BiophysTO Lunchtime Seminar Series

Date

Thursday
Nov 3rd 2022
12:00 – 1:00 pm

Location

MP 606

Dr. Hue Sun Chan

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University of Toronto

Physical Principles of Protein Phase Separation in Biomolecular Condensates

Compartmentalization at the cellular and sub-cellular levels is essential for biological functions. Some of these compartmentalized bodies possess material properties similar to those of mesoscopic liquid droplets. Referred to collectively as “biomolecular condensates”, their assembly is underpinned to a significant degree by liquid-liquid phase separation (LLPS) of intrinsically disordered proteins (IDPs), intrinsically disordered regions (IDRs) of proteins, globular protein domains, and nucleic acids—though other physicochemical processes also contribute. To gain physical insights, our group has developed analytical theories—including Flory-Huggins formulations, random phase approximation, Kuhn-length renormalization, and new formulations for field-theoretic simulation—as well as coarse-grained explicit-chain simulation models for sequence-specific LLPS of IDPs/IDRs. This effort has elucidated the effect of sequence charge pattern, π-related interactions, pH, salt, and osmolytes on biomolecular LLPS. Our results point to a “fuzzy” mode of molecular recognition by charge pattern matching, which is relevant to deciphering how different IDP species may demix upon LLPS to achieve functional sub-compartmentalization. A first step has also been taken toward rationalizing the temperature and pressure dependence of LLPS by empirical and atomic models of solvent-mediated hydrophobic interactions. Biological ramifications of our findings will be discussed, including how the pressure sensitivity of an *in vitro* model of postsynaptic densities might offer biophysical insights into pressure-related neurological disorders in terrestrial vertebrates.

Host: Wilson Zeng

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