Predictive Modeling of Plasma Halo Evolution in Post-Thermal Quench Disrupting Plasmas*

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Halo currents, which flow in plasma residing on open field lines during tokamak disruptions, can apply large, highly localized forces to plasma facing components. Successful models of halo and core plasma current evolution developed in the last decade account for many of the processes, and allow prediction of halo currents provided the post-thermal quench (TQ) core and halo resistivities and halo width evolution are given.[1] Use of the KPRAD impurity radiation code with these models allows reasonably accurate prediction of post-TQ average plasma resistivity when the ohmic input power is balanced by radiation from a known quantity of identified impurity species.[2] Key elements lacking predictability remain the halo width evolution, effectiveness of impurity penetration, resulting impurity species concentrations in the post-TQ plasma, and separate evolution of the resistivities of the core and halo.

We describe a predictive model for evolution of the key relevant characteristics of a plasma halo in DIII-D disruptions, including halo width and resistivities. The effective halo width is set by plasma motion and current diffusion across open field lines in the post-TQ plasma, typically filling the entire machine aperture with current by the end of the current quench. Integration of KPRAD with dynamic plasma and field line evolution models allows core and halo resistivities to be determined separately. Although the amounts of impurity sputtering, ablation, and penetration into mitigated or naturally disrupting plasmas are not yet predictable, sufficient simulation detail is now available to allow realistic scoping studies based on varying the assumed quantity of first wall material or actively injected impurity in the core plasma. The model is applied to DIII-D experiments and ITER disruption scenarios.

[1]D.A. Humphreys and A.G. Kellman, Phys. Plasmas **6**, 2742 (1999).
[2]D.G. Whyte, et al., Phys. Plasmas **7**, 4052 (2000).

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