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SPIRAL DEFECT CHAOTIC STATE IN CONVECTION

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The patterns and dynamics that are observed in natural convection have been explored using non-equilibrium system in the laboratory, the *Rayleigh-Bénard Convection*, in which a fluid is driven out of equilibrium by a destabilizing temperature gradient. Large scale flows in convection are known to play an important role in the dynamics of the Spiral Defect Chaos (SDC) state and in the existence of the skew-mechanism in *Rayleigh-Bénard Convection.* Spiral Defect Convection happens in large domains, so computations involving the full three dimensional Partial Differential Equations (PDEs) for convection are very time consuming. We therefore explored the phenomena of SDC and the skew-mechanism in Generalized Swift-Hohenberg (GSH) models that include the effects of large scale flow. Our analysis is aimed at linking the two phenomena.

We solved the PDEs of one GSH model in spatially-extended domains for a very long time and the numerical scheme was developed in C and MATLAB using spectral methods and Runge-Kutta based method. We were able to investigate the influence of domain size and other parameters much more systematically, and to develop a criterion for when the spiral defect chaos state could be expected to persist in the long time limit. Interestingly, we established a relationship between these parameters that preserves the same pattern. Therefore, the influence of the large scale flow can be adjusted via any parameter in the model.

Any outstanding issue in the understanding of SDC is that it exists at parameter values where simple straight roll convection is also stable, and the region of co-existence increases as the domain size increases. The results of our numerical simulations are coupled with the analysis of the skew-mechanism of the straight- roll pattern in the GSH equation, allowing us to identify the role that skew-events in local patches of stripes play in maintaining SDC.

The instability of the skew-mechanism squeezes and bends convection rolls and increase the wave number that falls into the skew-unstable region. Due to the instability this higher wave number is unstable and tries to reduce by breaking the pattern in to defects. These defects contribute to the formation of spirals. The persistent dynamic is chaotic due to the variation of this large scale flow and hence the system shows the SDC state. We anticipate that our results will support the investigation of several properties of dynamics of SDC. In addition, the local wave number combined with the skew-mechanism gives an accurate description of why SDC occurs in convection.