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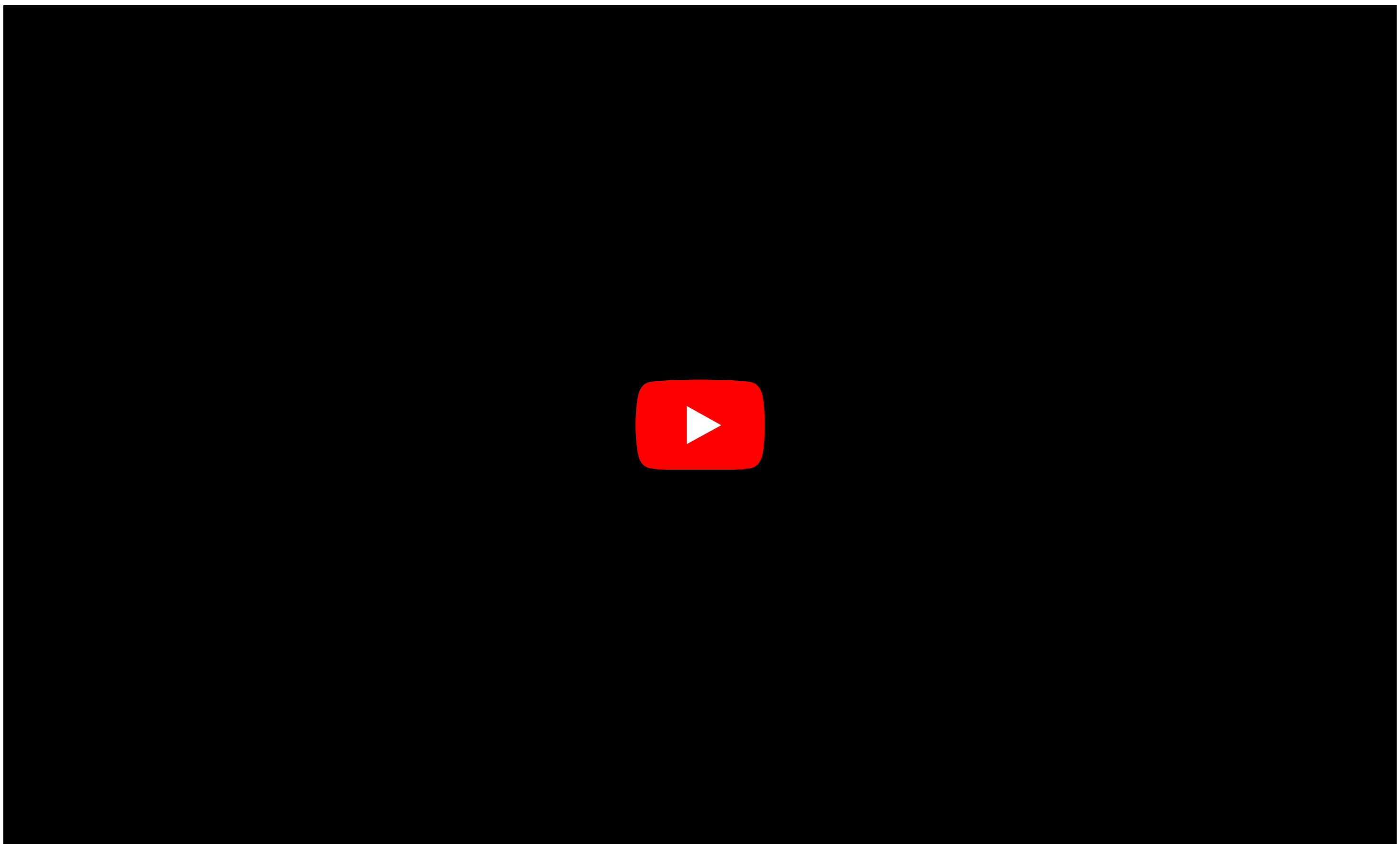
**75TH ANNUAL MEETING OF THE APS DIVISION OF FLUID DYNAMICS (NOVEMBER 20, 2022 — NOVEMBER 22, 2022)**

## V0025: High-Resolution 4D Lagrangian Coherent Structures



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military applications. Furthermore, compressible boundary layers present additional challenges for energy and active scalar transport. Understanding transport phenomena is critical to efficient high-speed vehicle designs. Although at any instantaneous point in time a flow field may seem random, regions within the flow can exhibit coherency across space and time. These coherent structures play a key role in momentum and energy transport within the boundary layer. The two main categories for coherent structure identification are Eulerian and Lagrangian approaches. In this video, we focus on 4D (3D+Time) Lagrangian Coherent Structure (LCS), and the effect of wall curvature/temperature on these structures. We present the finite-time Lyapunov exponent (FTLE) for three wall thermal conditions (cooling, quasi-adiabatic and heating) for a concave wall curvature that builds on the experimental study by Donovan et al. (J. Fluid Mech., 259, 1-24, 1994). The flow is subject to a strong concave curvature ($\delta/R \approx -0.083$, $R$ is the curvature radius) followed by a very strong convex curvature ($\delta/R \approx 0.17$). A GPU-accelerated particle simulation forms the basis for the 3-D FTLE where particles are advected over flow fields obtained via Direct Numerical Simulation (DNS) with high spatial/temporal resolution. We also show the cross-correlation between Q2 events (ejections) and the FTLE.

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