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Evolution to a minimum energy Taylor state in multiple flux conserving boundaries in SSX[1]

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Dynamical evolution and final MHD states are measured and analyzed in four different flux conserving boundaries in SSX. Oblate (L/R = 1.2), slightly prolate (L/R = 2.0), prolate (L/R = 3.0), and super prolate (L/R = 10) geometries are studied. The flux conserving boundaries are provided by highly conducting copper walls. In each case, dynamics are initiated by injecting small, dense spheromaks into each end of the flux conserver. The helicity of the spheromaks can be individually chosen, allowing for both counter and co-helicity merging, both of which have been tried. During the merging process, complex behavior is observed; interpenetrating, two component flows are measured with a high resolution ion Doppler spectrometer (IDS), as well as dynamic activity of the magnetic fields. After the merging phase, complex activity subsides and a minimum energy Taylor state with constant helicity is reached. This state is measured and compared to the lowest energy eigenmode predicted by $\nabla \times B = \lambda B$. Eigenmodes for the various flux conserver geometries are calculated by PSI-TET. Ion temperatures are monitored throughout the process by the IDS system. Between 48 and 288 separate magnetic probes have been employed to characterize the magnetic structure of the plasma. Typical parameters of the merged low beta plasmas are $B = 0.1$ T, $n_e = 1 - 5 \times 10^{20}$ m^{-3}, $T_i = 20$ eV, and $\beta = 0.1$.

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