Department of Chemistry Seminar

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"DNA Mechanotechnology: nucleic acids that sense and generate molecular forces enable a new class of diagnostics"

Cells are highly dynamic structures that are constantly converting chemical energy into mechanical work to pull and push on one another and on their surroundings. These pulls and pushes are mediated by tiny molecular forces at the scale of piconewtons. For context, 7 pN applied a distance of 1 nm is ~1 kcal/mol. Nonetheless, these forces can have profound biochemical consequences. For example, the rapidly fluctuating forces between immune cells and their targets can drastically tune immune response and function. Despite the importance of such forces, there are limited methods to study forces at the molecular scale and particularly at the junction of living cells. In this talk, I will discuss how studying the biophysical properties of nucleic acids has led to advent of DNA-based force sensors. I will then describe how these molecular probes have been used to study single molecule force dynamics in cells, map mechanical forces at fluid membranes and for the development of new drug delivery strategies that employ forces. I will spend some time discussing force-triggered switches to detect molecular crowding at interfaces and testing different models of mechanotransduction in immunology. I'll end my talk describing the advent of new CRISPR catalytic amplification strategies for medical diagnostics which includes published and unpublished work.

Wednesday, April 30th, 2025

12:30 pm, Chemistry 412

Refreshments 12:15 pm

Stony Brook University