

MIT Biophysics Special Seminar

Hitching a Ride at the Nanometer Scale: Transport in Passive and Active Complex Media

Nikta Fakhri

Third Institute of Physics - Biophysics
University of Göttingen

Transport in crowded and complex media is a ubiquitous phenomenon in nature, which poses fundamental questions in statistical and soft matter physics. In particular, transport in the bustling interior of living cells is fascinating and far from understood. On a molecular scale, transport can be diffusive or driven, either externally or by local force generators. In this talk, I will introduce single-walled carbon nanotubes (SWNTs) as highly versatile multi-scale probes to investigate different modes of transport in media of increasing complexity. Using SWNT as the ideal model semiflexible filament, I will discuss the confined dynamics of semiflexible polymers in crowded environments, solving a long-standing controversy in polymer physics. In fixed porous networks, SWNTs reptate, and rotational diffusion is proportional to the filament bending compliance. Counter-intuitively, rotational diffusion is independent of the network pore size. In equilibrium and non-equilibrium biopolymer networks, the dynamics of SWNTs is more complex. I will discuss a new microrheology technique in which I use nanotubes as “stealth probes” to measure viscoelastic properties of the host media.

Finally I will present a quantitative study of the motions of molecular targets tagged with SWNTs in cells and whole organisms over times from milliseconds to hours. In addition to thermal diffusion and directed motor protein transport, I found a new regime of active random “stirring” which may constitute an intermediate mode of transport. The random stirring by the cytoskeleton could strongly enhance non-specific transport in the narrow confines of the cell periphery. I will present a quantitative theoretical model connecting molecular mechanisms to the observed mesoscopic fluctuations.

Host: Mehran Kardar

Date & Time: Thursday, February 27@ 10am

Room: 4-331 (Duboc Room)

Please visit <http://biophysics.mit.edu/seminar> for more information about this seminar series or to join the seminar announcement e-mail list.