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Magnetic Flutter Plasma Transport Induced by 3D Fields in DIII-D[1]

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New combined MHD and transport modeling show that the recently developed magnetic flutter model of plasma transport [1] predicts an electron thermal diffusivity "hill" at the top of the pedestal comparable to that seen in DIII-D discharges where edge localized modes (ELMs) are suppressed by the application of 3D fields. It is hypothesized that this "hill" prevents the inward growth of the pedestal to avoid reaching the peeling-ballooning limit that precipitates an ELM. The magnetic perturbations in the plasma are modeled with the two fluid MHD M3D-C1 code, which results in perturbation harmonics that are flow-screened or amplified (relative to vacuum calculations) at their corresponding rational surface. Despite any screening, the flutter predicted diffusivity peaks at the rational surfaces in the plasma. However, in integrating the inverse of the diffusivity to obtain an electron temperature profile, the average predicted temperature gradient is dominated by the smaller but finite diffusivity between rational surfaces. The magnitude of the flutter predicted diffusivity is decreased by a factor of about 4/13 when the effects of the pressure gradient and radial electric field (off-diagonal transport matrix terms) are taken into account, and this lower predicted diffusivity is much closer to the experimentally inferred diffusivity. On the other hand, adding a large diffusivity in the approximate island width regions around the rational surfaces leads to a diffusivity much higher than inferred experimentally. Flutter effects on the electric field and particle transport are also currently being investigated. These flutter model studies provide a promising new approach for developing a predictive capability for achieving ELM suppression in future devices.

[1] J.D. Callen, A.J. Cole, and C.C. Hegna, Phys. Plasmas **19**, 112505 (2012).

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