Advances in understanding the generation and evolution of the toroidal rotation profile on DIII-D

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Abstract.

Recent experiments using DIII-D's capability to vary the injected torque at constant power have focused on developing the physics basis for understanding rotation through detailed study of momentum sources, sinks and transport. Non-resonant magnetic braking has generally been considered a sink of momentum; however, recent results from DIII-D suggest that it may also act as a source. The torque applied by the field depends on the rotation relative to a non-zero "offset" rotation. Therefore, at low initial rotation, the application of non-resonant magnetic fields can actually result in a spin-up of the plasma. Direct evidence of the effect of reverse shear Alfvén eigenmodes on plasma rotation has been observed, which has been explained through a redistribution of the fast ions and subsequent modification to the neutral beam torque profile. An effective momentum source has been identified by varying the input torque from neutral beam injection at fixed β_N, until the plasma rotation across the entire profile is effectively zero. This torque profile is largest near the edge, but is still non-negligible in the core, qualitatively consistent with models for a so-called "residual stress". Perturbative studies of the rotation using combinations of co and counter neutral beams have uncovered the existence of a momentum pinch in DIII-D H-mode plasmas, which is quantitatively similar to theoretical predictions resulting from consideration of low-k turbulence.