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PHYSICS COLLOQUIUM 293

Dissecting Intracellular Transport: A Physicist's Perspective

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ABSTRACT

The continued and dynamic movement of materials within live cells (intracellular transport) is critical to cellular health and function. Importantly, dysfunctions in this process are linked to diseases including neurodegeneration. Intracellular transport cannot be accomplished by passive diffusion alone. Instead, Nature employs nanomachines (molecular motors) to actively shuttle materials along biopolymer-based molecular "roads" in cells. Significant advances in single-molecule biophysics have revealed a great deal about how motors function individually in minimal, cell-free environments. As a result, we are now poised to dissect the physical principles of transport under complex conditions such as those that occur in living cells. With this goal in mind, research in my lab tackles three distinct aspects of intracellular transport that are not being considered in single-motor investigations: (1) the number of motors involved, (2) the condition of the molecular highways that the motors step along, and (3) the physical properties of the lipid membrane that couple the motors to their cargo. Our primary research tools are optical instrumentation (in the form of optical trapping) and Monte Carlo simulations. I will report our recent findings on the isolated roles of the above three key factors. I will also discuss our future work to build up the complexity of our experimental system to mimic the diverse yet tightly controlled trafficking observed in living cells.

BIO:

Professor Xu is an Assistant Professor in the physics department at the University of California, Merced. She obtained her BS with honor at the California Institute of Technology, her Ph.D. at the University of California Santa Barbara with Professors S. James Allen and Kevin W. Plaxco, and was a postdoctoral researcher at the University of California Irvine with Professor Steven P. Gross from 2006-2011. She has been awarded with a NASA Graduate Student Fellowship in 2005, an American Heart Association Postdoctoral Fellowship (2008-2010), and recently a National Institute of Health Research Enhancement Award (2016-2019). Her long-term research goal is to understand how "traffic control" takes place and to contribute to future therapeutic strategies that exploit traffic control in cells to promote human health.