Global configuration and cusp structure of Mercury's magnetosphere

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Observations by MESSENGER found that Mercury's magnetosphere is analogous to the Earth's while there are several differences of the two. One of the big differences is a dipole offset which could affect to the global configuration of Mercury's magnetosphere especially making a strong north-south asymmetry. In this study, first we performed several cases of MHD simulation solving a interaction with solar wind plasma and offset dipole of Mercury. Solar wind densities are given nominal(35cm^{-3}) and high(140cm^{-3}) with velocity for 400km/s which is almost average value in the Mercury's orbit. IMF conditions are given ideal one which has only Bz component, and realistic one which comes from Parker Spiral which has strong Bx component at the Mercury's orbit but fluctuations are added in By and Bz components.

When solar wind density is nominal, magnetopause is formed at 1.4R$_M$, and the global structure has weak north-south asymmetry in the MHD simulation. One of the important characteristics is open field line from south pole even in the northward IMF condition without Bx and By components. When solar wind dynamic pressure is high, Mercury's magnetosphere is compressed to the scale of Mercury itself and intrinsic magnetic field cannot sustain the solar wind especially the southward because of the offset. In this case, almost whole area of southward dayside of Mercury is identified as a 'cusp' region, while northward magnetosphere barely keep its structure including cusp. In this case, planetary surface disturbs the magnetospheric convection in the southward, and as the result, north-south asymmetry of magnetosphere as well as similarity to Earth's magnetosphere are strongly violated.

In the realistic IMF case, global configurations of magnetosphere drastically change and become more complicated structures which include north-south and dawn-dusk asymmetry by strong Bx and By components. IMF Bx also affects to the intensity ratio of north and south cusp pressure, and By component 'twist' the cusp region to longitudinal direction. The identification of global structures especially the cusp region is important not only on the understanding of magnetospheric physics itself, but also making a proposal to the observational plan of spacecraft such as Bepi-Colombo.