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Mapping Liquid-liquid protein phase separation using ultra-fast-scanning fluorescence correlation spectroscopy. MING-TZO WEI, SHANA ELBAUM-GARFINKLE, CRAIG B. ARNOLD, RODNEY D. PRIESTLEY, CLIFFORD P. BRANGWYNNE, Princeton University — Intrinsically disordered proteins (IDPs) are an understudied class of proteins that play important roles in a wide variety of biological processes in cells. We've previously shown that the C. elegans IDP LAF-1 phase separates into P granule-like droplets in vitro. However, the physics of the condensed phase remains poorly understood. Here, we use a novel technique, ultra-fast-scanning fluorescence correlation spectroscopy, to study the nano-scale rheological properties of LAF-1 droplets. Ultra-fast-scanning FCS uses a tunable acoustic gradient index of refraction (TAG) lens with an oil immersion objective to control axial movement of the focal point over a length of several micrometers at frequencies of 70kHz. Using ultra-fast-scanning FCS allows for the accurate determination of molecular concentrations and their diffusion coefficient, when the particle is passing through an excitation volume. Our work reveals an asymmetric LAF-1 phase diagram, and demonstrates that LAF-1 droplets are purely viscous phases which are highly tunable by salt concentration.

Ming-Tzo Wei
Princeton University

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