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Temperature fluctuation in Rayleigh-Bénard convection: Logarithmic vs power-law

YU-HAO HE, KE-QING XIA, The Chinese University of Hong Kong — We present an experimental measurement of the rms temperature ($\sigma_T$) profile in two regions inside a large aspect ratio ($\Gamma = 4.2$) rectangular Rayleigh-Bénard convection cell. The Rayleigh number ($Ra$) is from $3.2 \times 10^7$ to $1.9 \times 10^8$ at fixed Prandtl number ($Pr = 4.34$). It is found that, in one region, where the boundary layer is sheared by a large-scale wind, $\sigma_T$ versus the distance ($z$) above the bottom plate, obeys power law over one decade, whereas in another region, where plumes concentrate and move upward (plume-ejection region), the profile of $\sigma_T$ has a logarithmic dependence on $z$. When normalized by a typical temperature scale $\theta_a$, the profiles of $\sigma_T$ at different Rayleigh numbers collapse onto a single curve, indicating a university of $\sigma_T$ profile with respect to $Ra$. 1. This work is supported by the Hong Kong Research Grant Council under grant number N_CUHK437/15.

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