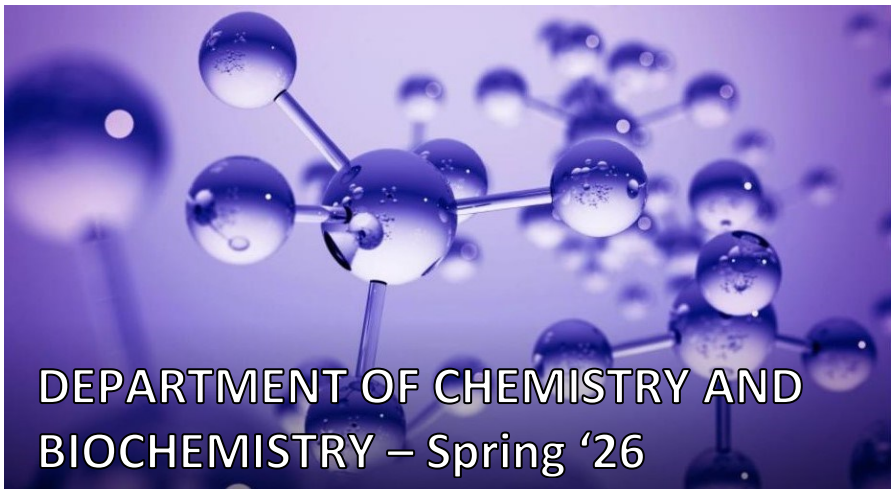

THE SALZBERG CHEMISTRY SEMINAR SERIES

The City College of New York

CREST iDEALS PHASE II

Monday, April 13 2026 @ 12:00 noon – MR1027

From Molecular Complexity to Predictive Mechanics in Lipid Membranes

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Abstract: Cell membranes have evolved to respond effectively to environmental and dietary changes by finely tuning their lipid and sterol composition. This adaptive mechanism enables cells to balance mechanical robustness with fluidity—properties essential for maintaining cellular integrity while enabling transport, signaling, and biochemical activity. Understanding how variations in lipid structure and sterol composition translate into membrane mechanical properties is therefore a central challenge at the interface of chemistry, biology, and materials science. Yet for decades, membrane studies have faced a major dilemma: measurements of membrane elasticity and structure often yield contradictory results, leading to interpretations that rely heavily on chemically specific effects. In this talk, I will highlight how nuclear spin–based experiments combined with computational analysis resolve this challenge. Our integrative approach shows that, unlike macroscopic observations, lipid membranes exhibit a unified elastic behavior in the mesoscopic regime that bridges molecular and macroscopic dimensions. These findings reveal that despite substantial chemical diversity in lipid and sterol architecture, membrane elasticity follows simple structure–property relationships governed primarily by lipid packing. More broadly, this work establishes predictive design principles for lipid-based materials, opening new opportunities to translate nature's rules into biotechnologies and human health solutions.

Biography: Rana Ashkar is the Patricia Caldwell Faculty Fellow and an Associate Professor of Physics at Virginia Tech. Prior to joining Virginia Tech, she held a Clifford G. Shull Fellowship at Oak Ridge National Laboratory, following a joint postdoctoral position at NIST and the University of Maryland. Dr. Ashkar earned her Ph.D. in experimental condensed matter physics from Indiana University, where her doctoral work received the Esther L. Kinsey Dissertation Award. Her research group investigates mesoscopic structure and dynamics in soft and biological materials, including bioinspired lipid membranes and polymeric systems. Her lab aims to uncover dynamic material responses to interfacial and environmental cues on underexplored, yet functionally critical, spatiotemporal scales using advanced experimental and computational approaches. Her research has been recognized by several honors, including selection as a 2021 Soft Matter Emerging Investigator and 2025 Sloan Research Fellow.

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