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Transition of the flow dynamics in two-dimensional Rayleigh-Bnard convection[1] ZHENYUAN GAO, Department of Mechanics and Aerospace Engineering, Southern University of Science and Technology, YUN BAO, Department of Mechanics, Sun Yet-sen University, SHIDI HUANG, Department of Mechanics and Aerospace Engineering, Southern University of Science and Technology
— We investigate the flow dynamics in two-dimensional Rayleigh-Bnard convection through high resolution direct numerical simulation, with the Rayleigh number Ra range being 10^{7}~10^{12} and the Prandtl number Pr fixed at 4.3. It is found that there exists a transitional Rayleigh number $\mathrm{Ra_c}$ at which the flow pattern changes significantly and the large-scale circulation (LSC) evolves from an elliptical shape into a circular one. Detailed Fourier mode analysis reveals that, while the single-roll mode becomes weaker and other modes become stronger during the transition, all the flow modes experience violent fluctuations. This is also manifested by the sharp change of the local turbulent fluctuations near $\mathrm{Ra_c}$, in both magnitude and Ra-dependent scaling. We understand this transition by stability analysis.

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