Properties of magnetic hole/decrease structures in the solar wind

Ken Tsubouchi[1]; Hironori Shimazu[1]

[1] NICT

Magnetic holes (MHs) are localized depressions in the magnetic field intensity, identified in the solar wind and planetary magnetosheaths. Main characteristics of MHs are: (1) the pressure-balanced structure in the high beta regime, (2) the wide range of its spatial scale with several to several hundreds of proton gyroradii, and (3) the presence of proton temperature anisotropy marginally stable for the mirror mode. These features lead one to propose several processes which account for the physical mechanism of MH formation. It is favorable to regard MHs as remnants of the mirror instability. However, the occurrence frequency of magnetic depression and compression exhibits asymmetric distribution (depression is dominant), so that the mirror instability, at least in the linear stage, alone is inadequate to describe the MH evolution. The other candidate is that MHs are the consequence of nonlinear Alfven wave evolution, especially the solution of Alfven solitons in the Hall-MHD system. This soliton model can be applied to the linear hole, where the magnetic field direction remains unchanged through the MH.

In the present study, we focus on the other category of MHs, often called magnetic decreases (MDs), where the field rotation is taken place at their boundaries in the form of discontinuities. MDs are dominantly identified in the corotating interaction region (CIR), especially within the area between the streaming interface and the reverse shock. Based on our previous study [Tsubouchi, 2009] that the source of MDs is Alfven waves in the fast solar wind carried into CIR, we construct a simplified model of MDs bounded by the Alfvenic field rotation. The numerical simulations using a 1D hybrid code are performed to investigate the MD properties, such as structural stability, behavior of kinetic energization/diffusion and so on. The results are compared with the case for linear holes, as has already studied by Baumgartel et al. [2003]. The preliminary results of 2D simulations will also be presented.