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The scaling transition between Nu number and boundary thickness in RB convection HONG-YUE ZOU, SKLTCS, COE, Peking Univ., XI CHEN, Department of Mechanical Engineering, Texas Tech Univ., ZHEN-SU SHE, SKLTCS, COE, Peking Univ. — A quantitative theory is developed for the vertical mean temperature profile (MTP) and mean velocity profile (MVP) in turbulent Rayleigh-Benard convection(RBC), which explains the experimental and numerical observations of logarithmic law in MTP and the coefficient A varying along the Ra. Based on a new mean-field approach via symmetry analysis to wall-bounded turbulent flowsit yields accurate scaling of the sub-layer buffer layer and log-layer over a wide range of Rayleigh numberand gives an explanation of their physical mechanism. In particular, based on the scaling of multi-layer thickness for mean temperature and velocity, we first prove that the coefficient A follows a -0.121 scaling, which agrees well with the experimental data, and the scaling transition of Nu from 1/3 to 0.38 is due to the thickness variation of the multi-layer. The new explanation of mean temperature logarithmic law is that the effect of inverse pressure gradient (LSC) driving the plume to side wall, which yields the similarity between vertical temperature transport and vertical momentum.

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