Reconstruction of the electron diffusion region of magnetic reconnection observed by Magnetospheric MultiScale

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We present first results of the electron magnetohydrodynamic (EMHD) reconstruction applied to the electron diffusion region encountered by the Magnetospheric Multiscale (MMS) spacecraft on 16 October 2016, 1307 UT [Burch et al., Science, 2016]. The reconstruction is based on a two-dimensional, incompressible, and inertia-less version of the EMHD equations [Sonnerup et al., JGR, 2016] and uses, as the initial conditions, magnetic fields and electron moments observed along the path of a single spacecraft and the coordinate system estimated from four-spacecraft magnetic field measurements [Denton et al., GRL, 2016]. An X-type magnetic field configuration and quadrupolar Hall field pattern, consistent with the electron inflow and outflow, were successfully recovered. The results show that although MMS encountered the dissipation region of near antiparallel magnetopause reconnection, the X-point was not inside the MMS tetrahedron but at a few km from the MMS4 spacecraft at the closest approach. The electron flow stagnation point was shifted toward the magnetosphere from the X-point. The estimated reconnection electric field is 0.3-0.9 mV/m, equivalent to the dimensionless reconnection rate of 0.1-0.3. Comparison between the reconstruction results from individual MMS data and multi-spacecraft measurements suggests that there were significant spatial structures along the X-line direction.