Resistive Wall Modes and Plasma Rotation in DIII-D*

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A quantitative comparison between experiments in the DIII-D tokamak and models of the interaction of the n=1 resistive wall mode (RWM) with plasma rotation leads to an improved understanding of the phenomena of rotational stabilization of the RWM [1] and resonant field amplification (RFA) of small externally applied magnetic fields [2]. On the one hand a finite amplitude resistive wall mode exerts drag on the plasma. The rotation is observed to decay uniformly across the entire profile when a finite amplitude RWM is present. The magnitude of the observed rotation decay exceeds the decay predicted by the increased toroidal neoclassical viscosity due to the perturbed magnetic field. On the other hand plasma rotation is observed to stabilize the RWM [1]. The stabilizing effect is analyzed by exciting the marginally stable mode with external resonant fields at various values of beta, plasma rotation, plasma-wall distance and frequencies of the external field. The plasma response is compared to a one-dimensional RWM model [3], which is extended to include the stabilizing effect of plasma rotation [4]. It is found that the energy dissipation associated with plasma rotation in the presence of a perturbed magnetic field rather than the energy dissipation associated with eddy currents in the resistive wall constitutes the dominant stabilizing effect.

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