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Chaotic Escape of Particles from a Vase-Shaped Billiard[1] JAISON NOVICK, College of William and Mary, JOHN DELOS, Collge of William and Mary, KEVIN MITCHELL, University of California, Merced — We study the escape of particles from a two dimensional, open billiard with the shape of a vase. At the narrowest point of the vase's neck lies an unstable periodic orbit that defines a dividing surface between orbits that escape and those that are turned back into the cavity. We imagine a burst of particles emanating from a point source with all possible launch angles. We show that the particles arrive at the detector in pulses. We record the time for escaping particles to reach the dividing surface. The escape time, as a function of the launch angle, displays a fractal structure that is understood upon transformation to a suitable phase space. Here, we find two infinitely long, invariant curves, called stable and unstable manifolds, emanating from the unstable fixed point. These curves intersect in a complicated way forming a structure known as a homoclinic tangle. The intersection of the initial conditions with the tangle produces the escape time fractal. We present a topological method that, given a finite development of the tangle, allows us to predict a subset of the fractal seen in numerical experiments.

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