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Proton Orbit Calculations in Relaxed Taylor States at SSX[1]

LUCAS DYKE, ADAM LIGHT, MICHAEL BROWN, Swarthmore College, CHRISTOPHER HANSEN, University of Washington — We aim to analyze the dynamical properties of plasma particles within the cylindrical, helical Taylor state magnetic field structure. We also wish to study the potential confinement properties of the Taylor state to assess if it is a viable fusion energy configuration. We simulate the motions of particles in the Taylor state through of a total of $2\pi \times 10^5$ orbits of particles with a set distribution of initial positions and velocities. The field structure itself is calculated by first solving the eigenvalue equation $\nabla \times \mathbf{B} = \lambda \mathbf{B}$ using the program PSI-Tet. Then, the Boris algorithm is implemented to solve the equations of motion for the particle orbits. The results of the simulation show that the majority of escaped particles escape either at the ends of the Taylor state or at points along the surface of the cylinder containing the state that have a weak field. In addition, we found that the particles that remain confined within the state for an extended period of time exhibit general trends for the distribution both radially and along the z-axis. The data also shows that particles initialized with greater initial velocities were generally more likely to escape the Taylor state, and approximately 55% of particles stayed confined.

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