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Hybrid Simulations of the Callisto–Magnetosphere Interaction

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Abstract

The simulations of the Callisto–magnetosphere interaction is important (1) to understand the origin of the magnetic field perturbations recorded by Galileo [1] potentially related to the subsurface ocean, and (2) to model the plasma environment at this moon in preparation for the coming Jupiter system mission. The airless non-magnetic Callisto is just a factor of 1.4 larger than the Moon. Therefore, global hybrid models (particle ions, fluid mass-less electrons) simulating the Moon–solar wind interaction [2, 3] may be readily applied to investigate the Callisto–magnetospheric interactions provided the near–Earth solar wind parameters are replaced by the ones corresponding to the Jovian conditions. We conducted runs of such a model assuming the "solar wind" ions have the mass/charge equal to 16, the temperature 45 eV, the density 0.5 cm^{-3}, and the magnetic field equals to the magnetospheric field. In these initial simulations we assumed the obstacle (Callisto) to be fully non-conductive to simplify the boundary conditions. The first runs demonstrate that the model used is capable of handling satisfactory the plasma conditions around this satellite, as illustrated in Fig. 1.

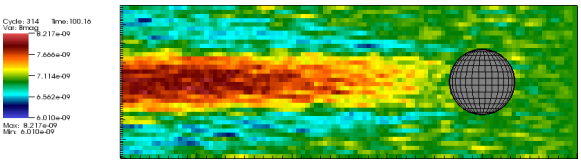

Figure 1: The interaction of Callisto with its plasma environment, computed by the three-dimensional hybrid solver. Shown is a cut of magnetic field magnitude [T]. The solar wind flows from the right with the IMF in the plane, perpendicular to the solar wind flow direction. The ion mass is 16 amu, the number density is 0.5 [cm^{-3}], and the temperature is 45 [eV].

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