Melander, M. V.; **McWilliams, J. C.**; **Zabusky, N. J.**

Axisymmetrization and vorticity-gradient intensification of an isolated two-dimensional vortex through filamentation. (English) Zbl 0633.76023

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We consider the evolution of an isolated elliptical vortex in a weakly dissipative fluid. It is shown computationally that a spatially smooth vortex relaxes inviscidly towards axisymmetry on a circulation timescale as the result of filament generation. Heuristically, we derive a simple geometrical formula relating the rate of change of the aspect ratio of a particular vorticity contour to its orientation relative to the streamlines (where the orientation is defined through second-order moments).

Computational evidence obtained with diagnostic algorithms validates the formula. By considering streamlines in a corotating frame and applying the new formula, we obtain a detailed kinematic understanding of the vortex's decay to its final state through a primary and a secondary breaking. The circulation transported into the filaments although a small fraction of the total, breaks the symmetry and is the chief cause of axisymmetrization.

MSC:

76B47 Vortex flows for incompressible inviscid fluids
76M99 Basic methods in fluid mechanics

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isolated elliptical vortex; weakly dissipative fluid; spatially smooth vortex

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