Exact steady-state reconnection solutions in weakly collisional plasmas

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Abstract

We consider the problem of reconnection in weakly collisional plasmas in the strong guide field limit. In this regime the standard resistive Ohm's law is modified to include electron compressibility and electron inertia effects. Despite the increased complexity of the governing equations we show that analytic steady-state solutions, like those discovered by Craig & Henton [1] for the purely resistive case, can be developed for this new system. The resulting solutions are somewhat richer than those of Craig & Henton and there are various regimes in parameter space to consider where the solutions exhibit very different behavior. We also test the dynamical accessibility of these new solutions by solving the time-dependent problem numerically. In certain regimes we find that the steady solutions are unstable, and we postulate that the onset of instability corresponds to the transition from long thin current sheets observed in collisionally dominated plasmas, to the cross shaped current structures observed in certain types of collisionless plasmas.

[1] Craig, I. J. D. and Henton, S. M., *Astrophys. J.*, **450**, 280, (1995)

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