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Vortex dynamics in a turbulent shear flow over a cavity at near-zero Mach number SHIYAO BIAN, STEVEN CECCIO, JAMES DRISCOLL, University of Michigan, Ann Arbor — A kilohertz frame-rate Cinematographic Particle Imaging Velocimetry system was used to acquire time series of whole-field velocity data for an incompressible, turbulent shear flow over a rectangular, shallow cavity with $\mathrm{Re}_L = 2.87 \times 10^5$, where L is the cavity length. The cavity shear layer was divided into three regions that exhibited different vortex dynamics: formation, convection/evolution, and impingement. The second region is similar to a free shear layer, with vortex roll-up that is well predicted by linear, inviscid instability theory. The impinging shear layer produces a jet-like flow along the downstream wall, resulting in a large-scale recirculation zone in the cavity. This flow impinges on the shear layer in the formation region, increasing the shear layer growth rate. No self-sustained pressure or flow-field oscillations were observed for a variety of flow speeds. The dynamics of the shear layer in the impingement region was found to be correlated with the dynamic pressure on the downstream wall.

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