SHOTS simulations of Mercury's magnetosphere for the BepiColombo mission

Hideyuki Usui[1]; Sae Aizawa[2]; Manabu Yagi[3]; Go Murakami[4]; Usui Hideyuki BepiColombo SHOTS simulation team[5]
[1] System informatics, Kobe Univ; [2] Geophysics, Tohoku Univ; [3] RIKEN R-CCS; [4] ISAS/JAXA; [5] -

http://shots-bepicolombo.irap.omp.eu/

We present the current activities of the SHOTS team (Studies on Hermean magnetosphere Oriented Theories and Simulations). SHOTS is an international simulation collaboration that was formed by some motivated members in Young Scientists Working Group of the BepiColombo Mercury mission. It focuses on the plasma simulations of the plasma interaction with Mercury's environment using multi-fluid/MHD, hybrid, and fully kinetic (particle-in-cell) models. SHOTS aims to figure out which model is more suitable to describe particular environments or physical processes in Mercury's magnetosphere, and how and where the kinetic effect has significant influence.SHOTS has been currently working on global simulations to examine Mercury's magnetosphere using different numerical approaches. The small size of Mercury's magnetosphere is a promising topic to compare and benchmark simulation codes based on different numerical approaches such as MHD, Hybrid particle, and Full PIC. These codes are used in numerical simulations within the BepiColombo community for specific questions needed to be investigated. However, there has never been a quantitative comparison of the existing codes in their numerical effectiveness, stability, and different approaches for the same physical problems. To demonstrate how different numerical approaches in the simulations affect our understanding of the features of Mercury's magnetosphere, we have been working on MHD and hybrid particle simulations with a common solar wind condition in terms of density, Mach number, and IMF. We will discuss how the major features of the magnetosphere are characterized by each simulation, including the bow shock, the magnetopause, and a typical current sheet crossing. We will also discuss the effect that different boundary conditions between each code can have on overall structures visible in the various simulations.

In preparation for BepiColombo observations, we plan to run all the codes with realistic physical conditions. In addition to inter-code comparisons, we will compare our simulations with available data from the MESSENGER mission.