DPP07-2007-001074

Abstract for an Invited Paper
for the DPP07 Meeting of
the American Physical Society

Momentum transport from current-driven reconnection

FATIMA EBRAHIMI, University of Wisconsin and Center for Magnetic Self-Organization in Lab and Astrophysical Plasmas

In rotating toroidal plasmas in both laboratory and astrophysical settings, toroidal angular momentum is observed to be transported radially outward. In both cases the transport is much greater than can be explained by collisional viscosity. In the reversed field pinch (RFP), the toroidal rotation profile flattens abruptly during a reconnection event. To explain the RFP transport, we have performed a theoretical and computational study of momentum transport from reconnection - from tearing modes in the presence of sheared flow. We find that, whereas a single mode produces transport, a strong enhancement in transport arises from the nonlinear coupling of multiple modes. A single tearing mode, in the presence of equilibrium flow, produces momentum transport in the vicinity of the reconnection layer. This is demonstrated from quasilinear calculation of Maxwell and Reynolds stresses. However, nonlinear, resistive MHD computation of the full, multi-mode dynamics reveals an additional effect. In the presence of multiple tearing modes, nonlinear coupling strongly enhances the torques. The effect of multiple tearing modes is not merely the superposition of independent, radially separated effects. Rather, the torque from one spatial mode is itself increased by the presence of other modes. The resulting transport is much more rapid than that from viscosity only. Theoretical results will be compared to momentum transport measurements in the MST experiment. Momentum transport in astrophysical plasmas (such as accretion disks) is generally thought to arise from flow-driven MHD instability. Our work raises the question of whether current-driven instability can play a role. Preliminary application to astrophysical disks will be discussed. Work supported by NSF and DOE.