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Modeling and Measurement of Toroidal Currents in the HSX Stellarator J.C. SCHMITT, HSX Plasma Laboratory, J.N. TALMADGE, J. LORE, HSX PLASMA LABORATORY TEAM — A set of magnetic diagnostics are installed to measure the magnetic field at several locations around HSX. Rogowski coils and diamagnetic loops measure the toroidal current and toroidal flux, and two poloidal belts, separated by $\sim 1/3$ of a field period measure the magnetic field vector at 16 poloidal locations at each toroidal angle. A self-consistent calculation of the Pfirsch-Schlüter (PS) and bootstrap currents is found with VMEC and BOOTSJ, and the 3D equilibrium reconstruction code, V3FIT calculates the expected signal of the magnetic diagnostics. The lack of toroidal curvature in HSX results in a dipole PS current that has a helical rotation and nearly reverses at the two toroidal locations. Also, the bootstrap current reduces the rotational transform (~ 1) but increases the effective transform (~ 3). Compared to a tokamak, the magnitude of each current is reduced by ~ 3. Improvements in the modeling include: 1) Comparison of the measured bootstrap current to the PENTA code which includes the effects of parallel momentum conservation and finite electric field. 2) Comparison of the evolution of the net toroidal current to a 3D model involving the susceptance matrix. 3) Analysis of the sensitivity of the diagnostic set and the ability of the V3FIT code to reconstruct the plasma pressure and current profiles based on the magnetic signals.

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