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Lessons from Mini-Magnetospheres

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A mini-magnetosphere can extend over large distances, so one must first define what the term means. A useful requirement specifies that the magnetopause of a planet's (or moon's) magnetosphere must somewhere approach within roughly a planetary radius of the surface. Examples known to this time are Mercury and Ganymede. These magnetospheres are so small that radiation belts, familiar from studies of Earth, cannot form. They rotate so slowly that the concept of a plasmasphere must be abandoned. In both systems, volatiles from which are formed pickup ions may be important to consider. Length and time scales differ greatly from those familiar from the study of Earth. One can argue that Mercury's magnetotail neutral line will form at $\sim$30 planetary radii downtail, a distance covered by the solar wind in 3 minutes. Contrast this with Earth where it takes the solar wind about 1 hour to flow to the downtail neutral line. Data support the view that time scales are governed by these characteristic values. Simple parallels to Earth do not apply at Ganymede where the plasma confining the magnetosphere is a low beta plasma flowing at sub-Alfvénic speed. Unique to this magnetosphere are the absence of an upstream shock, the unusual configuration that links it to Jupiter's ionospheres, and the quasi-steady form of the external magnetic field that leads to a steady form of reconnection. Much of what we know about Ganymede comes from Galileo's flybys, but simulations now underway are revealing interesting aspects of the unmeasured portions of the system.