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Three-dimensional Dynamics of Magnetic Reconnection in Line-Tied Systems WILLIAM DAUGHTON, CIHAN AKCAY, Los Alamos National Laboratory, WALTER GEKELMAN, TIM DEHASS, BART VAN COMPERNOLLE, University of California, Los Angeles — Using both fully kinetic and two-fluid simulations, we consider the evolution of thin current layers with line-tied boundary conditions, and plasma parameters relevant to an experiment on the LAPD device. With initial half-thickness $3d_e \approx 0.5$ cm, the current layers are unstable to (1) the tearing instability which gives rise to the formation of magnetic flux ropes, and (2) to a short wavelength instability ($kd_e \sim 3$) that grows on the edge of layer. A simple theory is presented for collisionless tearing in line-tied geometry which roughly agrees with the simulations. The nonlinear evolution of magnetic reconnection is characterized using field-line mapping diagnostics to compute the quasi-potential and the squashing factor. While the number of flux ropes predicted by these simulations is in agreement with the experiment, the subsequent evolution features a variety of differences which will be discussed. Finally, we also consider the dynamics of the short-wavelength instability, which appears to be driven by gradients in the current density on the edge of layer. These modes give rise to fluctuations in the electric field and density, and may be a possible candidate to explain the anomalous resistivity that has been observed within the experiment.

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