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Mechanisms of core perturbation growth in vortex-turbulence interaction FAZLE HUSSAIN, DHOORJATY PRADEEP, University of Houston — Vortex-turbulence interaction is studied through DNS. Ensemble-averaged statistics show strong core waves induced by organized structures in the core periphery, originating from the ambient turbulence. Three core breakdown mechanisms are studied: (i) growth through instability resulting from a mean circulation overshoot, (ii) resonant forcing of Kelvin waves by ring-like structures wrapping the column's core, and (iii) growth of optimal transient perturbations. Radial transport of mean angular momentum leads to an overshoot of the circulation profile. The overshoot enhances turbulence production, but is found to rapidly diminish through "turbulent mixing." In problem (ii) we find ring-vortex wave resonance even for relatively weak rings. Resonance leads to strong core dynamics, resulting in sheath-like structures in the core, known to be unstable to a Kelvin-Helmholtz-like instability. However, this process requires sustained organized ring-like structures over several vortex turnover times. Amplification of core perturbations in optimal modes also occurs through resonant forcing. Nonlinear evolution of optimal bending modes captures features of vortex interaction with fully developed turbulence: enhanced core diffusion, core perturbation growth, and circulation overshoot. We also discuss possible self-sustaining turbulence and compare DNS results with modeling predictions.

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