Finite Pressure Effects on Momentum Transport in a Toroidal Plasma

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Abstract:

Anomalous momentum transport has been observed in both the tokamak and reversed field pinch (RFP). For example, both toroidal magnetic confinement configurations see a redistribution of momentum at the sawtooth crash. Direct measurements in MST plasmas (with nominal beta=5-10%) show that parallel pressure fluctuations correlated with radial magnetic fluctuations produce a mean parallel torque that alters the flow profile. In the core plasma, the fluctuation-induced torque acts to suppress the mean flow, while in the edge the torque acts to enhance flow as required by momentum conservation. Observed mean flow changes are consistent with measurements of fluctuation-induced torque in both the plasma core and edge thereby demonstrating kinetic effects are important for momentum transport in ~~a~~ hot plasmas. Furthermore, core measurements of the parallel Maxwell stress indicate that it is much larger than the pressure-related effects. Numerical results from the NIMROD code suggest that both the Maxwell and Reynolds stresses are large in the core. Measurements in the MST edge identified that both the Reynolds and Maxwell fluid stresses are large (and oppositely directed) during these relaxation events. Thus multiple momentum transport mechanisms appear to be active in the RFP. Measurement of the fluctuation-induced momentum flux and Maxwell stress in the core is accomplished using advanced interferometry and polarimetry techniques.