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Effects of Prandtl number in quasi-two-dimensional turbulent Rayleigh-Bnard convection[1] XIAO-MING LI, JI-DONG HE, PENG HAO, SHI-DI HUANG, Department of Mechanics and Aerospace Engineering, South University of Science and Technology, Shenzhen, Guangdong 518055, China — We report an experimental study of the Prandtl (Pr) number effects on flow pattern and local temperature fluctuation in quasi-two-dimensional turbulent Rayleigh-Bnard convection. The experiments were conducted in four rectangular cells with same aspect ratio but different heights, the Rayleigh number Ra range (1e9 – 2e10) remains unchanged while Pr is varied from 11.6 to 157.4. The flow patterns visualized by the shadowgraph show that thermal plumes become more slender as Pr increases, and their organized-motion is more concentrated towards the sidewall. The mean flow strength, characterized by the Reynolds number Re, becomes weaker with the increase of Pr, i.e. $Ra^{0.57}Pr^{-0.81}$. It is further found that the temperature fluctuations in the center ($\sigma_c/\Delta T$) and near sidewall ($\sigma_s/\Delta T$) behave different, i.e. $Pr^{-0.19}Ra^{-0.28}$ and $Pr^{0.10}Ra^{-0.20}$, respectively. This result quantitatively demonstrates that, as Pr increases, thermal plumes prefer to move along the sidewall rather than traveling through the center of the cell.

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