A new scaling law for temperature variance profile in the mixing zone of turbulent Rayleigh-Bénard convection\textsuperscript{1} YIN WANG, WEI XU, Department of Physics, Hong Kong University of Science and Technology, XIAO-ZHOU HE, Shenzhen Graduate School, Harbin Institute of Technology, HIU-FAI YIK, Department of Physics, Hong Kong University of Science and Technology, XIAO-PING WANG, Department of Mathematics, Hong Kong University of Science and Technology, JORG SCHUMACHER, Institut für Thermo- und Fluidodynamik, Technische Universität Ilmenau, PENDER TONG, Department of Physics, Hong Kong University of Science and Technology — We report a combined experimental and numerical study of the scaling properties of the temperature variance profile \(\eta(z)\) along the central \(z\) axis of turbulent Rayleigh-Bénard convection in a thin disk cell and an upright cylinder of aspect ratio unity. In the mixing zone outside the thermal boundary layer region, the measured \(\eta(z)\) is found to scale with the cell height \(H\) in both cells and obey a power law, \(\eta(z) \sim (z/H)^\varepsilon\), with the obtained values of \(\varepsilon\) being very close to -1. Based on the experimental and numerical findings, we derive a new equation for \(\eta(z)\) in the mixing zone, which has a power-law solution in good agreement with the experimental and numerical results. Our work thus provides a common framework for understanding the effect of boundary layer fluctuations on the scaling properties of the temperature variance profile in turbulent Rayleigh-Bénard convection.

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