Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Prandtl-Blasius temperature and velocity boundary layer profiles in turbulent Rayleigh-Benard convection[1] KE-QING XIA, The Chinese Univesity of Hong Kong, QUAN ZHOU, Shanghai University, RICHARD STEVENS, University of Twente, KAZUYASU SUGIYAMA, University of Tokyo, SIEGFRIED GROSSMANN, Philipps-Universität Marburg, DETLEF LOHSE, University of Twente — The shapes of the velocity and temperature profiles near the horizontal conducting plates' center regions in turbulent Rayleigh-Benard convection are studied numerically and experimentally over the Rayleigh number range spanning from 10^8 to $3\text{x}10^{11}$ and the Prandtl number range 0.7∼5.4. The results show that both the temperature and velocity profiles well agree with the classical Prandtl-Blasius laminar boundary-layer profiles, if they are re-sampled in the respective dynamical reference frames that fluctuate with the instantaneous thermal and velocity boundary-layer thicknesses. The study further shows that the Prandtl-Blasius boundary layer in turbulent thermal convection not only holds in a time-averaged sense, but is also valid in an instantaneous sense most of the time.

[1]Work supported by the Research Grants Council of Hong Kong SAR (Project No. CUHK 403807).

Ke-Qing Xia
The Chinese Univesity of Hong Kong

Date submitted: 04 Aug 2010 Electronic form version 1.4