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The Topology of Chaotic Transport and Escape[1] JAISON NOVICK, College of William and Mary, KEVIN MITCHELL, University of California, Merced, JOHN DELOS, College of William and Mary — Chaotic transport and escape appears in many different systems such as the escape of an asteroid from a planet's gravitational field to the escape of ionizing electrons from hydrogen in parallel electric and magnetic fields. Numerical simulations have shown that the times to escape some region without return possess a complicated fractal structure. These fractals result from the intersection of a line of initial conditions and a homoclinic tangle, which is formed from the intersections of infinitely long stable and unstable manifolds emanating from an unstable fixed point. Our group has developed Homotopic Lobe Dynamics, a topological theory that allows one to predict subsets of the fractals seen in numerical simulations. We first show how to apply homotopy to a homoclinic tangle to obtain a set of symbols and a dynamical mapping on the symbols. A symbol and its mappings encode the evolution of an entire family of trajectories. Given a symbol and its mappings, we show how to construct a theoretical fractal. Finally, we compare a predicted fractal to one obtained from a numerical simulation of trajectories propagating in an open chaotic vase-shaped billiard.

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