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Lower-hybrid instabilities and turbulence associated with reconnection in asymmetric current sheets V. ROYTERSHTEYN, UCSD, W. DAUGHTON, LANL, H. KARIMABADI, UCSD — The role of microscopic plasma turbulence in enabling magnetic reconnection is a long-standing problem in plasma physics. In this work, we consider reconnection in asymmetric current sheets as encountered for example at the Earth's magnetopause and laboratory experiments, such as MRX. Using 3D PIC simulations with Monte-Carlo treatment of Coulomb collisions, we demonstrate that Lower-Hybrid (LH) turbulence naturally arises in this configuration in both collisionless and weakly collisional plasma. Two sources of LH turbulence are identified. In regimes with moderate ratio of electron-to-ion temperature $T_e \leq T_i$ and low overall β, electromagnetic LH instability with hybrid wavelength $k(\rho_e\rho_i)^{1/2} \sim 1$ (Daughton, 2003) localized near the X-line can reach large amplitude. This mode produces substantial modifications to the average force balance in the form of fluctuation-induced drag and stress terms and significantly alters the structure of the diffusion region. It persists in weakly collisional regimes typical of MRX. Under parameters typical of the magnetopause, LH turbulence is predominantly localized around the separatrices on the low-β side of the current sheet, where it is driven by short-wavelength instability with $k\rho_e \sim 1$ (e.g. Davidson, 1977). Under these conditions, the overall structure of the reconnection region is not appreciably modified compared to 2D simulations.

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