Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Roughness as a Route to the Kraichnan Regime in Thermal Convection SRIKANTH TOPPALADODDI, Yale University, SAURO SUCCI, Istituto per le Applicazioni del Calcolo "Mauro Picone" (C.N.R.), JOHN WETTLAUFER, Yale University, University of Oxford, NORDITA — We use highly resolved numerical simulations to study turbulent Rayleigh-Bénard convection in a cell with sinusoidally rough upper and lower walls in two dimensions. By varying the wavelength at a fixed amplitude, we find an optimal wavelength for which the Nusselt-Rayleigh scaling relation is $(Nu - 1 \propto Ra^{0.482})$. This is consistent with (i) the upper bound of Goluskin and Doering (2016) who prove that Nu can grow no faster than $\mathcal{O}(Ra^{1/2})$ as $Ra \to \infty$, and thus (ii) the concept that roughness facilitates the attainment of the so-called ultimate regime of Kraichnan (1962). In the limits of very small and very large wavelengths we recover the planar case results, demonstrating how controlling the wall geometry manipulates the interaction between the boundary layers and the core flow.

Srikanth Toppaladoddi
Yale University

Date submitted: 28 Jul 2016 Electronic form version 1.4