Particle Transport Barriers Dependence on the Magnetic Configuration

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For some discharge configurations in tokamaks, transport barriers reduce particle transport, improving plasma confinement. In this context, a model has been applied to describe the turbulent transport by drift waves, attributing this transport to $\mathbf{E} \times \mathbf{B}$ chaotic drift orbits [1]. In the present work we use this model to investigate the influence of magnetic safety factor on creation, maintaining and destruction of particle transport barriers. The model results in a set of differential equations that describe the motion of a test particle on the plasma, that we integrate numerically and analyze the behavior of trajectories using Poincaré sections [2]. Introducing a nonmonotonic safety factor profile, the phase space structure is deeply modified and a shearless invariant curve appears. Such curves are robust under electrostatic fluctuations, so they act like Shearless Transport Barriers (STB) [3].

We obtained a bifurcation diagram of the rotation number [2] of the STB as a function of the safety factor at plasma edge, q_a . In this bifurcation diagram, we identify intervals of the parameter with or without STB. In some intervals of q_a, more than one STB are present in phase space. The results obtained show that nonmonotonic safety factor profiles creates STB and its variation results in an intermittent sequence of STB breakup and resurgence.

References

[1] W. Horton et al, Physics of Plasmas, **5**, 11 (1998)

[2] L. A. Osorio et al, Physics of Plasmas, **28**, 8, (2021).

[3] J. D. Szezech Jr, et al. Physical Review E, **86**, 3 (2012).