PHYSICS COLLOQUIUM:

Mechanically-driven closure of extreme membrane wounds in a single cell

Dr. Sindy Tang

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Date:
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Time:
10:30 AM – 11:50 AM

Location:
SSB 130

About The Speaker:

Prof. Sindy K.Y. Tang is the Kenneth and Barbara Oshman Faculty Scholar and Associate Professor of Mechanical Engineering, with courtesy appointments in Bioengineering and Radiology (Precision Health and Integrated Diagnostics) at Stanford University. Her research group aims to develop engineering platforms that measure biological systems and convert these measurements into quantitative datasets, enabling both mechanistic insight and data-driven discovery. Current work focuses on experimental systems that probe biological processes across cellular and tissue scales, particularly how physical context—geometry, mechanics, and spatial organization—shapes biological function. By creating new measurement infrastructure for biology, her work aims to advance understanding of immune responses, spatial tissue organization, and cellular self-repair. Website: http://web.stanford.edu/group/tanglab/.

Abstract:

How much damage can a single cell survive, and what does that reveal about the physical limits of life? While most cells fail under even modest membrane disruption, the giant ciliate Stentor coeruleus can recover from catastrophic wounds resulting in the loss of more than half of its cell membrane. Using microfluidic tools to impose controlled wounds, we uncover a geometric limit to survival, set by the minimum membrane required to enclose the cell volume. Strikingly, Stentor does not rely solely on local repair. Instead, it executes large-scale wrapping of intact membrane around the exposed cytoplasm to aid in wound closure, driven by the extension of cortical KM fiber bundles. These findings position single cells as active mechanical systems capable of whole-cell remodeling under extreme stress and establish a new framework for understanding cellular resilience. We conclude by outlining how these microfluidic tools extend to tissue dissection, with emerging applications in organoid generation and spatial biology.

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