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Particle Confinement in a Relaxed Taylor State[1] ADAM D. LIGHT, Colorado College, CHRIS J. HANSEN, University of Washington, HARIHARAN SRINIVASULU, LUCAS DYKE, MICHAEL R. BROWN, Swarthmore College —
We present properties of protons confined in a self-organized, helical "Taylor state" magnetic field (Beltrami field). Despite the lack of axisymmetry, a significant fraction of the particles are confined and there is evidence of confinement surfaces. Particle confinement has been studied extensively in most magnetized plasma equilibria that can be produced in the laboratory. Very little, however, is known about the confinement properties of the minimum energy force-free equilibrium in an elongated cylinder (Taylor helix or Taylor state). We construct minimum-energy solutions to the force-free equation $\nabla \times \vec{B} = \lambda \vec{B}$ using the PSI-Tet eigenvalue solver and integrate the proton equations of motion using a Boris stepper. Initial results indicate that the fraction of particles confined by the Taylor state magnetic fields is similar to the fraction confined by the well-studied spheromak configuration. Using a large ensemble of initial conditions, we construct statistical characterizations of the particles that remain confined in the Taylor state and those that escape. We also give examples of trajectories that indicate the presence of confinement surfaces and demonstrate progress towards identifying these surfaces.

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Adam Light
Colorado College

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