Advances in 3-D Equilibrium Reconstruction using V3FIT

M. Cianciosa[a], J. D. Hanson[a], J. Koliner[b], J. Herfindal[a], X. Ma[a] and M. C. ArchMiller[a]
[a)]Auburn University [b)]University of Wisconsin, Madison

V3FIT[1] is a fully three dimensional equilibrium reconstruction code used to analyze a wide range of fusion devices. Built around the VMEC[2] 3-D equilibrium solver, V3FIT can reconstruct any configuration with closed nested flux surfaces. V3FIT is used to reconstruct equilibria on the Compact Toroidal Hybrid (CTH) and Helically Symmetric eXperiment (HSX) stellarators, and the Madison Symmetric Torus (MST) and RFX-Mod reversed-field pinches. On the DIII-D and JET tokamaks, V3FIT is used to explore the deformations that error correction coils apply to the nominally axisymmetric plasma. Initial forward modeling has begun for the Wendelstein 7-X (W7-X) experiment.

Magnetic diagnostics measure signal from sources of current outside of the equilibrium. VMEC operates in one of two modes. In free boundary, vacuum fields are precomputed from a coil model. In fixed boundary, the equilibrium boundary is specified and sources of external currents are ignored. The MST reversed-field pinch has a 5cm thick conducting shell. In addition to plasma current, significant eddy currents driven in the shell are detected by magnetic diagnostics. Since the boundary is well defined by the shell, and the eddy current distribution cannot be easily modeled as coil currents, a free boundary solution is infeasible. By assuming a perfect conductor, eddy currents in the shell can be computed from the magnetostatic boundary conditions. This presentation will discuss results of MST equilibrium reconstructions incorporating eddy current information, enhancements to V3FIT and future directions of 3-D Equilibrium reconstruction.

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[2] S. P. Hirshman, J. C. Whitson, Phys. Fluids **26**, 3553 (1983)

This material is based upon work supported by Auburn University and the U. S. Department of Energy, Office of Science, Office of Fusion Energy Sciences under Award Number DE-FG02-03ER54692