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The Rotating Polygon Instability of a Swirling Free Surface Flow
TOMAS BOHR, LAUST TOPHØJ, Physics Department and Center for Fluid Dynamics, Technical University of Denmark, JEROME MOUGEL, DAVID FABRE, Institut de Mecanique des Fluides de Toulouse — We present a theory of the rotating polygon instability on a swirling fluid surface [G. H. Vatistas, J. Fluid Mech. **217**, 241 (1990), Jansson et al., Phys. Rev. Lett. **96**, 174502 (2006)]. Our approach is based on potential flow theory, linearised around a potential vortex flow with a free surface. Limiting our attention to the lowest order wave-modes, we obtain an analytically solvable model showing the symmetry breaking instability, and which, together with estimates of the circulation based on angular momentum balance, reproduces the main features of the experimental phase diagram. The generality of our arguments implies that the instability should not be limited to flows with rotating bottom (implying singular behaviour near the corners) and indeed we show that we can obtain the polygons transiently in a much simpler way.

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