Observations of multi-scale wave coupling and plasma mixing in the magnetotail separatrix

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One of the notable features of the Magnetospheric MultiScale (MMS) mission is the four spacecraft formation that enables direct measurement of electron scale features using various reconstruction and curlometer methods. We present an example of these techniques in the separatrix region associated with an electron diffusion region encounter by MMS on July 11th 2017, where spacecraft separation was less than 20 km. The overall structure of the inflow-outflow boundary is shown with gradient reconstruction to be on ion-gyro scales with evidence for time-dependent compression of the magnetic field. Possible $\mathbf{J}\cdot\mathbf{E}$ dissipation and coupling between lower-hybrid, Buneman, and electron beam-mode waves near the magnetic peak can be inferred from curlometer measurements of current and local structure of the electric field. As in previous observations and simulations of reconnection separatrices, lower-hybrid waves appear to enable parallel, electrostatic mixing between inflow and outflow plasmas, enhanced by larger scale, time-dependent behavior of the reconnection outflow. To continue investigating these multi-scale phenomena, it is important to utilize MMS’ s unique capabilities for simultaneous observations of ion and electron scale physics in future extended mission phases.

Keywords: plasma, reconnection, separatrix, magnetotail

