building on results obtained in the terrestrial magnetosphere, emphasis will be placed on the consequences of the small spatio-temporal scales and of the specific boundary conditions (proximity of magnetopause, absence of atmosphere) that characterize Mercury's magnetosphere. Distinct processes expected during transport will be addressed such as impulsive acceleration in the high-altitude cusp and boundary layers, pitch angle diffusion in the magnetotail and thin current sheet build-up via bunching in gyration phase, or nonadiabatic energization and injection toward the planet due to electric fields induced by dynamical reconfigurations of the magnetosphere. Based on the simulation results, we will also put into perspective the role of the solar wind and that of the internal plasma source in populating the magnetosphere.

Keywords : planetary magnetospheres ; charged particle motion and acceleration ; numerical simulation studies.