Scaling of Momentum Transport and Intrinsic Torque with Normalized Gyroradius in DIII-D

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Experiments at DIII-D have been used to investigate the scaling of momentum transport and intrinsic torque with a dimensionless parameter scan that varies only the normalized gyroradius, ρ_*. Intrinsic torque, normalized by the ion temperature, was found to scale as $\rho_*^{-1.6\pm0.6}$, suggesting that intrinsic torque will be significant in ITER. Within DIII-D, ρ_* was varied by a factor of 1.3. The high- and low-ρ_* plasmas created for this scan can be combined with results from other tokamaks in order to increase the amount that ρ_* is varied. Prandtl number, momentum pinch, and intrinsic torque are determined by measuring the plasma response to repeated torque perturbations. Co- and counter-current neutral beam injection is used to vary the applied torque while maintaining a constant injected power. Measurements show that energy and momentum confinement are nearly constant during the torque perturbations. The intrinsic torque was also measured by determining the neutral beam torque required to null the toroidal rotation profile. Independent measurements of intrinsic torque are consistent with each other and show that the dependence of intrinsic torque on the Mach number is minimal.

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