STABILITY AND CONTROL OF RESISTIVE WALL MODES IN HIGH BETA, LOW ROTATION DIII-D PLASMAS

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ABSTRACT. Recent high-β DIII-D [J.L. Luxon, Nucl. Fusion **42** (2002) 64] experiments with the new capability of balanced neutral beam injection show that the resistive wall mode (RWM) remains stable when the plasma rotation is lowered to a fraction of a percent of the Alfvén frequency by reducing the injection of angular momentum in discharges with minimized magnetic field errors. Previous DIII-D experiments yielded a high plasma rotation threshold (of order a few percent of the Alfvén frequency) for RWM stabilization when resonant magnetic braking was applied to lower the plasma rotation. We propose that the previously observed rotation threshold can be explained as the entrance into a forbidden band of rotation that results from torque balance including the resonant field amplification by the stable RWM. Resonant braking can also occur naturally in a plasma subject to magnetic instabilities with a zero frequency component, such as edge localized modes (ELMs). In DIII-D, robust RWM stabilization can be achieved using simultaneous feedback control of the two sets of non-axisymmetric coils. Slow feedback control of the external coils is used for dynamic error field correction; fast feedback control of the internal non-axisymmetric coils provides RWM

stabilization during transient periods of low rotation. This method of active control of the $n = 1$ RWM has opened access to new regimes of high performance in DIII-D. Very high plasma pressure combined with elevated q_{min} for high bootstrap current fraction, and internal transport barriers (ITBs) for high energy confinement, are sustained for almost 2 s, or 10 energy confinement times, suggesting a possible path to high fusion performance, steady-state tokamak scenarios.

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