Nonlinear Mirror Mode Structures in the magnetosheath: Two- and Three-dimensional Hybrid Simulations

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The temperature anisotropy ($T_{perp}/T_{para}>1$) of ions in the magnetosheath drives the mirror instability. We performed two-dimensional (2D) and three-dimensional (3D) hybrid simulations in both periodic and open boundary models to study the nonlinear mirror mode structures. In the open boundary systems, because of the propagation of EMIC waves, we can obtain clearer non-propagating mirror mode structures. We analyzed the relation between the mirror instability and the magnetic peaks and dips which are peculiar magnetic structures observed in the magnetosheath and the heliosheath. In the 3D model, the mirror instability is dominant both in the periodic and open boundary models and makes the magnetic peak structures at the linear stage. In the 2D open boundary model, we obtain the clear magnetic dips at the nonlinear stage. In the 3D open model, on the other hand, we obtain the cigar-like magnetic peak structures, because of the nonlinear evolution of mirror mode structures and the symmetric property of structures in the perpendicular directions. Based on the MHD equations, we studied eigen mode structures of the mirror instability in the 2D and 3D models. We performed the parametric analyses and discussed the stability of these structures comparing with the observations in the magnetosheath.