PAPER

Secondary shearless bifurcations in tokamaks

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Abstract

Isochronous island chains have been shown to have an impact on plasma transport. To investigate this effect, we use an area-preserving twist map that describes the trajectories of the magnetic field lines in a tokamak with an ergodic limiter composed of two pairs of coils. In this setup, the plasma is perturbed by two independent modes that act on the same magnetic surface, which provides a framework for analyzing scenarios where isochronous bifurcations occur. These bifurcations are associated with the emergence of secondary shearless curves, which, like shearless curves in nontwist systems, act as robust transport barriers, but locally, restricting the transport of chaotic field lines in the regions near the island chains. By computing the internal rotation number, we identify the presence of secondary shearless curves and analyze their dependence on the perturbation parameters. We show that these curves may emerge, persist, or break as the parameters

vary, and that even after breaking, they continue partially restricting field line transport. This persisting trapping effect might serve as a possible explanation of the results observed in previous works.

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