

§20. Particle Confinement in Edge Plasma Region of LHD

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Particle confinement is studied numerically in the outside of closed magnetic surface of LHD.

Not only for the energy loss of hot plasma, but also for the control of heat and particle flux to the wall, it is very important for LHD to prevent (or reduce) the charge exchange process between the high temperature plasma (hot plasma) and neutral atoms.

Hot plasma is confined in the closed magnetic surface region. Outside of the outer most closed magnetic surface, LHD has a chaotic lines of force region.

In this chaotic region, passing particles show chaotic motion and eventually lost to the divertor plate, similar to the behavior of the lines of force. On the other hand, particles with large pitch angle repeat the mirror reflection process moving along the lines of force.

Because LHD has $\ell = 2$ helical coils, the fundamental period of drift motion is almost 1/2 of the period of the motion of lines of force. This suggest that the LHD has better confinement for reflecting particles compared to the passing particles, and chaotic lines of force region can confine the reflecting particles if particle energy is not so high.

This possibility is confirmed numerically solving the collision less drift equation for 10keV hydrogen ions. Starting positions are placed at chaotic field line region at $\phi = 0$ and pitch angle are distributed equally from 0 to π . Fig.1 shows Poincare plot of particles at meridian planes. This figures show that large pitch angle particle is confined and circulating around the magnetic axis. Due to mirror reflection, no confined particle reach near to the helical coils where magnetic field become strong.

The mirror ratio $R(\simeq 4.5T/1.8T = 2.5)$ of chaotic field lines region is consistent with the ratio of confined particles ($\simeq 70\%$) of numerical computations.

This results show very interesting nature for the steady state high performance operation of LHD. Plasma blanket against neutral atoms may be possible.

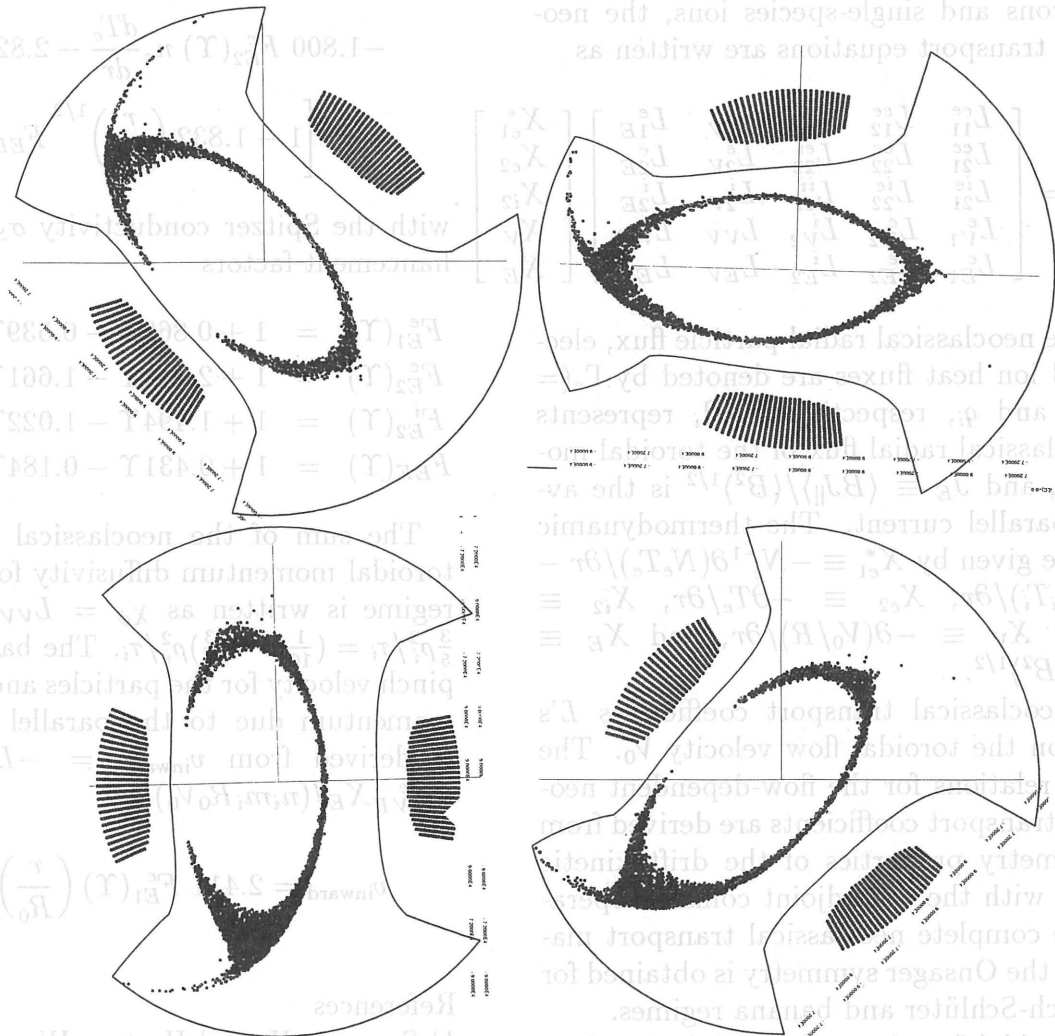


Fig.1 Poincare plot of 10KeV ions confined in chaotic field lines region.