Soft Living Active and Adaptive Matter

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Mechano-adaptation in a large protein complex

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Abstract:

Macromolecular protein complexes perform essential biological functions across life forms. A fundamental, though yet unsolved question in biology is how the function of such complexes is regulated by intracellular or extracellular signals. For instance, we have little understanding of how forces affect multi-protein machines whose function is often mechanical in nature. We address this question by studying the bacterial flagellar motor, a large complex that powers swimming motility in many bacteria. This rotary motor autonomously adapts to changes in mechanical load by adding or removing force-generating 'stator' units that power rotation. In the bacterium Escherichia coli, up to 11 units drive the motor at high load while all the units are released at low load. We manipulate motor load using electrorotation, a technique in which a rapidly rotating electric field applies an external torque on the motor. This allows us to change motor load at will and measure the resulting stator dynamics at single-unit resolution. We found that the force generated by the stator units controls their unbinding, forming a feedback loop that leads to autoregulation of the assembly. We complemented our experiments with theoretical models that provide insight into the underlying molecular interactions. Torque-dependent remodeling takes place within seconds, making it a highly responsive control mechanism, one that is mediated by the mechano-chemical tuning of protein interactions.

Date:
11/22/2021

Time:
9:00 AM-10:15 AM (PT)

About the speaker:

Dr. Navish Wadhwa is a postdoctoral fellow at Harvard University where he works in the labs of Dr. Howard Berg and Dr. Ethan Garner. He earned a Ph.D. in Physics from the Technical University of Denmark where he was a member of the Center for Ocean Life. Prior to this, he received a B. Tech. in Mechanical Engineering from Indian Institute of Technology Delhi, and an M.S. in Engineering Mechanics from Virginia Tech.

Dr. Wadhwa seeks to understand how mechanical forces influence the behavior of living matter at scales ranging from single molecules to whole cells. He is investigating how bacteria sense mechanical cues from their environment and how these cues are transduced into biochemical signals to modulate behavior. He is supported by a K99/R00 Pathway to Independence Award funded by NIH.

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