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A new magnetic reconnection paradigm: Stochastic plasmoid chains[1]

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Recent analytical and numerical research in magnetic reconnection has converged on the notion that reconnection sites (current sheets) are unstable to the formation of multiple magnetic islands (plasmoids), provided that the system is sufficiently large (or, in other words, that the Lundquist number of the plasma is high). Nonlinearly, plasmoids come to define the reconnection geometry. Their nonlinear dynamics is rather complex and best thought of as new form of turbulence whose properties are determined by continuous plasmoid formation and their subsequent ejection from the sheet, as well as the interaction (coalescence) between plasmoids of different sizes. The existence of these stochastic plasmoid chains has powerful implications for several aspects of the reconnection process, from determining the reconnection rate to the details and efficiency of the energy conversion and dissipation. In addition, the plasmoid instability may also directly bear on the little understood problem of the reconnection trigger, or onset, i.e., the abrupt transition from a slow stage of energy accumulation to a fast (explosive) stage of energy release. This talk will first provide a brief overview of these recent developments in the reconnection field. I will then discuss recent work addressing the onset problem in the context of a forming current sheet which becomes progressively more unstable to the plasmoid instability.

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