Electron crescent distributions as a manifestation of diamagnetic drift in an electron scale current sheet: Magnetospheric Multiscale observations using new 7.5 ms Fast Plasma Investigation moments

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We report Magnetospheric Multiscale spacecraft observations of electron pressure gradient electric fields near a magnetic reconnection diffusion region using a new technique for extracting 7.5 ms electron and 37.5 ms ion moments from the Fast Plasma Investigation (FPI) data. Comparing our results to previously reported 30 ms electron and 150 ms ion FPI moments (e.g., Burch et al. Science 2016, Torbert et al. GRL 2016), we find a significant improvement in the agreement between the FPI perpendicular electron bulk velocity and the ExB drift as measured by the Electric Field Double Probes (EDP) and Flux Gate Magnetometer (FGM) instruments (averaged to the FPI data). While the 7.5 ms moments recover significant additional structure in the electron bulk velocity, no significant additional structure is observed in the 7.5 ms electron parallel or perpendicular pressure. The violation of the electron frozen flux constraint in the vicinity of the stagnation point (where electron crescent shaped velocity distributions have been previously reported by Burch et al. Science 2016) can be explained largely by the gradient of the perpendicular electron pressure perpendicular to the magnetic field. These results suggest that the electron crescent distributions are a manifestation of the electron diamagnetic drift and do not in themselves contribute to the dissipation of magnetic energy.

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