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Flux-rope mediated turbulent reconnection

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Understanding the interplay between magnetic reconnection and turbulence is an important challenge in solar physics, which must be solved to address the fundamental processes and properties of solar flares and other coronal energy releases. In the last few years, exciting advances in this area have been enabled by 3D direct numerical simulations that capture the generation of turbulence inside the reconnection layer. Interestingly, these simulations exhibit features associated with the Lazarian-Vishniac model of 3D turbulent reconnection (turbulence and field line dispersion) and features associated with 2D plasmoid mediated reconnection (flux ropes and a reconnection rate of 0.01 in MHD and 0.1 with collisionless physics). This talk presents a new theoretical model that reconciles aspects of turbulent and plasmoid-mediated reconnection, differing from the Lazarian-Vishniac theory by emphasizing the roles of locally coherent magnetic structures and magnetic helicity, and formally extending the plasmoid-mediated mechanism to 3D. The new conceptual model successfully describes the main features of MHD and PIC simulations of self-generated turbulent reconnection, including the magnetic field structure and reconnection rate.

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