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An Accurate Mode Selection Mechanism for Magnetic Fluids
DAVID JACKSON, Dickinson College, JOSÈ MIRANDA, Universidade Federal de Pernambuco — When a ferrofluid is trapped in a Hele-Shaw cell and subjected to a perpendicular magnetic field a fingering instability results in the droplet evolving into a complex branched structure. This fingering instability depends on the magnetic field ramp rate but it also depends critically on the initial state of the droplet. Small perturbations in the initial droplet can have a large influence on the resulting final pattern. By simultaneously applying a stabilizing azimuthal magnetic field, we gain more control over the mode selection mechanism. In fact, a linear stability analysis predicts that any mode can be selected by appropriately adjusting the strengths of the applied fields. We present the results of numerical simulations that demonstrate that this mode-selection mechanism is quite robust and "overpowers" any initial perturbations on the droplet. This provides a predicable way to obtain patterns with any number of fingers whatsoever.

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