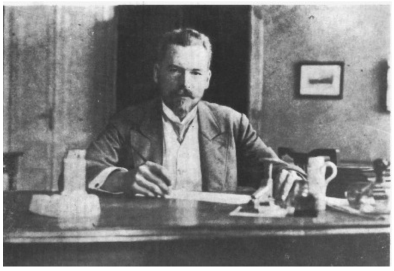

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RNA dynamics in the cytoplasm of mammalian cells

Monday, 19 September 2022 15:55 (25 minutes)

We study the motion of individual messenger RNA (mRNA) in the cytoplasm of HeLa cells using single-molecule tracking. The trajectories are analyzed in terms of the mean squared displacement and the power spectral density. We observe that the motion resembles an antipersistent random walk, which suggests fractional Brownian motion as a useful model. However, the trajectories alternate between different states due to cellular heterogeneities and interactions with specific partners. Interestingly, mRNA dynamics exhibit aging and ergodicity breaking. In order to shed light on the process, we compare the mRNA trajectories to that of semiconductor nanocrystals that were introduced into the cytoplasm. Statistical analyses of these trajectories also reveal subdiffusion with antipersistent increments and substantial heterogeneities. Furthermore, particles randomly switch between different mobility states, which can be dissected using a hidden Markov model. Our data indicate that one of these states is rooted in the transient associations with the cytoskeleton-shaken endoplasmic reticulum network. We find that the nanocrystal motion serves as a good baseline for understanding the dynamics of biological molecules in the cell, but in the latter, specific interactions introduce additional complexities.

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