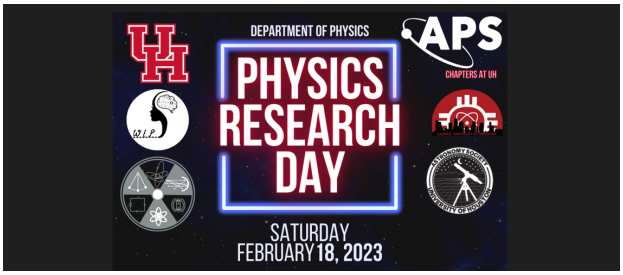

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Fundamental Constitutive Effects of Anomalous Diffusion in Lévy Walk

Saturday 18 February 2023 13:15 (5 minutes)

Diffusive behavior is normally governed by the Central Limit Theorem (CLT), which states that the displacement $x(t)$ in the limit of large time t has a Gaussian distribution with a width that increases as $t^{1/2}$. However, diffusive behavior that differs from the CLT is found in a wide array of experimental systems.
In many cases, the dynamics in these systems can be modeled with non-linearly coupled Lévy Walks that have steps of random duration τ chosen from a probability distribution that decays as $\tau^{-1-\gamma}$ and a velocity in each step of random direction with magnitude proportional to $\tau^{\nu-1}$.
The root causes of anomalous diffusive behavior can be identified by decomposing the behavior into three fundamental constitutive effects, each of which are associated with the violation of an assumption of the CLT. The anomalous diffusive behavior produced by coupled Lévy Walks is a complex combination of the three effects.
We show that for $\gamma \in [0, 1]$ the distribution of $x(t)$ scales with t and the behavior can be straightforwardly decomposed into the three effects, but that for $\gamma \in (1, 2]$ the bulk and the tails of the distribution of $x(t)$ scale differently with t and there is a crossover in the results of the decomposition.

Academic year

3rd year

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