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Insight in the stabilization of a resistive wall mode by plasma rotation*

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Abstract

Measurements of the resistive wall mode (RWM) response to external resonant fields are used for describing the effects of error fields on a high-β tokamak plasma, as well as the RWM dispersion relation in the parameter range explored. We have generalized an ideal MHD model [1] to include the effects of plasma rotation and dissipation, and we find that the new model can explain quantitatively the experimental observations. In particular, we have analyzed the measurements of the RWM characteristics vs. the plasma β, at $\beta > \beta^{\text{no-wall}}$. Rotation of the RWM with respect to the wall is often described as an essential feature of the mechanism by which plasma rotation stabilizes the RWM [2-4]. This common understanding of the rotational stabilization of the RWM appears inconsistent with the recent experimental evidence from DIII-D. We find that the stabilization by plasma rotation is due principally to dissipation in the plasma, not to dissipation in the resistive wall. In this scenario, the theoretically predicted mode rotation with respect to the wall is not needed for stabilization, and is just a negligible consequence of torque balance in the absence of non-axisymmetric external magnetic-fields.

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