Geophysical Research Abstracts
Vol. 15, EGU2013-7239, 2013
EGU General Assembly 2013

Cluster observations of kinetic structures and electron acceleration within a dynamic plasma bubble

Meng Zhou (1), Xiaohua Deng (1), Maha Ashour-Abdalla (2,3), Raymod J Walker (3,4), Ye Pang (1), Chaoling Tang (5), Shiyong Huang (6), Mostafa El-Alaoui (3), Zhigang Yuan (6), and Huimin Li (6)

(1) Nanchang University, China (monmentum82@gmail.com), (2) Department of Physics and Astronomy, University of California, Los Angeles, (3) Institute of Geophysics and Planetary Physics, University of California, Los Angeles, (4) Department of Earth and Space Science, University of California, Los Angeles, (5) School of Space Science and Physics, Shandong University at Weihai, Weihai, 264209, (6) School of Electronic and Information, Wuhan University, Wuhan, 430072

Fast plasma flows are believed to play important roles in transporting mass, momentum and energy in the magnetotail during active periods, such as the magnetospheric substorms. In this paper, we present Cluster observations of a plasma-depleted flux tube, i.e. a plasma bubble associated with fast plasma flow before the onset of a substorm in the near-Earth tail around X= -18RE. The bubble is bounded by both sharp leading ($\partial bz/\partial x<0$) and trailing ($\partial bz/\partial x>0$) edges. The two edges are thin current layers ($\sim$ ion inertial length) that carry not only intense perpendicular current but also field-aligned current. The leading edge is a dipolarization front (DF) within a slow plasma flow, while the trailing edge is embedded in a super-Alfvénic convective ion jet. The electron jet speed exceeds the ion flow speed thus producing a large tangential current at the trailing edge. The electron drift is primarily given by the $E\times B$ drift. Interestingly, the trailing edge moves faster than the leading edge, which causes shrinking of the bubble and local flux pileup inside the bubble. This resulted in a further intensification of Bz, or a secondary dipolarization. Both the leading and trailing edges are tangential discontinuities that confine the electrons inside the bubble. Strong electron acceleration occurred corresponding to the secondary dipolarization, with perpendicular fluxes dominating the field-aligned fluxes. We suggest that betatron acceleration is responsible for the electron energization. Whistler waves and lower hybrid drift waves were identified inside the bubble. Their generation mechanisms and potential roles in electron dynamics are discussed.