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A Generic Mechanism for By-Pass Transition in Vortices

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Vortices are common structures that can be found in a wide variety of flows, ranging from industrial to geophysical ones. There has been in the literature several studies investigating the instabilities of vortices induced by the presence of an external strain field or an axial jet in the vortex. Yet, the only studies concerning an isolated vortex (axisymmetric monopole) all seemed to predict the damping of disturbances injected in such a swirling flow and long-time re-axisymmetrization of the vortex, though rare but violent disruptions cases have been reported. In a recent paper, we have shown the possibility for an azimuthal wavenumber-one (m = 1) spiral-shaped disturbance lying in the periphery of a vortex to be amplified and capable of contaminating the core of the vortex, producing a strong bending wave. In the present work, we will investigate $|m| \neq 1$ optimal perturbations, whose linear growth via the Orr mechanism is associated with the transient production of a multipolar strain field in the core region. The nonlinear evolution and the possible secondary instability leading to transition will also be sketched.

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