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The origin of turbulence in thermal convection. KATEPALLI SREENIVASAN, New York University, JOERG SCHUMACHER, AMBRSIH PANDEY, Technical University, Ilmenau, Germany, VICTOR YAKHOT, Boston University — If a fluid flow is driven by a weak Gaussian random force, the nonlinearity in the Navier-Stokes equations is negligibly small and the resulting velocity field obeys Gaussian statistics. Nonlinear effects become important as the driving becomes stronger and a transition occurs to turbulence with anomalous scaling of small scales. This process is reasonably well understood for homogeneous and isotropic turbulence. In this paper, we discuss the Reynolds-number dependence of moments of the kinetic energy dissipation rate in the bulk of thermal convection in the Rayleigh-Benard system. The data for different Reynolds numbers are obtained from direct numerical simulations using three-dimensional spectral element method in a convection cell with square cross section and aspect ratio 25. The normalized moments of the kinetic energy dissipation rate show a non-monotonic dependence for small Reynolds numbers before obeying the algebraic scaling for the turbulent state. This feature is explained via the transition akin to "soft-to-hard turbulence" in convection where, depending on the Rayleigh number, turbulence is produced by either the instabilities of the bulk and the wall boundary layers.

Katepalli Sreenivasan
New York University

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