Research Theme: Interdisciplinary Biology (**Biophysics, Biochemistry, Cell biology**)

PhD Research Project Title: **The formation mechanisms and dynamics of biomolecular condensates**

Scholarship category (Please indicate the source of funding for this project):

SBS Research Student Scholarship (for SBS faculty only)

Principal Investigator/Supervisor: **Tianjin Yang**

Co-supervisor/ Collaborator(s) (if any):

Project Description

a) Background:

Biomolecular condensates, which lack a lipid membrane and include nucleoli, P-bodies, and stress granules, are formed through phase separation driven by multivalent macromolecular interactions involving intrinsically disordered proteins/regions (IDPs) and nucleic acids. These condensates create microenvironments that can respond rapidly to environmental changes. They can assemble and dissolve quickly to support diverse cellular functions, and may also transition into solid aggregates and fibrils, potentially contributing to neurodegenerative diseases, cancer, and metabolic disease. However, the dynamics of biomolecular condensates—especially under non-equilibrium conditions—have not yet been comprehensively studied. This project aims to leverage our advanced non-equilibrium detection technologies to systematically investigate the complete life cycle of biomolecular condensates, from rapid initial cluster formation to gradual aging processes, and to connect these states to cellular functions. We aim to determine whether these processes or states follow universal or context-specific mechanisms and to explain them using possible physical models.

b) Proposed work:

The successful candidate will work on deciphering the structure, dynamics, and interactions of IDPs involved in biomolecular condensate formation. This project will leverage top-notch in vitro protein reconstitution and labeling technologies, as well as cutting-edge single-molecule fluorescence spectroscopy methods and microfluidics, to investigate the formation and aging of biomolecular condensates under non-equilibrium conditions, combining in vitro and in vivo approaches. The project will involve close collaborations with researchers in simulation.

c) Preferred skills:

Applicants should have an MSc (or equivalent experience) in biochemistry, biophysics, molecular biology, cell biology, or a closely related discipline, with foundational knowledge of fluorescence. Experience in one or more of the following areas is desired (with willingness to learn others): Single-molecule techniques, structural biology, protein chemistry, polymer physics, microfluidics. Data analysis skills are advantageous, particularly with MATLAB, Mathematica, or similar platforms.

Supervisor contact:

If you have questions regarding this project, please email the Principal Investigator:

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SBS contact and how to apply:

Associate Chair-Biological Sciences (Graduate Studies) : AC-SBS-GS@ntu.edu.sg

Please apply at the following:

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Biological Sciences
College of Science

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Application portal:
https://venus.wis.ntu.edu.sg/GOAL/OnlineApplicationModule/frmOnlineApplication.ASPX

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