§22. Energetic Particle Orbits in a Field-Reversed Configuration

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We made a computer code which pursues the 3D orbit of ionized particle in an FRC plasma. It solves with given initial position and initial velocity the equation of motion using sixth-order Runge-Kutta method (D. Sarafyan, J. Math. Anal. Appls.). An analytical equilibrium model was simply chosen as $\psi \propto r^2 (1 - r^2/a^2 - z^4/b^4)$ (L.C.Steinhauer,Phys.Fluids 2, 1990,3081) (a=50cm,b=2.5m). Fig.1 shows its contour map. An energetic neutral beam is injected perpendicular to the symmetric axis and its particle is taken to ionize along the injection line (y axis). Several computations were tried. First we confirmed the injection at the midplane the orbit was limited in the midplane and didn't move in the axial direction since no deviation in the velocity at ionization was considered. The vacuum magnetic intensity was taken 0.4T and the beam energy 10keV. Larmor radius is 3.6cm. Removed 10cm (x axis) from the midplane we computed at several ionization positions (initial y values). Orbits can be grouped into three. In the exterior the particle immediately gets out of the separatrix. Inside of neutral surface it gyrating it circulates the axis (Fig.2). In the deep it circulates the axis without gyration. (Fig.3). For the latter the particle will escape to the end but stays more than several 10 μsec in the FRC.

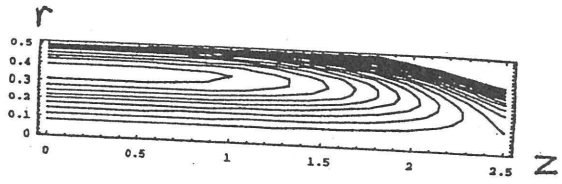
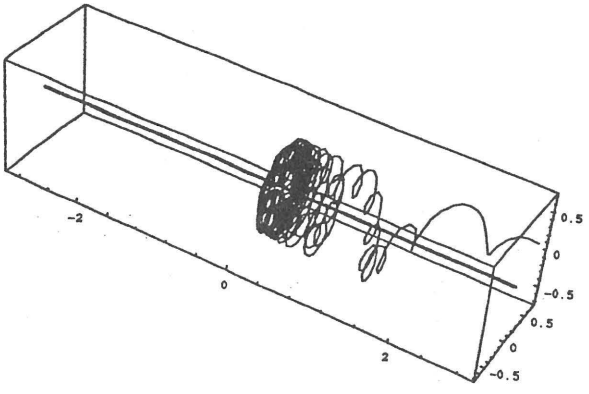


Fig.1



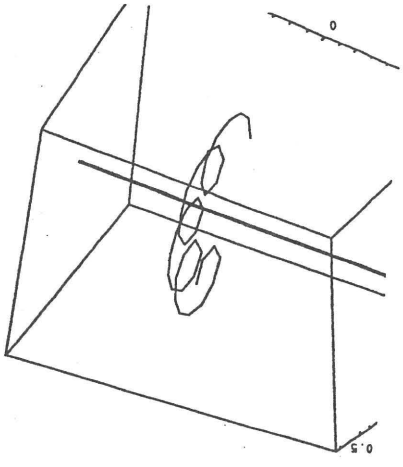
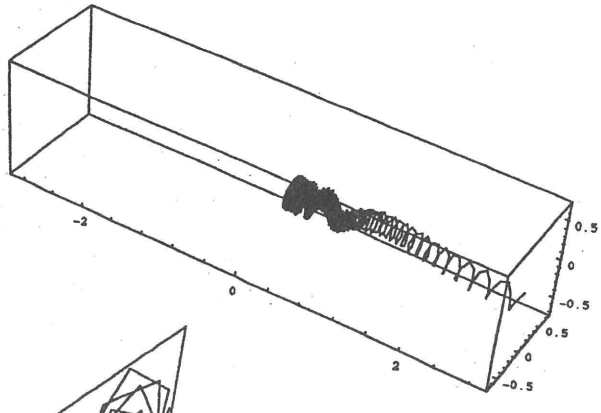


Fig.2



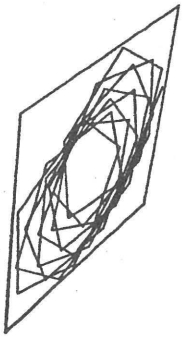


Fig.3