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P5.1038 Simulation of nonresonant stellarator divertor

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The nested magnetic surfaces that confine a fusion plasma can be designed to be bounded by a limiter or a divertor. For a limiter, confining surfaces extend until they intercept a part of the surrounding structure. For a divertor, an outermost confining magnetic surface exists which is well separated from the surrounding structures. The only designs that are thought to be fusion relevant have divertors that direct field lines from the plasma edge into chambers where the particle exhaust can be pumped and the residual heat exhaust can be handled. The topological properties of magnetic field lines just outside the outermost confining surface determine much of the physics of divertors. Axisymmetric tokamak divertors are well-known, and the outermost confining surface is defined by a sharp separatrix. The topology of the magnetic field lines associated with a stellarator divertor is far more subtle. Related subtleties arise in tokamak divertors when subjected to sufficiently strong non-axisymmetric perturbations. An efficient simulation method for carrying out topological studies of nonaxisymmetric divertors was recently developed [A. H. Boozer and A. Punjabi, Phys. Plasmas 25, 092505 (2018)]. This method uses the ideas of Hamiltonian mechanics, including symplectic invariant, cantori, and turnstiles, to explore the magnetic topology to understand the physics of divertor configurations in both stellarators and tokamaks, and in particular nonresonant stellarator divertors. Results of this study on the width of the footprint, loss rate of magnetic flux, and the decay of confinement will be presented. The study aims to find the scaling laws that govern the loss of magnetic flux; and whether the scaling laws are universal in nature [A. H. Boozer and A. Punjabi, Phys. Plasmas 23, 102513 (2016)].

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