Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Turbulent thermal convection in two superposed fluid layers[1] YI-CHAO XIE, KE-QING XIA, Department of Physics, The Chinese University of Hong Kong, Shatin — We present an experimental investigation of turbulent thermal convection in a cylindrical cell with two superposed immiscible fluid layers, namely water layer above fluorinert FC-77 electronic liquid (FC77) layer. The flow dynamics and coupling are studied using a multi-thermal-probe method. It is found that while one large-scale circulation (LSC) still exists in each fluid layer, their dynamics change dramatically compared to the single-layer case. Cessations of the LSC in FC77 of the two-layer system occur much more frequently than they do in single layer case and a cessation is most likely to result in a reversal, which can be understood as a symmetry breaking imposed be the orientation of the LSC in the water layer that remained unchanged most of the time. It is further found that the frequently occurring cessations and reversals are caused by the system switching between its two metastable state, i.e. thermal and viscous coupling modes with the former as the predominant one. It is also observed that the influence of the LSC in one fluid layer on the other is not symmetric, i.e. the strength of the LSC in water becomes weaker when the LSC in FC77 rotates faster azimuthally and that the flow strength in FC77 becomes stronger when the LSC in water rotates faster azimuthally.

[1]This work is supported by the Hong Kong Research Grant Council under a GRF Grant No. CUHK403811.

Keqing Xia
Department of Physics, The Chinese University of Hong Kong, Shatin

Date submitted: 31 Jul 2014 Electronic form version 1.4