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3D Equilibrium Reconstruction with Internal Measurements on Madison Symmetric Torus J.J. KOLINER, B.E. CHAPMAN, J.S. SARFF, J.K. ANDERSON, S. MUNARETTO, W. CAPECCHI, UW-Madison, L. LIN, UCLA, J.D. HANSON, M.R. CIANCIOSA, Auburn U. — Plasmas in the MST reversed field pinch (RFP) bifurcate to a helical equilibrium, forming a single helical axis (SHAx) at high plasma current ($I_p \approx$500 kA) and low density ($n_e \approx 0.5 \times 10^{19}$ m^{-3}). In order to understand the physics of confinement and self-organization in SHAx, 3D equilibrium reconstruction is needed. The V3FIT equilibrium reconstruction code is applied using measurements from the 11-chord interferometer-polarimeter, 22-point Thomson scattering system, 4-camera soft x-ray probes, and magnetics. Equilibria have been generated using a fixed plasma boundary with no external currents. Model signals fit well to observed signals, $\chi^2 \approx 1$, and the zero crossing of line-averaged $n_e B_z$ from Faraday rotation is matched by the model. External magnetics are shown to be an inadequate equilibrium constraint with the VMEC model, due to possible shear in the poloidal phase of the helical structure, as well as strong contribution to the edge magnetic field from currents in the conducting shell. To address this shortcoming, a filament current model has been created to simulate the conducting shell with many external currents for a free plasma boundary. Axisymmetric equilibria have been reconstructed using the filament model and compared to solutions obtained with the MSTFIT axisymmetric equilibrium reconstruction code. The filament model has been extended to allow reconstruction of helical equilibria. Supported by DoE.

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