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Fully nonlinear simulations of ferrofluid patterns in a radial magnetic field[1] RAFAEL OLIVEIRA, Pontificia Universidade Catolica do Rio de Janeiro, JOSE MIRANDA, Universidade Federal de Pernambuco — We present numerical simulations for computing the interface separating a ferrofluid droplet, surrounded by a nonmagnetic fluid, confined in a Hele-Shaw cell, and subjected to an in-plane, external radial magnetic field. The radial field destabilizes the interface, while surface tension tends to stabilize it. We investigate the fully nonlinear behavior of the interface dynamics by employing an accurate boundary integral method. In this setting, we examine how the viscosity contrast, a dimensionless surface tension parameter, and the magnetic susceptibility impact the shape of the complex interfacial patterns. A gallery of visually striking morphologies, presenting radially stretched, starlike shapes, typically having spiky fingers, is observed. These patterns are very different from ferrofluid structures usually obtained for other magnetic field configurations. Simulation results are also compared to linear and weakly nonlinear stages of the dynamics. Reproduction of growth rates and early tip-sharpening structures substantiate the validity of our numerical approach. This work has been submitted to Physical Review Fluids.

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