ナトリウムイオンの水星磁気圏に対する寄与

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Contribution of the sodium ions to the Mercury's magnetospheric dynamics

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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 and the observations by MESSENGER in 2008 seem to support this assumption. 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 strong dynamic pressure of the solar wind at the Mercury's orbit. The MHD simulation is one of the powerful methods to understand the global structure of the planetary magnetosphere though kinetic effects of heavy ions originated from the exosphere might not be negligible because of their large gyro-radius in the Mercury's magnetosphere. The statistical trajectory tracing of test particles is an important scheme to investigate the kinetic effects of heavy ions. Delcourt et al. [2003, 2005] calculated the motions of sodium ions launched from the exosphere using the analytical electric and magnetic field models. Although their approach is efficient to see the dynamics of heavy ions, resultant properties largely depend on the used field models. Therefore, it is necessary to examine the particle motion in the self-consistent electro-magnetic fields obtained by the MHD simulation.

In this study, we first obtain the magnetic and electric fields from our newly developed global MHD simulation model of the Mercury's magnetosphere [Yagi et al., in press]. Solar wind conditions used in this simulation are: 140cm^{-3} for the number density, 400km/s for the solar wind speed, and [0,0,10]nT for the IMF Bs, By, Bz, respectively. Based on the simulated MHD fields, we examine trajectory tracings of sodium ions which are initially loaded by the exosphere model [Leblanc and Johnson, 2003]. As results, we find an efficient acceleration process and also a high pressure region around the planet consisting of energetic sodium ions. From the statistical results of test particles, we find the sodium pressure around the planet is 5 to 10 percent of the background MHD pressure. On the other hand, the ion motions are consistent with the MHD flows and their contribution to the MHD pressure is less than 1 percent except for the vicinity of the planet. These results indicate that the sodium ions will not change the global structure, though their contribution is not negligible around the vicinity of the planet. In this presentation, we will discuss the contribution of sodium exosphere to the Mercury's magnetosphere with different solar wind conditions.