Joint Condensed Matter

and

Center for Soft Matter and Biological Physics

Seminar

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A study of the complex Ginzburg-Landau equation: analytical and numerical results

Monday, March 12, 2018

4:00pm – 5:00pm

304 Robeson Hall

The complex Ginzburg-Landau equation (CGLe) is a stochastic partial differential equation that describes a remarkably wide range of physical systems: coupled non-linear oscillators subject to external noise near a Hopf bifurcation instability; spontaneous structure formation in non-equilibrium systems, e.g., in cyclically competing populations; and driven-dissipative Bose-Einstein condensation, realized in open systems on the interface of quantum optics and many-body physics. We employ the perturbative field-theoretic renormalization group method to analytically investigate the universal critical behavior near the continuous non-equilibrium phase transition in the complex Ginzburg–Landau equation with additive white noise. We show that to first order in the dimensional expansion about the upper critical dimension, the initial-slip exponent in the complex Ginzburg–Landau equation is identical to its equilibrium model A counterpart. In our second project, we have employed a finite-difference method to numerically solve the noisy complex Ginzburg-Landau equation on a two-dimensional domain with the goal to investigate the coarsening dynamics following a quench from a strongly fluctuating defect turbulence regime to a long-range ordered phase. We study the spatio-temporal behavior characterized by the spontaneous creation and annihilation of topological defects (spiral waves). We check our simulation results against the known dynamical phase diagram in this non-equilibrium system, tentatively analyze the coarsening kinetics following sudden quenches between different phases, and have begun to characterize the ensuing aging scaling behavior. Moreover, we are currently extracting the activation energy barrier for the nucleation process of the stable spiral wave structures.