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Aging transient superdiffusive dynamics in in vivo neuronal mRNP transport: a Levy walk description

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Localization of messenger ribonucleoproteins (mRNPs) plays an essential role in the regulation of gene expression required for long-term memory formation and neuronal development. Knowledge concerning the nature of neuronal mRNP transport is thus crucial for understanding how mRNPs are delivered to their target synapses. In this talk, we show experimental and theoretical evidence that the active transport dynamics of neuronal mRNPs, which is distinct from the previously reported motor-driven transport, follows an aging Levy walk. Such nonergodic, transient superdiffusion occurs because of two competing dynamic phases: the motor-involved ballistic run and static localization of mRNPs. Our proposed Levy walk model reproduces the experimentally extracted key dynamic characteristics of mRNPs with quantitative accuracy. Moreover, the aging status of the mRNP particles in an experiment is inferred from the model. The potential physical mechanisms for the observed aging behaviors are shortly discussed.

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