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**Higher Temperature Steady-State FRCs Formed and Sustained by Rotating Magnetic Fields in the New TCS-Upgrade Device**[1]

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Previous work in the Translation, Confinement, and Sustainment (TCS) device has demonstrated the formation and steady-state sustainment of FRCs by rotating magnetic fields (RMF). The RMF was shown to provide complete FRC stability and good particle confinement. Simple theory shows that the particle density is set primarily by the applied RMF torque, but that the plasma temperature is separately determined by power balance. In TCS this temperature was limited to several 10s of eV due to high impurity content. A new upgraded device, TCSU, with a bakable, ultra-high vacuum chamber was built to reduce these impurities and overall recycling. Spectacular improvements were obtained in the first month of TCSU operation, with temperatures increasing to well over 100 eV. The higher temperatures resulted in higher magnetic fields and toroidal currents without higher RMF power inputs, indicating improvements in current drive efficiency and energy confinement time with temperature. These results were obtained with simple, even-parity RMF antennas, which cause field line opening. Results with both odd-parity antennas, which can achieve complete field line closure and reduce fundamental non-radiative energy loss rates, as well as with advanced wall conditioning methods will also be reported on.

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