Effects of the inner boundary condition of the global MHD simulation on the structure and dynamics of the Mercury's magnetosphere

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From the observations by Mariner 10, it has been suggested that the Mercury's magnetosphere might be an analogous to the Earth's magnetosphere. Observation by MESSENGER in Janurary 2008 seems to support this assumption under a quiet solar wind condition. On the other hand, the temporal and spatial scales of the Mercury's magnetosphere are much smaller than those in the Earth's magnetosphere because of its week intrinsic magnetic field and large dynamic pressure of the solar wind at the Mercury's orbit. Recent study based on the global MHD simulation of Mercury's magnetosphere showed that the global convection pattern and location of the reconnection line in the magnetotail depend on the conductivity at the surface of the planet as well as on the strength of IMF Bz [Seki et al. 2006]. In this study, we developed a new MHD simulation code for the Mercury's magnetosphere that automatically satisfies solenoidal condition for the magnetic field (B) i.e., divB=0. It is known that divB=0 condition is not necessarily satisfied in numerical simulation and a number of studies has been done to fix this problem [Brackbill and Barnes, 1980] [Evans and Hawley, 1988]. To fulfill the condition, we solve a set of MHD equations based on the vector potential instead of the magnetic field itself.

The new code reconstructed a global structure of Mercury's magnetosphere such as the bow shock, magnetopause, and cusp at expected position from previous studies [e.g., Slavin, 2004]. Usage of vector potential make the boundary condition setting more complex and we tried several cases of the inner planetary surface boundary condition. In this presentation, we will report on the result of the global simulation of Mercury's magnetosphere mainly focused on the effects of the inner boundary condition on its structure and dynamics.