Spontaneous Rotation and Momentum Transport in Tokamak Plasmas

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Recently there has been widespread attention paid to rotation and momentum transport in tokamak plasmas. Of particular interest is spontaneous or intrinsic toroidal rotation in plasmas without external momentum input. The strong co-current spontaneous rotation in enhanced confinement regimes, with Mach numbers up to 0.3, may allow for resistive wall mode suppression in high pressure ITER discharges, without requiring the use of neutral beam injection. Spontaneous rotation in L-mode discharges exhibits a complex dependence on plasma parameters and magnetic configuration compared to the relatively simple scaling of $M_A \sim \beta_N$ in enhanced confinement plasmas. There is currently no comprehensive, quantitative explanation of this phenomenon. There has been a renewed interest in poloidal rotation, especially in ITB discharges, which is generally found to be at odds with the predictions of neo-classical theory. This calls into question the common practice of the determination of E_r from toroidal rotation measurements with the assumption of neo-classical poloidal rotation. Recently there have been extensive investigations into any correlation between energy and momentum diffusivities, and whether there are systematic trends of the Prandtl number with plasma parameters. Of late, there has been vigorous theoretical activity in all of these areas.