**Measurement of the electromagnetic torque in rotating DIII-D plasmas**

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## Abstract

The electromagnetic torque due to either static or rotating magnetic perturbations, or both, on a rotating DIII-D plasma is studied by deriving an estimate of the torque from measurements of various components of the magnetic perturbation at the wall. This approach is based on the Maxwell stress tensor formalism [I.H. Hutchinson 2001, *Plasma Phys Control. Fusion* **43** 145]. For the locking of large tearing modes, this measurement of the electromagnetic torque at the time of the locking is consistent with the equation of motion. Measurements and modeling show that for mode rotation frequencies above a few hundred Hz the momentum transfer between magnetic perturbations and the graphite tiles is no longer negligible, revealing the necessity for a new two-wall model of the tokamak. The shielding effect of the tiles on magnetic field measurements is calculated, and shown to be consistent with unrealistically small torques measured during high frequency modes. The electromagnetic torque proves to be an important factor in determining plasma rotation at a wide range of mode frequencies from zero to the kilohertz range. It can be comparable to other sources of torque, such as tangential neutral beam injection for heating.

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