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3D Global PIC Simulation Focusing on Cusp dynamics: Striking Features of Alfven Transition Layer

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We analyzed the global solar wind-terrestrial magnetosphere interaction with the help of three-dimensional (3D) global full electromagnetic particle-in-cell (PIC) simulations. Recent results of 3D PIC simulations (Cai et al., 2015) have analyzed the main features of the cusp in the case when the Interplanetary Magnetic Field (IMF) is in a northward configuration. These have allowed (i) to compare with previous results obtained with 3D MHD simulations, (ii) to complete the updated global view of the cusp (in particular the features not accessible by MHD approach), and (iii) to compare with statistical results of experimental Cluster mission. One new striking feature is the evidence of an Alfven transition layer (ATL) almost adjacent to the upper edge of the stagnant exterior cusp (SEC), through which the plasma flow transits from super (from magnetosheath) to sub-(to SEC) Alfvenic regime. This ATL is in a good agreement with experimental statistical data performed by Lavraud and al. (2005) but not mentioned in MHD results. Simulation results show that the ATL expands towards areas even far from the cusp region. The most striking features of ATL are its asymmetric complicate 3D shape around the cusp region. ATL reveals the extremely complicate 3D particle entry mechanism into the cusp. The 3D features of this ATL are extensively analyzed in details (i) for Northward IMF, and (ii) as the IMF is rotating from Northward to Southward.