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Transition to complex dynamics in the cubic lid-driven cavity KE WU, JUAN M. LOPEZ, BRUNO D. WELFERT, JASON YALIM, Arizona State Univ — The cubic lid-drive cavity flow is simulated numerically by a Chebyshev collocation method, focusing on the onset of unsteadiness. The onset is directly to intermittent chaos. This has been reported by others in 2014, but they were unable to explain why, in such a simple geometry at quite modest Reynolds numbers ($Re \approx 1930$), the flow should go from being steady directly to intermittent chaos. In this presentation, we show that the reason has three components: instability of the steady flow is subcritical, breaking of the reflection symmetry about the spanwise midplane, and spanwise confinement. These ingredients lead to there being no locally attracting states for Re beyond which the steady state loses stability, and the intermittent bursts are excursions shadowing unstable and stable manifolds of the (unstable) saddle local states. We show that this comes about because the instability of the steady state is close to a subcritical double Hopf bifurcation, and note that very recent theory on such bifurcations shows that they have associated dynamics that captures all the observed complexity in the cubic lid-driven cavity in the neighborhood of its primary instability.

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