Suggested Projects for D-12-3

1. Instabilities of Fronts

   In 1 dimension: transition from stationary to traveling front (Ising-Bloch)
   In 2 dimensions: Pinching instability, spot replication, transverse instability
   literature: [1]

2. Parity-Breaking Instability

   Derivation of phase-amplitude equations
   Stability of drift waves
   Localized drift waves
   Experimental systems: directional solidificagion, viscous fingering, Taylor vortex flow (video)
   literature: [2, 3, 4, 5]

3. Parametrically Forced Waves

   Temporal forcing:
   Derivation of coupled amplitude equations, phase diagram
   Takens-Bogdanov bifurcation and parity-breaking instability
   Reduction to real Ginzburg-Landau equation
   Connection with Faraday experiments
   Spatial forcing:
   hexagonal structures
   literature: [6, 7, 8, 9, 10]

4. Instability of Developing Flows

   Convective vs. absolute and global mode.
   literature: [11, 12]

5. Instabilities in Wide-Area Lasers

   Derivation of Ginzburg-Landau equation from Maxwell-Bloch equations
   Distinction between different classes of lasers
   Stability of lasers, coupling to a long-wave mode
   literature: [13, 14]

6. Coupled Map Lattices

   motivation for maps, effect of spatial coupling of chaotic maps, spatio-temporal intermittency
   literature: [15, 16]

7. Sand Pile Models

   simple discrete models for avalanches on sand piles
   scaling of avalanches
   literature: tba

8. Perturbed Solitons

   soliton perturbation theory to obtain solitary waves in complex Ginzburg-Landau equation.
   literature: [17, 18, 19, 20, 21]

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