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Breakdown of chiral symmetry during saturation of the Tayler instability

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We study spontaneous breakdown of chiral symmetry during the nonlinear evolution of the Tayler instability. We start with an initial steady state of zero helicity. Within linearized perturbation calculations, helical perturbations of this initial state have the same growth rate for either sign of helicity. Direct numerical simulations (DNS) of the fully nonlinear equations, however, show that an infinitesimal excess of one sign of helicity in the initial perturbation gives rise to a saturated helical state. We further show that this symmetry breaking can be described by weakly nonlinear finite--amplitude equations with undetermined coefficients which can be deduced solely from symmetry consideration. By fitting solutions of the amplitude equations to data from DNS we further determine the coefficients of the amplitude equations.

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