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Isochronous island bifurcations driven by resonant magnetic perturbations in tokamaks

B. B. Leal, I. L. Caldas, M. C. de Sousa, R. L. Viana, and A. M. Ozorio de Almeida
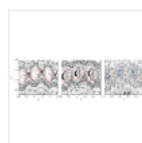
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ABSTRACT

Recent evidence shows that heteroclinic bifurcations in magnetic islands may be caused by the amplitude variation of resonant magnetic perturbations in tokamaks. To investigate the onset of these bifurcations, we consider a large aspect ratio tokamak with an ergodic limiter composed of two pairs of rings that create external primary perturbations with two sets of wave numbers. An individual pair produces hyperbolic and elliptic periodic points, and its associated islands, that are consistent with the Poincaré-Birkhoff fixed-point theorem. However, for two pairs producing external perturbations resonant on the same rational surface, we show that different configurations of isochronous island chains may appear on phase space according to the amplitude of the electric currents in each pair of the ergodic limiter. When one of the electric currents increases, isochronous bifurcations take place and new islands are created with the same winding number as the preceding islands. We present examples of bifurcation sequences displaying (a) direct transitions from the island chain configuration generated by one of the pairs to the configuration produced by the other pair, and (b) transitions with intermediate configurations produced by the limiter pairs coupling. Furthermore, we identify shearless bifurcations inside some isochronous islands, originating nonmonotonic local winding number profiles with associated shearless invariant curves.
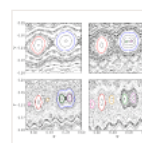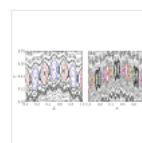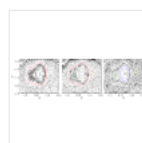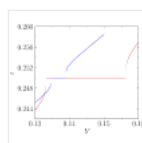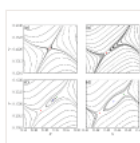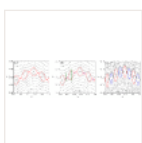
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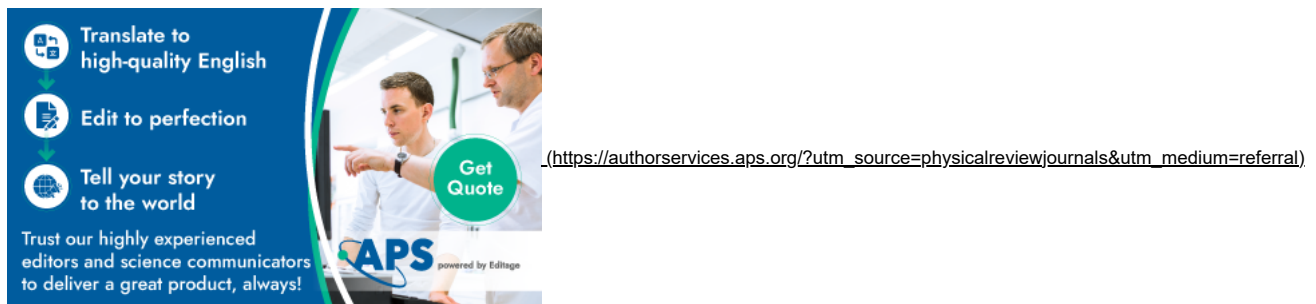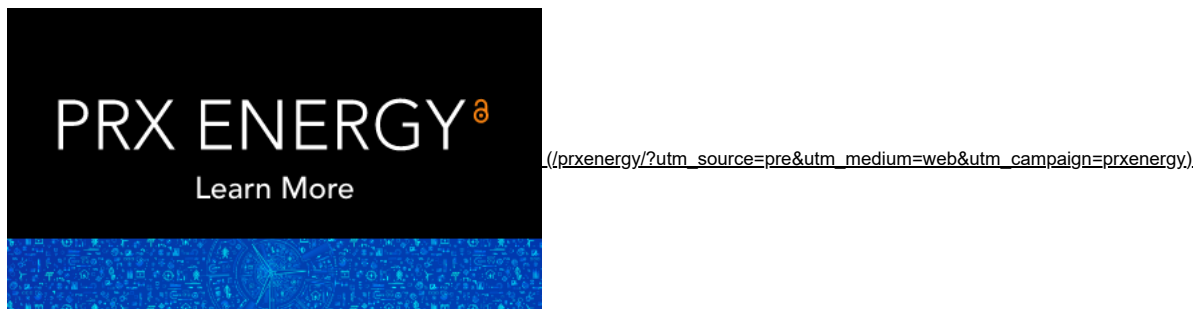
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