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Plasmoid-Mediated Reconnection and Turbulence in Laboratory and Space Plasmas AMITAVA BHATTACHARJEE, PPPL — Among recent new developments, the so-called plasmoid instability of thin current sheets has challenged classical nonlinear reconnection models. Within the framework of the resistive MHD model, this instability alters qualitatively the predictions of the classical Sweet-Parker model, leading to a new nonlinear regime of fast reconnection in which the reconnection rate itself becomes independent of the Lundquist number. This regime has also been seen in Hall MHD as well as fully kinetic simulations. Plasmoids, which can grow by coalescence to large sizes, provide a powerful mechanism for coupling between large (global) and small (kinetic) scales as well as an efficient accelerator of particles to high energies. A new phase diagram of fast reconnection has been proposed, informing the design of experiments (such as the FLARE experiment at Princeton, and TREX at Madison). In 3D, the instability produces self-generated and strongly anisotropic turbulence in which the reconnection rate for the mean magnetic field remains approximately at the 2D value, but the energy spectrum deviates strongly from standard MHD turbulence phenomenology. Applications of the theory to observations in laboratory (including fusion) and space (both magnetospheric and solar) plasmas will be discussed.

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