Electron Distribution Functions near an Electron Diffusion Region

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We have used a global magnetohydrodynamic (MHD) simulation of the interaction between the solar wind and the magnetosphere with an embedded particle-in-cell (PIC) simulation to investigate magnetic reconnection in the magnetotail. In these calculations, we first use solar wind observations to drive the global MHD simulation for a magnetospheric substorm. At a time when magnetotail reconnection is just starting in the MHD simulation, we embed a large-scale PIC simulation. The MHD simulation determines the initial and boundary conditions in PIC simulation. We used the UCLA global MHD code and the iPic3D implicit particle-in-cell code for this study. The PIC simulation results allowed us to identify the electron diffusion region (EDR) and based on that determination, we have examined the electron distribution functions (EDF) in and near the EDR and find that they are very complex with beams of electrons in velocity space jetting away from the reconnection site. The distribution function is three-dimensional. Two-dimensional projections are inadequate for demonstrating the full complexity of the EDF. In this presentation, we present examples of the distribution functions and discuss the origin of the complex beam like structures.