Abstract Submitted
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Topology of a Swirling Jet and Vortex Breakdown REILEY WEEKES, KEIKO NOMURA, University of California, San Diego — Swirling jet flow is studied by analyzing properties of the velocity gradient field. Numerical simulations are performed for a 3D jet comparable to those in the experiments of Billant et al. (1998) at moderate Re. Invariants of the velocity gradient tensor, Q and R, as well as the invariants of the strain-rate and rotation rate tensors are evaluated. For relatively low swirl number, S, the flow begins with an unstrained vortex core $(Q > 0, R \sim 0)$ and high strain at the periphery. A helical disturbance develops with alternating sign changes in R. For flows with high swirl, $S > S_{cr}$, a bubble type vortex breakdown is observed. The initial vortex core is compressed $(Q > 0, R > 0)$ with relatively high strain along the axis. The stagnation point and bubble occur where Q changes sign. The JPDF of Q-R evaluated in the unsteady flow downstream of the bubble exhibits the characteristic teardrop shape previously reported in various turbulent shear flows. Details of the structure and topology of moderate to high swirl jets will be presented.

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