

## Spiral Vortex Breakdown as a Global Mode

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Non-axisymmetric vortex breakdown states observed in the numerical simulations of Ruith, Chen, Meiburg and Maxworthy (J. Fluid Mech. 486: 331-378, 2003) are interpreted as the result of local instability of the unstable axisymmetric breakdown serving as spatially varying baseflow. A local stability analysis demonstrates that the azimuthal mode  $m=1$  is absolutely unstable in the wake region of the breakdown bubble. The corresponding frequency at the convective-absolute transition location is in excellent agreement with the naturally selected frequency obtained in the direct numerical simulations. This suggests that the breaking of symmetry of vortex breakdown may be interpreted as a nonlinear steep global mode in the wake of the bubble.

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