Recent results from and proposed changes to the TCS rotating magnetic field FRC generation experiment

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FRCs have been generated and sustained in steady state from preionized gas fills using Rotating Magnetic Fields (RMF) in the TCS device. These FRCs are limited to sub 100 eV temperatures by at least several percent impurity content. Hot FRCs have also been translated and expanded (axial confinement field dropping from ~10 kG to ~0.5 kG) into TCS from the LSX/mod theta pinch. These FRCs reflected off the end mirrors of TCS and their high supersonic directed energies were rethermalized to close to the original formation temperatures, but at less than one tenth the density (~10^{20} m^{-3} as opposed to ~10^{21} m^{-3} formation densities). Typical trapped FRCs had separatrix radii of ~25 cm inside 47 cm radius flux conserving coils. RMF applied to these FRCs altered the internal field $B_z(r)$ profiles and could stabilize the n=2 rotational instability, but could not sustain the flux due to a surrounding layer of ionized quartz vapor ablated from the quartz plasma tube walls. Ablation was caused by lack of centering of the reflected FRCs and the resultant vapor absorbed most of the RMF power and significantly reduced its amplitude. Smaller, less energetic FRCs would sometimes remain centered and exhibit excellent confinement scaling (much better than the $\eta_\perp \sim 16/(x_s n_m(10^{20}\ m^{-3})^{1/2}$ $\mu\Omega$-m) obtained at high FRC densities), but these FRCs had electron rotation rates higher than our present RMF frequencies and were thus not candidates for RMF sustainment. A modification to the TCS device will add internal metal flux conserving rings to shield the quartz insulating wall from hot plasma. Also a small diameter quartz transition tube between LSX/mod and TCS (previously used for FRC acceleration experiments) will be changed to a large diameter metal section and multipole fields will be provided to better center the translated FRC. In addition, discharge cleaning and wall conditioning will be added, which should maintain the good vacuum environment found necessary in all other quasi steady-state devices.