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Study of Rayleigh-Bénard-Brinkman Convection Using LTNE Model and Coupled, Real Ginzburg-Landau Equations

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Abstract : A local nonlinear stability analysis using a eight-mode expansion is performed in arriving at the coupled amplitude equations for Rayleigh-Bénard-Brinkman convection (RBBC) in the presence of LTNE effects. Streamlines and isotherms are obtained in the two-dimensional unsteady finite-amplitude convection regime. The parameters’ influence on heat transport is found to be more pronounced at small time than at long times. Results of the Rayleigh-Bénard convection is obtained as a particular case of the present study. Additional modes are shown not to significantly influence the heat transport thus leading us to infer that five minimal modes are sufficient to make a study of RBBC. The present problem that uses rolls as a pattern of manifestation of instability is a needed first step in the direction of making a very general non-local study of two-dimensional unsteady convection. The results may be useful in determining the preferred range of parameters’ values while making rheometric measurements in fluids to ascertain fluid properties such as viscosity. The results of LTE are obtained as a limiting case of the results of LTNE obtained in the paper.

Keywords : coupled Ginzburg–Landau model, local thermal non-equilibrium (LTNE), local thermal equilibrium (LTE), Rayleigh–Bénard-Brinkman convection
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