Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Flow mode transitions in turbulent thermal convection[1] HENG-DONG XI, KE-QING XIA, The Chinese University of Hong Kong — We report an experimental study of structures and dynamics of the large-scale mean flow in Rayleigh-Bénard convection cells with aspect ratio (Γ) 1, 1/2 and 1/3. It is found that both a single circulating roll flow structure and two vertically stacked counter-rotating rolls exist in the three aspect ratio cells. The average percentage of time that the large-scale mean flow spends in the single-roll mode (SRM) and the double-roll mode (DRM) are 87.1% and 0.8% for $\Gamma = 1$, 69.5% and 7.9% for $\Gamma = 1/2$, and 26.7% and 34.1% for $\Gamma = 1/3$. Several routes of transitions among the different flow modes are identified. In addition, different structures for the DRM are found and their relative weights are determined. We also show direct evidence that the SRM is more efficient for heat transfer than the DRM. Although the difference is very small, it shows how changes in internal flow state can manifest in the global transport properties of the system. It is also found that the time interval between successive flow mode transitions has an exponential distribution, suggesting a Poisson process for the underlying dynamics. The duration of the flow mode transition is found to be log-normally distributed.

[1]This work was supported by the Research Grants Council of Hong Kong under Grant No. CUHK403705 and CUHK403806.

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Date submitted: 25 Nov 2007 Electronic form version 1.4