

EGU21-12954, updated on 26 May 2022

<https://doi.org/10.5194/egusphere-egu21-12954>

EGU General Assembly 2021

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Global Hybrid-VPIC Simulations of the Solar Wind Interaction with Mercury's Dynamic Magnetosphere: Reconnection and Foreshock

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We explore the dynamic magnetosphere of Mercury by employing a three-dimensional hybrid particle-in-cell (particle ions and massless fluid electrons) code – hybrid-VPIC. The newly developed hybrid-VPIC code (based on the high-performance fully kinetic Vector Particle-In-Cell, VPIC code) incorporates ion kinetics (beam and anisotropy driven instabilities) that are critical for foreshock and magnetosheath physics, as well as the Hall effect which is important for collisionless magnetic reconnection; therefore, it is particularly well suited for investigating the kinetic physics of Mercury's dynamic magnetosphere. The simulation results are in good agreement with MESSENGER's magnetic field measurements during its second Mercury flyby. We will investigate collisionless magnetic reconnection (including flux transfer events or FTEs and ion velocity distribution functions) and foreshock physics (including plasma turbulence and particle acceleration) in this study.

