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CURRENT-SHEET FORMATION AND RECONNECTION AT A MAGNETIC X LINE IN PARTICLE-IN-CELL SIMULATIONS

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The integration of kinetic effects into macroscopic numerical models is currently of great interest to the heliophysics community, particularly in the context of magnetic reconnection. Reconnection governs the large-scale energy release and topological rearrangement of magnetic fields in a wide variety of laboratory, heliophysical, and astrophysical systems. We are examining the formation and reconnection of current sheets in a simple, two-dimensional X-line configuration using high-resolution particle-in-cell (PIC) simulations. The initial minimum-energy, potential magnetic field is perturbed by excess thermal pressure introduced into the particle distribution function far from the X line. Subsequently, the relaxation of this added stress leads self-consistently to the development of a current sheet that reconnects for imposed stress of sufficient strength. We compare the time-dependent evolution and final state of our PIC simulations with macroscopic magnetohydrodynamic simulations assuming both uniform and localized electrical resistivities (C. R. DeVore et al., this meeting), as well as with force-free magnetic-field equilibria in which the amount of reconnection across the X line can be constrained to be zero (ideal evolution) or optimal (minimum final magnetic energy). We will discuss implications of our results for understanding magnetic-reconnection onset and cessation at kinetic scales in dynamically formed current sheets, such as those occurring in the solar corona and terrestrial magnetotail.

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