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Studies of the boundary layer structure in turbulent Rayleigh-Bénard convection[1] JOERG SCHUMACHER, NAN SHI, MOHAMMAD EMRAN, TU Ilmenau, D-98684 Ilmenau, Germany — The structure of the laminar boundary layer in turbulent Rayleigh-Bénard convection is studied by three-dimensional direct numerical simulations. We consider convection in a cylindrical cell at an aspect ratio of one for Rayleigh numbers of 3×10^9 and 3×10^{10} and at a Prandtl number of $Pr = 0.7$. The laminar boundary layers of the velocity and temperature fields are found to deviate from the classical prediction of the Prandtl-Blasius-Pohlhausen theory, even when a dynamical rescaling of the data with an instantaneously defined thickness scale is performed in a plane that is aligned with the instantaneous orientation of the large-scale wind. We show on the basis of the existing numerical data that none of the assumptions that enter this classical solution are satisfied. Three-dimensional structures are present and important, the large-scale wind changes direction and amplitude and the pressure gradients are found to fluctuate significantly. The local boundary layer structure is compared with perturbative expansions of the boundary layer equations of forced and natural convection.

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