Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Topological chaos in a lid-driven cavity flow JIE CHEN, MARK STREMLER, Vanderbilt University — Periodic motion of three or more stirrers in a two-dimensional flow can lead to exponential stretching and folding of the surrounding fluid. For certain stirrer motions, the generation of chaos is guaranteed solely by the topology of the stirrer motion and continuity of the fluid. Appropriate stirrer motions are determined using the Thurston–Nielsen classification theorem, which also predicts a lower bound on the fluid stretching rate. Most of the work in this area has focused on using physical rods as stirrers, but the theory applies equally well when the 'stirrers' are passive fluid particles. We demonstrate the occurrence of topological chaos in Stokes flow in a two-dimensional lid-driven cavity without internal rods for periodic operation of piecewise constant boundary velocities. For appropriate choices of boundary velocity, there exist three periodic points in the flow that produce a chaos-generating stirrer motion. These points are found using a numerical solution of the biharmonic equation for Stokes flow in a rectangular cavity.

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Date submitted: 04 Aug 2005 Electronic form version 1.4