Formation of Bursting Events in a Lattice Dynamical System

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Abstract

This research is motivated by the work of Knobloch and Moehlis on a mechanism of symmetry breaking amplitude bursts observed in heat convection transport of binary fluid mixture. Sullivan and Ahlers had reported that for a ^{3}He/^{4}He mixture in a rectangular container, regardless of the heat input, convective heat transport occurs along with a sequence of irregular bursts. Knobloch and Landsberg successfully developed a system of two complex ordinary differential equations that approximates the dynamics of ^{3}He/^{4}He mixture discovered by Sullivan and Ahlers based on Hopf bifurcation with weakly broken $D_4 \times \mathrm{SO}(2)$ symmetry:

$$\dot{z}_\pm = [\lambda \pm \Delta\lambda + i(\omega \pm \Delta\omega)]z_\pm + A(|z_+|^2 + |z_-|^2)z_\pm + B|z_\pm|^2 z_\pm + C\overline{z}_\pm z_\mp^2$$

In this model, it was observed that large scale amplitude spikes arose for suitable choices of parameters and initial conditions. A principal goal of this research is to establish the potential of this model to feature such bursts, as well as to examine the manifestation of such bursts in the realm of a lattice of diffusively coupled elements, each with the dynamics of the above ODEs.

Index terms— Rogue Waves, Nonlinear Dynamics, Hopf Bifurcation

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