Turbulent convection at high Rayleigh numbers and aspect ratio 4

JOSEPH NIEMELA, KATEPALLI R. SREENIVASAN, Abduc Salam International Center for Theoretical Physics — We report measurements of the Nusselt number, Nu, in turbulent thermal convection in a cylindrical container of aspect ratio 4. The highest Rayleigh number achieved was $Ra = 2 \times 10^{13}$. Except for the last half a decade or so of Ra, experimental conditions obey the Boussinesq approximation accurately. For these conditions, the data show that the $\log Nu$-$\log Ra$ slope saturates at a value close to 1/3, as observed previously by us in experiments of smaller aspect ratios. The increasing slope over the last half a decade of Ra is inconclusive because the corresponding conditions are non-Boussinesq. Finally, we report a modified scaling relation between the plume advection frequency and Ra that collapses data for different aspect ratios. At moderately high Rayleigh numbers the mean wind can no longer be considered coherent over the entire container as indicated by the lack of long-time correlation between opposite wall sensors.

Joseph Niemela
Abdus Salam ICTP