PHYSICS AND PHYSICAL OCEANOGRAPHY SEMINAR SERIES

Anomalous, caged, obstructed and facilitated diffusion in complex and biological media

Tuesday
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2 p.m. in C-2045

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The diffusion of macromolecules in biological systems and in complex fluids is often found to deviate from simple Fickian diffusion, with a strong dependence on lengthscale. I will discuss our work using a single-molecule sensitivity fluorescence technique called variable-lengthscale fluorescence correlation spectroscopy, which allows studying diffusive processes of biomolecules over five decades in time. It has allowed us characterizing the anomalous diffusion of particles in gels and in crowded polymer solutions. The main focus in my group, however, is to study protein diffusion in biological systems. I will describe our efforts to characterize and quantify the mobility of transcription factors in cell nuclei. These proteins bind to specific target sequences on genomic DNA and control the transcription of nearby genes - and they do so at an astounding speed. Different physical models (e.g. transient one-dimensional diffusion along the DNA, formation of phase-separated condensates) have been proposed to explain how transcription factors are able to reach their targets so quickly. Our work sheds some light on which of these mechanisms are indeed used by the proteins in vivo.

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