Universality at low Reynolds numbers and the emergence of intermittent behavior in isotropic turbulence

DIEGO DONZIS, Texas A&M University, VICTOR YAKHOT, Boston University, K.R. SREENIVASAN, New York University — Most approaches to understand turbulence have sought universal behavior believed to manifest at high Reynolds numbers ($R_\lambda$). However, recent theory and simulations suggest that universal characteristics, such as the non-trivial anomalous scaling exponents of moments of velocity gradients, emerge even at very low $R_\lambda$ at which no inertial range exists. Furthermore, with decreasing Reynolds numbers, a transition occurs from fully intermittent turbulence to (approximately) Gaussian behavior at an apparently universal critical $R_\lambda$. A potential implication of these observations is that significant information concerning the inertial range (e.g. scaling exponents) is already manifest in the dissipation range at very low $R_\lambda$. Thus, high $R_\lambda$ properties can be studied with well-resolved low-$R_\lambda$ simulations instead of marginally resolved high-Reynolds flows. The focus of this talk is to explore signatures of universality at high-Reynolds numbers in the dissipation range of highly resolved DNS ($k_{max}\eta \sim O(20)$) for $R_\lambda$ up to 90, and decaying simulations close to the critical $R_\lambda$. In addition to statistics of velocity gradients and dissipation we explore evidence of Beltramization as suggested in past theoretical work.