"A Fractional PDE Approach to Turbulent Mixing; Part II: Numerical Simulation"

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A Fractional PDE Approach to Turbulent Mixing; Part I: an Anomalous Transport Theory MOHSEN ZAYERNOURI[1], MEHDI SAMIEE[2], Michigan State Univ — It has been experimentally and theoretically shown that even in the most ideal cases of homogeneous and isotropic turbulence, the statistical distributions are asymmetric and heavy-tailed. Similar observations, in addition to high peaks, have been made in grid turbulence and atmospheric boundary layer. In the aforementioned problems, the skewness, as a measure of asymmetry, is nonzero and negative, also the flatness (kurtosis), as a notion of the tail heaviness in the distribution, significantly exceeds the Gaussian value 3, reflecting a strong non-Gaussianity. In this talk, we demonstrate that the existence of such *anomalous characteristics* e.g., heavy tails, asymmetric distributions, and high peaks can naturally put the phenomenology of Taylor, Richardson, and Kolmogorov in broader framework, where the generalizing fractional Brownian motions and stochastic Lévy jump processes (or Lévy flights), investigated in the context of fractional PDEs in the fluid limit, can physically and mathematically explain, hence, predict the notion of anomalously enhanced (sub-to-super) diffusion and self-similar features in passive scalar turbulence.

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