Lack of Dependence on Resonant Error Field of Locked Mode Island Size in Ohmic Plasmas in DIII-D

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Abstract: DIII-D experiments show that fully penetrated resonant *n*=1 error field locked modes in Ohmic plasmas with safety factor $q_{95} \geq 3$ grow to similar large disruptive size, independent of resonant error field correction. Relatively small resonant (*m/n*=2/1) static error fields are shielded in Ohmic plasmas by the natural rotation at the electron diamagnetic drift frequency. However, the drag from error fields can lower rotation such that a bifurcation results, from nearly complete shielding to full penetration, i.e., to a driven locked mode island that can induce disruption.

Error field correction (EFC) is performed on DIII-D (in ITER relevant shape and safety factor $q_{95} \gtrsim 3$) with *either* the *n*=1 C-coil (no handedness) *or* the *n*=1 I-coil (with "dominantly" resonant field pitch). Despite EFC which allows significantly lower plasma density (a "figure of merit") before penetration occurs, the resulting saturated islands have similar *large* size; they differ only in the phase of the locked mode after typically being pulled (by up to 30 degrees toroidally) in the electron diamagnetic drift direction as they grow to saturation. Island amplification and phase shift are explained by a second change-of-state in which the classical tearing index changes from stable to marginal by the presence of the island. The eventual island size is thus governed by the inherent stability and saturation mechanism rather than the driving error field.

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