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Compression of an Accelerated Taylor State in SSX[1] J.E. SHROCK, E. M. SUEN-LEWIS, L. J. BARBANO, M. KAUR, Swarthmore College, D.A. SCHAFFNER, Bryn Mawr College, M.R. BROWN, Swarthmore College
— In the Swarthmore Spheromak Experiment (SSX), compact toroidal plasmas are launched from a plasma gun and evolve into minimum energy twisted Taylor states. The plumes initially have a velocity $\sim 40\ km/s$, density $\sim 0.4 \times 10^{16}\ cm^{-3}$, and proton temperature $\sim 20\ eV$. After formation, the plumes are accelerated by pulsed pinch coils with rise times $\tau_{1/4} = (\pi/2)\sqrt{LC}$ less than 1 μs and currents $I_{peak} = V_0/Z = V_0/\sqrt{L/C}$ on the order of $10^4\ A$. The accelerated Taylor States are abruptly stagnated in a copper flux conserver, and over the course of $t < 10\ \mu s$, adiabatic compression is observed. The magnetothermodynamics of this compression do not appear to be dictated by the MHD equation of state $d/dt(P/n^\gamma) = 0$. Rather, the compression appears to evolve according to the Chew-Goldberger-Low (CGL) double adiabatic model. CGL theory presents two equations of state, one corresponding with particle motion perpendicular to magnetic field in a plasma, the other to particle motion parallel to the field. We observe Taylor state compression most in agreement with the parallel equation of state: $d/dt(P_\parallel B^2/n^3) = 0$.

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