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Regenerative centrifugal instability on a vortex column ERIC STOUT, FAZLE HUSSAIN, University of Houston — The limitation and renewal of centrifugal instability of a vortex column (due to a sheath of negative axial vorticity, -Ω_z, surrounding the +Ω core, i.e. a circulation overshoot) is studied via the transport dynamics of perturbations to the initially unstable vortex using DNS of the incompressible Navier-Stokes equations for a range of vortex Reynolds numbers (Re=circulation/viscosity). Any radial perturbation vorticity, ω'_r, is tilted by the column's mean shear to form filaments with azimuthal vorticity, ω'_θ, generating positive Reynolds stress, $+u'v'$ (u',v' are the radial and azimuthal perturbation velocities), required for energy growth. This ω'_θ in turn tilts -Ω_z to amplify ω'_r (and consequently ω'_θ) – thus causing instability. Limitation of ω'_r growth, thus also energy production, occurs as the perturbation transports angular momentum (rV) radially outward from the overshoot, moving the overshoot outward, hence lessening and shifting -Ω_z, while also transporting core +Ω_z, around the location of the filament. After the overshoot shifts, tilting of -Ω_z reverses ω'_r (hence reducing ω'_θ), causing the filament to generate $-u'v'$, i.e. energy decay, and hence self-limitation of growth. Associated with $- - u'v'$ is the filament's radially inward transport of rV, which can produce a new circulation overshoot and renewed instability. New overshoot formation and renewed generation of $+u'v'$ is examined using a helical ($m = 1$) mode – a promising scenario for regenerative transient growth and possible turbulence generation on a vortex column.

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