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Magnetic Mapping Techniques for Poloidally Diverted Tokamaks[1]

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Resonant magnetic perturbations have recently been used to control type-I ELM instabilities by controlling the edge pressure gradient of the DIII-D tokamak. To characterize the 3D structure of the perturbed magnetic field, we have developed an efficient symplectic mapping technique based on the Hamilton Jacobi method. We first numerically determine the resonant Hamiltonian of the magnetic field lines inside DIII-D. Then the Hamilton Jacobi method is used to construct a symplectic map describing the spatial structure of the magnetic field near the separatrix. We use this map to numerically compute a number of quantitative features of the tokamak. We determine the Lyapunov exponents, describing the divergence of the field lines inside the tokamak. We also study the fractal nature of the magnetic field near the divertor plates. The results are compared with other methods of numerical approximation as well as analytic techniques.

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