School of Natural Sciences
Special Physics Colloquium

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Moving in a Crowd: Understanding Individual Motor Properties from the Ensemble

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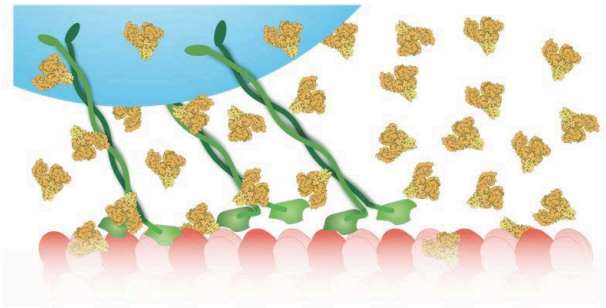
Abstract:

The cytosol is crowded by a high concentration of macromolecules. Crowding can alter protein conformation, binding rates, and reaction kinetics, yet it is not known how crowding affects cargo transport by molecular motors. I will report on experiments in which we mimicked cellular crowding in vitro to study its consequences on cargo transport by kinesin -1 motors.



Surprisingly, we find that crowding significantly slows transport by teams of motors, while having a negligible effect on single motor run-length or velocity. To understand how this multiple-molecule behavior emerges from single motor properties, we applied controlled forces on single motors and motor ensembles using an optical trap. We find that the detachment kinetics of individual motors in response to force depend on the presence of crowding agents. This change in motor response not only explains the differences in the velocity of multiple-motor transport that we observe, but also makes predictions on how cargoes transported by motor ensembles should respond to force, which we confirm using the optical trap.

Finally, since in vivo transport is accomplished by multiple-motors and in crowded conditions, our studies suggest that both aspects are necessary to understand kinesin function in the cell. Indeed, we find that transport by ensembles of motors in living cells is impacted by crowding similarly to what we observe in vitro.

Bio

George Shubeita is assistant Professor of Physics at New York University Abu Dhabi. He graduated with a BSc degree in physics from Birzeit University in 1995 and completed his PhD work in physics from the University of Lausanne in Switzerland in 2002. It was during his postdoctoral work at the University of California Irvine that he started working in the field of biological physics studying molecular motor-based intracellular transport. In 2015 he moved his laboratory to NYU AD from the University of Texas at Austin where he had been since 2007. The general theme of research in his laboratory is in the area of cell physics, where the synergy between physics and biology leads to concurrent advancement of our understanding of biological function and the physical principles governing it.