Abstract Submitted for the 53rd Annual Meeting
Division of Plasma Physics
November 14–18, 2011, Salt Lake City, Utah

Category Number and Subject:

[ ] Theory [x] Experiment

Numerical Investigation of Solving the Generalized Diffusion Equation in the Edge Pedestal with Extended Diffusion Theory Codes,* J.-P. Floyd, W.M. Stacey, *Georgia Tech* – Radial and toroidal momentum balance requires the ion particle flux in the edge pedestal to satisfy a pinch-diffusion relation, $\Gamma = -D\nabla n + nV_r^{pinch}$, rather than the pure diffusion relation used to derive standard diffusion theory. Re-derivation of diffusion theory by using the pinch-diffusion relation in the particle continuity equation yields a generalized diffusion equation [1] which, in principle, can be solved by modifying the standard diffusion theory methods and codes. We have investigated this possibility by using standard finite difference and Gauss reduction solution procedures for 1D diffusion theory to solve this equation. Analysis of the equation yields an expression for the numerical error of various finite-difference algorithms proportion to the square of the ratio of the mesh spacing to the characteristic scale length, $L \equiv \left| D_j / V_{rj}^{pinch} \right|$. The implication of this result is that smaller mesh spacing will be necessary in the edge pedestal, where the inward pinch velocity is large, than is necessary for similar accuracy further inward, where the pinch velocity diminishes. This result was confirmed by numerical solution of the equation for a DIII-D shot.

[1] W.M. Stacey, Contrib. Phys. Plasmas **48**, 94 (2008).

*Supported by the US DOE under DE-FG02-00ER54538, DE-FG02-04ER54698, & DE-AC02-09CH11466.