Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Convective Heat Transfer in Bulk- and Boundary-Dominated Regimes in Turbulent Thermal Convection[1] PING WEI, RUI NI, XIAO-ZHENG ZHAO, KE-QING XIA, The Chinese University of Hong Kong — We report Nusselt number measurements in Rayleigh-Bénard convection systems with modified boundary conditions and over the range of the Rayleigh number (Ra) spanning from 3×10^8 to 8×10^9 and with the Prandtl number $Pr \sim 4.3$. These measurements were made in three convection cells: (1) both the top and bottom plates of the cell have plat smooth surface; (2) the top plate has a flat smooth surface while the bottom plate has a rough surface in the form of regularly-arrayed pyramids; and (3) the top plate is rough as in (2) but the bottom plate is smooth. All these cells have cylindrical shape with aspect ratio one. The experimental results suggest that the $Nu \sim Ra$ relationship can be represented by the combination of two power laws, corresponding to the bulk-dominant regime (exponent = 1/2) and boundary layer dominant one (exponent =1/4) of the Grossmann-Lohse model. The behaviors of the coefficients of the two power laws suggest that the roughness of the plate can enhance the contribution of bulk and push the system to change from the boundary dominant state to bulk dominant state.

[1]Work supported by the Research Grants Council of Hong Kong SAR (Project Nos. CUHK 403806).

Ke-Qing Xia
The Chinese University of Hong Kong

Date submitted: 05 Aug 2010 Electronic form version 1.4