
THE STABILITY OF CUBIC COMPLEX GINZBURG-LANDAU EQUATION DRIVEN WITH DRIFT AND DEFECTS

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ABSTRACT

This study investigates the complex dynamics of dissipative solitons within the cubic complex Ginzburg-Landau equation (CCGLE) under the influence of drift and defect mechanisms. Utilizing a modified variational formulation paired with pulsating soliton trial functions, we analyze the behavior and stability of the resulting Euler-Lagrange equations. Standard stability analyses via the Routh-Hurwitz criterion and Hopf bifurcation theory reveal that the system's eigenvalues fail to satisfy stability conditions, rendering the localized solutions inherently unstable. Interestingly, treating these Euler-Lagrange equations as fixed points uncovers a distinct class of non-stationary phenomena which is exploding solitons. We demonstrate that eigenvalues possessing positive real parts directly drive the explosive phases of these solutions. Our results indicate that systems with infinite degrees of freedom allow external drift and defect mechanisms to self-organize, forcing the system to oscillate periodically into explosive regimes before experiencing complete decay. Ultimately, these insights underscore the profound complexity introduced by drift and defects in the CCGLE. The observed "explosions" are characterized by high-amplitude, intermittent excursions in phase space, followed by a rapid collapse and subsequent reorganization toward localized attractors. These dynamics represent a robust self-organization mechanism inherent to driven-dissipative nonlinear media.

Keywords Dissipative solitons · Complex Ginzburg-Landau equation · Dynamical systems · Hopf bifurcation · Exploding solitons

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