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The Stability and Evolution of a Family of $M = 2$ Uniform Vortices P. LUZZATTO-FEGIZ, C.H.K. WILLIAMSON, Cornell University — Motivated by observations of merger of two corotating vortices, Cerretelli & Williamson (2003) discovered a family of vortex patches representing the continuation of the uniform pair into a single 'dumbbell' shape. This branch of solutions passes through a bifurcation from the Kirchhoff ellipses (found by Kamm 1987) and ends into a cat's eye shape. We compute the linear stability of the two-vortex configuration, with findings in agreement with Kamm (1987) and Dritschel (1995). Evolutions computed using contour surgery show that, while a pair of marginally unstable vortices remains roughly antisymmetric through the simulation (see Dritschel 1995), two strongly unstable vortices, after merging into a 'dumbbell' shape, spontaneously exhibit symmetry breaking, leading to two structures of unequal size. Interestingly, we find that all the singly connected shapes are unstable to perturbations with wavenumber $m = 3$; indeed, simulations of 'dumbbells' show a striking similarity with the case of the strongly unstable pair, again yielding symmetry breaking. Intrigued by the possibility of discovering bifurcated solution branches, we studied two cases where a change of stability coincides with an energy extremum, only to find that, as each zero eigenvalue is approached, the associated eigenmode reverts to a rotation of the vortex. As the shapes are invariant under rotation, both bifurcations are trivial, and thus do not yield new solution branches.

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