A Particle-in-Cell Simulation of Ion and Electron Dynamics from Tail Reconnection to the Inner Magnetosphere

Raymond Walker¹, Mostafa El-Alaoui², Liutauras Rusaitis², Giovanni Lapenta³, Nicole Echterling¹, and David Schriver⁴

¹UCLA, Earth, Planetary, and Space Sciences, Los Angeles CA, United States of America (rwalker@igpp.ucla.edu)
²NASA Goddard Space Flight Center, Catholic University of America, Washington, DC, United States of America
³KU Leuven, Leuven, Belgium, Space Science Institute, Boulder, Colorado, United States of America
⁴UCLA Department of Physics and Astronomy, Los Angeles, CA, United States of America

We have used a PIC simulation combined with a global MHD simulation to model the interaction between magnetotail plasma from reconnection and inner magnetosphere region. The PIC simulation extended from the solar wind outside of the bow shock to beyond the reconnection region in the tail. The initial simulation was carried out with nominal solar wind parameters and southward IMF. A partial ring current and diamagnetic current formed in the PIC simulation. Initially, the partial ring current formed by drift of the particles loaded into the PIC simulation. However, the PIC run lasted ~2 m and by the end of the calculation particles from tail reconnection had reached the inner magnetosphere and contributed to the partial ring current. The sources of the particles to the inner magnetosphere are bursty bulk flows (BBFs) that originate from a complex pattern of reconnection in the near-Earth magnetotail at about XGSM=-25- to -30 RE. After the particles jet away from the initial reconnection site, they can undergo further acceleration at secondary reconnection sites. Electrons jet away from the reconnection much faster than the ions setting up an ambipolar electric field allowing the ions to catch up after 4-14 di (ion inertial lengths). The initial energy flux in the BBFs is mainly in the form of kinetic energy flux from the jetting particles, but as they move earthward the energy flux changes to enthalpy flux. The energy flux in the simulated ring current is primarily in the form of enthalpy flux. The power delivered from the tail reconnection in the simulation to the inner magnetosphere (~6X10¹¹ W) is consistent with observations.