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Late time vortex dynamics for a coherent structure interacting with fine-scale turbulence ERIC STOUT, FAZLE HUSSAIN, Texas Tech University — The vortex dynamics of perturbations to a coherent vortex column with fine-scale turbulence induced axial flow are examined using direct numerical simulation. Turbulence forms into azimuthally oriented filaments, which naturally results in axial flow as the filaments self-advect. Axial flow (W) modifies vorticity generation in two ways: 1) the radial gradient of W causes radial perturbation vorticity to tilt into the axial direction; and 2) axial perturbation vorticity tilts mean azimuthal vorticity (the vortical equivalent of W) into the radial direction. Given the cycle of radial and axial perturbation vorticity generation, with the concomitant generation of azimuthal vorticity by the column's mean strain, this provides a physical explanation for instability due to axial flow (i.e. instability of the Batchelor or q-vortex, where q is the ratio of peak azimuthal to peak axial velocities). Via this interpretation, the role of non-axisymmetric azimuthal modes in q-vortex instability is explained. Vorticity generation due to axial flow is explored using a simplified perturbation consisting of two, antiparallel helical vortex threads encircling a vortex column, which results in late time vorticity generation and energy production.

Eric Stout
Texas Tech University

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