その場観測を用いた二次元平衡プラズマ構造の時間発展の再現

長谷川 洋 [1]; ソネラップ ベングト [2]; 中村 琢磨 [3]
[1] JAXA・宇宙研; [2] ダートマス大; [3] 宇宙研

Recovery of time evolution of two-dimensional magnetohydrostatic structures from in-situ measurements

Hiroshi Hasegawa[1]; Bengt Sonnerup[2]; Takuma Nakamura[3]
[1] ISAS/JAXA; [2] Dartmouth Coll.; [3] ISAS,JAXA

Even after the advent of multi-spacecraft missions such as Cluster and THEMIS, it has been difficult to distinguish between time evolution of, and spatial variation within, a space plasma structure on the basis of in situ measurements. We present a method for analyzing time evolution of two-dimensional (2D), magnetohydrostatic equilibria, using data recorded by an observing probe as it traverses a quasi-static, 2D, magnetic-field/plasma structure. The method recovers spatial initial values used in the classical Grad-Shafranov (GS) reconstruction (Hau and Sonnerup, 1999) for an interval before and after the time of actual measurements, by advancing them backward and forward in time based on a set of equation for an incompressible plasma; the consequence is generation of multiple GS maps or a movie of the 2D field structure. The method is successfully benchmarked by use of a 2D magnetohydrodynamic simulation of time-dependent magnetic reconnection, and is applied to a magnetic flux transfer event (FTE) seen by the Cluster spacecraft at the dayside high-latitude magnetopause (Hasegawa et al., 2006). Possibilities of application to flux ropes in the magnetotail and magnetic clouds in the solar wind are also discussed.

Hasegawa, H., B. U. O. Sonnerup, C. J. Owen, B. Klecker, G. Paschmann, A. Balogh, and H. Reme, The structure of flux transfer events recovered from Cluster data, Ann. Geophys., 24, 603-618, 2006.

Hau, L.-N., and B. U. O. Sonnerup, Two-dimensional coherent structures in the magnetopause: Recovery of static equilibria from single-spacecraft data, J. Geophys. Res., 104, 6899-6917, 1999.