Kinetic Modeling of Mercury's Magnetosphere

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Mercury has an internal magnetic field with a magnetic moment at least 1000 times smaller than that of the Earth and thus it has a mini-magnetosphere estimated to be only a few times the planetary radius. Since the overall magnetic field strengths of the Hermean magnetosphere are relatively small (compared to Earth), finite ion gyroradius effects are important for the overall structure of the interaction between the Hermean magnetosphere and the solar wind. Thus, to accurately model Mercury's magnetosphere, a hybrid simulation approach is needed whereby ions are treated as fully kinetic particles and electrons are treated as a fluid. In this paper a global three dimensional hybrid simulation will be used to understand the physics, structure, and dynamics of Mercury's magnetosphere. A study of the overall structure of the bow shock and magnetosheath formed on Mercury's dayside will be made, and the formation of a magnetotail will be examined. Particle distribution functions at different locations of the Hermean magnetosphere will be calculated and qualitative comparison of the results with available measurements of the Mariner 10 spacecraft will be made. This work will also support the upcoming MESSENGER spacecraft mission, which will flyby Mercury in 2007 and eventually orbit the planet in 2009.