Global structure and heavy ion distribution in Mercury's magnetosphere

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From Mariner 10 and MESSENGER observations, Mercury’s magnetosphere is thought to be a miniature of the Earth’s magnetosphere. While these two magnetospheres have several characteristics in common, some critical differences are also evident. First, there is no atmospheric layer, but only tenuous exosphere. Second, center of dipole field is shifted to northward about 485km, which is equivalent to 0.2 Mercury's radius. Kinetic effects of heavy ions will also be important in Mercury's magnetosphere, because Mercury’s magnetosphere is relatively small compared to the large Larmor radii. Trajectory tracings is one of the dominant methods to estimate the kinetic effect of heavy ions which originate from the exosphere, though the results of the simulation are quite sensitive to the electric and magnetic field. Hence, it is important to provide a realistic field model in the trajectory tracings. In order to construct a large scale structure, we developed a MHD simulation code, and adopted it to the global simulation of Mercury’s magnetosphere. In this study, first we performed several cases of MHD simulation to investigate the interaction between solar wind plasma and offset dipole of Mercury. Solar wind densities are given 35cm^{-3}, and velocity for 400km/s which is typical value in the Mercury's orbit. IMF conditions comes from Parker Spiral which has strong Bx and By component at the Mercury's orbit, and fluctuations are added in By and Bz components. In the results of MHD simulations, global configuration of magnetosphere shows strong north-south asymmetry due to dipole offset and IMF-Bx in addition to dawn-dusk asymmetry which comes from IMF-By. IMF Bx also affects to the intensity ratio of north and south cusp pressure, while IMF By component “twist” the cusp region to longitudinal direction. The identification of global structures especially the cusp region is important not only for the understanding of magnetospheric physics itself, but also making a proposal to the observational plan of spacecraft such as Bepi-Colombo. In the presentation, we will also discuss the heavy ion distribution and precipitation on Mercury obtained by trajectory tracings of test particles.

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