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A 3D Hybrid Code for Solar Wind-Mini-Magnetosphere Interaction Simulation

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Interaction between the solar wind and the mini-magnetosphere of dipolar magnetized objects is investigated by a three-dimensional hybrid simulation, which treats the ions as kinetic super particles via particle-in-cell method and the electrons as a massless fluid. For the study of the mini-magnetosphere which scale is the order of the ion Larmor radius of the solar wind ions at the magnetopause, the hybrid simulation is suitable because the ion kinetic effects are important for the formation and structure of the mini-magnetosphere. However the development of the plasma wake in the shadow of the dipole field is difficult to calculate by the conventional hybrid codes. We develop a three dimensional hybrid code includes a fluid ion component to approximate the cold background plasma that spatially overlaps with the super particle component. The feature allows the code to suppress the generation of vacuum cells and to accommodate time and distance scales. We demonstrate the use of the code to simulate the formation of the mini-magnetosphere in the various solar wind conditions.

Keywords: Interaction between solar wind and mini-magnetosphere, 3D hybrid code