Gyrokinetic simulations of magnetic reconnection in non-uniform plasmas

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The transfer of magnetic to kinetic energy during magnetic reconnection in low-collisionality systems, such as tokamaks and solar flares, proceeds orders of magnitude faster than expected from theory. In order to have predictive models for the quantitative spatial and temporal evolutions of reconnection it is necessary to understand the influence of plasma parameters on the reconnection process [1, 2]. In the present paper, results of gyrokinetic simulations of driven magnetic reconnection in collisionless and weakly collisional plasmas are presented. A novel two-dimensional gyrokinetic particle-in-cell model [3], based on a low-noise plasma code [4], is employed to investigate the physics of fast reconnection. With a magnetic geometry consisting of a separatrix field, a drive field, and a strong perpendicular guide field, the induced electric fields and currents are studied as functions of reconnection drive and plasma profiles. The effects of non-uniformities on the evolution of drift currents and diamagnetism are analyzed together with the decoupling of electron and ion motions leading to Hall effects.

References