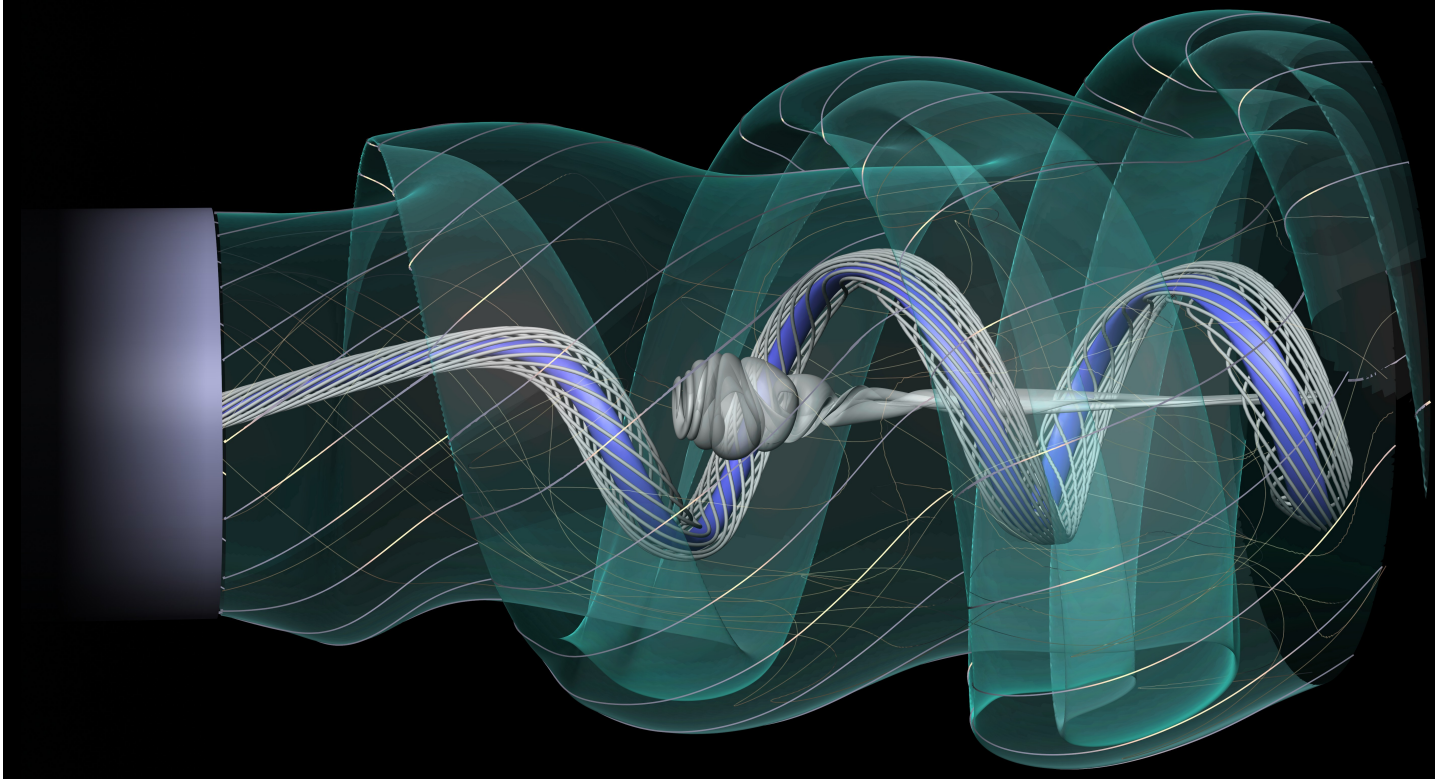

Global Modes in a Swirling Jet Undergoing Vortex Breakdown

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We consider experimental data of a turbulent swirling jet undergoing vortex breakdown. The jet is discharged from a round nozzle into steady ambient fluid. The dynamics of the flow are dominated by large scale oscillations that arise from a super-critical Hopf bifurcation to a global mode. Visualizations are based on the three-dimensional phase-averaged velocity field (Re=20000) that is constructed from uncorrelated 2D PIV snapshots. Thereby the focus is placed on three flow features: the internal recirculation zone that is characteristic for vortex breakdown (semi-transparent gray pathline-surface in the center); the meandering vortex core that acts as the pacemaker for the global oscillations (central streak-lines and bluish streak-surface); helical waves in the outer shear layer that amplify near the nozzle and roll up to spiral vortices (semi-transparent greenish streak-surface).

Flow Visualization (Re=1200)