Mappings of stochastic field lines in poloidal divertor tokamaks

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Abstract

Symplectic mapping methods are applied to study magnetic field lines near the separatrix of divertor tokamaks in the presence of nonaxisymmetric magnetic perturbations. The first mapping method is based on the Hamiltonian formulation of field lines equations in Clebsch coordinates. It has been previously applied to study field line's structure in the TEXTOR-DED [1]. The mapping uses the safety factor q and the Fourier spectra of magnetic perturbations as functions of toroidal flux. The latter are found by numerical integration of field line equations. This mapping method is ideal for obtaining of Poincaré plots at poloidal sections of torus. The second approach is the method of a canonical mapping of poloidal flux and toroidal angle to the plane perpendicularly crossing the poloidal section along the X-line. The method of construction of these canonical mappings near the separatrix of Hamiltonian systems has been developed recently in Ref. [2]. The construction of these two kind of mappings in the case of poloidal divertor tokamaks perturbed by external magnetic perturbations is described. As an example a three-wire model of plasma in the presence of external non-axisymmetric magnetic field created by a coil system is considered. For this model we have constructed mappings for magnetic field lines and applied them to study the properties of open stochastic field lines near the separatrix by plotting Poincaré sections, laminar and magnetic footprint plots (a contour plots of wall to wall connections lengths) in the plasma region and on the divertor plates.

1. S.S. Abdullaev, K.H. Finken, K.H. Spatschek, *Phys. Plasmas* **6**, 153 (1999); S.S. Abdullaev J. Phys. A, **32**, 2745 (1999); **35**, 2811 (2002).

2. S.S. Abdullaev, *Phys. Rev.* E, **70**, 064202 (2004).