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Order from Chaos: Creating Transport Barriers in Tokamaks IRIS TAVAREZ, JOSHUA MOLONEY, KYLE ALT, ESTHER UDUEHI, HALIMA ALI, ALKESH PUNJABI, Hampton University — In the previous paper, we showed how tearing modes create chaos in tokamaks. In this paper, we show how erecting barriers can control this chaos. We have constructed a new symplectic map to calculate trajectories of magnetic field lines in tokamaks. The map is given by

$$\psi_{n+1} = \psi_n - k\partial\chi(\psi_{n+1}, \theta_n)/\partial\theta_n, \theta_{n+1} = \theta_n + k\partial\chi(\psi_{n+1}, \theta_n)/\partial\psi_{n+1}.$$

Poloidal flux, χ, is the generating function for the map, the toroidal flux,ψ, is the action, and the poloidal angle θ is the angle. We use the standard safety factor profile for the ohmically heated tokamaks. We apply the magnetic perturbations (m,n) = {(3,2),(2,1)}, each with the same amplitude δ. As shown in the first paper, these perturbations lead to the creation of chaos within the tokamak for values of δ above 7.5X10^{-4}. Barriers are created through the addition of a term of order δ^2 to the generating function. This term can transform chaos at the barrier location into a good magnetic surface. We show that this newly created barrier surface is impermeable to surrounding field lines and therefore can prevent chaos on one side of the barrier from crossing to the other side. This invariant torus inside the chaos can help reduce transport in tokamaks. This work is supported by the US DOE DE-FG02-02ER54673 and NASA SHARP PLUS.

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