Momentum Transport during Spontaneous Reconnection Events and Edge Biasing in the MST Reversed Field Pinch*

A. Kuritsyn[1,2] , A.F. Almagri[1,2], D.L. Brower[1,3], W.X. Ding[1,3], F. Ebrahimi[1,2], G. Fiksel[1,2], M. Miller[1,2], V.V. Mirnov[1,2], S.C. Prager[1,2]

[1]NSF Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas
[2]Department of Physics, University of Wisconsin, Madison, WI 53706, USA
[3]Department of Physics, University of California, Los Angeles, CA 90095, USA

Transport of parallel momentum during reconnection events has been investigated in the Madison Symmetric Torus reversed field pinch (MST RFP). The events are characterized by a sudden increase of resistive tearing magnetic fluctuations and change in the plasma rotation. The parallel plasma velocity abruptly decreases in the core and speeds up in the edge which results in the flattening of the parallel momentum profile. The parallel velocity in the core is reconstructed from the poloidal velocity of bulk plasma measured with the Rutherford scattering diagnostic and the toroidal phase velocity of resistive tearing modes measured with an edge array of magnetic pickup coils. The edge flow is measured by the Mach probe. The transport of parallel momentum can be understood within the framework of two-fluid turbulent relaxation theory and from detailed calculations of fluctuation induced Maxwell and Reynolds stresses resulting from multiple tearing modes. Previous measurements show the Maxwell stress to be factor of ten larger than either the inertial or the viscous terms in the momentum balance equation both in the edge and in the core. Recently, measurements of the Reynolds stress have been performed in the edge plasma of MST using Mach and optical probes. The Reynolds stress is shown to balance the Maxwell stress in the edge and both are an order of magnitude larger than ion inertia, thus indicating that the balance of two stresses determines edge plasma dynamics during reconnection.

Recent experiments on generation of plasma rotation with bias electrodes inserted into the plasma edge will be also presented. The effect of the edge biasing on the core flow is substantially reduced in the improved confinement regime (PPCD) with significantly reduced level of magnetic fluctuations as compared to the standard RFP operation. This confirms that the level of magnetic stochasticity plays an important role in governing plasma rotation. *This work was supported by the U.S. D.O.E. and N.S.F.