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Electromagnetic dissipation during asymmetric reconnection with a moderate guide field

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We calculate the work done on the plasma by the electromagnetic (EM) field, $\vec{J} \cdot \vec{E}'$, and analyze the related electron currents and electric fields, focusing on a single asymmetric guide field electron diffusion region (EDR) event observed by MMS on 8 December 2015. For this event, each of the four MMS spacecraft observed dissipation of EM energy at the in-plane magnetic null point, though large-scale generation/dissipation was observed inconsistently on the magnetospheric side of the boundary. The current at the null was carried by a beam-like population of magnetosheath electrons traveling anti-parallel to the guide field, whereas the current on the Earthward side of the boundary was carried by crescent-shaped electron distributions. We also analyze the terms in Ohm's law, finding a large residual electric field throughout the EDR, inertial and pressure divergence fields at the null, and pressure divergence fields at the magnetosphere-side EDR. Our analysis of the terms in Ohm's law suggests that the EDR had significant three-dimensional structure.