Chaotic transport in symplectic maps: Applications in plasma dynamics

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Abstract

In this research, we investigate the transport properties present in symplectic maps, which describes qualitatively effects of the dynamics of magnetically confined plasma in tokamaks. The transport considered occurs along the lines of the magnetic field that confine the plasma. This confinement can be enhanced with the introduction of devices that disturb the magnetic configuration of the tokamak. We consider separately an introduction of poloidal divertors and chaotic limiters. In these cases, the magnetic field lines exhibit anomalous transport, caused essentially by the nonlinear dynamics of the model. To describe the field lines perturbed by the poloidal divertor, we use the map introduced by Boozer. To describe the lines perturbed by ergodic limiters, we use the map introduced by Ullmann.

Preliminary results from statistical analysis, provided by a theoretical and numerical study of the transport in the Ullmann map, show that the escape of particles can be redirected while increasing the electric current of the limiter. Regarding the Boozer map, we introduced a diagnosis that defines certain values of parameter and coordinates in which the escape is enhanced, or lowered. From these results, we can comprehend the investigated transport and relate it to control parameters of the confined plasma.

Keywords: Diffusion, Chaos, Magnetic confinement, Tokamak

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