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Kinetic Equilibrium and Dynamics of Dipolarization Fronts

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The unprecedented high-resolution data from the Magnetospheric Multi-Scale (MMS) satellites is revealing the physics of dipolarization fronts created in the aftermath of magnetic reconnection in extraordinary detail. The data shows that the fronts contain structures on small spatial scales beyond the scope of fluid framework. We develop a new kinetic model of dipolarization fronts and apply it to MMS data to find that global plasma compression produces a unique particle distribution in a narrow boundary layer with separation of electron and ion scale physics. Layer widths on the order of an ion gyro-diameter lead to an ambipolar potential across the magnetic field resulting in strongly sheared flows. Gradients along the magnetic field lines create a potential difference, which can accelerate ions and electrons into beams. It will be shown that these small-scale kinetic features determine the plasma dynamics in dipolarization fronts, including the origin of the distinctive broadband emissions.