ZHOUYI HE

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Leibniz Institute for Polymer Research, 01069 Dresden, Germany

EDUCATION

Leibniz Institute for Polymer Research Dresden (IPFDD) *03/23 - now*
Dr. rer. nat. in Physics (Theoretical Biophysics/ Soft condensed matter) Expected *09/26*

Doctoral Project: Theory and simulation of biomolecular condensates

Supervisor: Prof. Jens-Uwe Sommer and Dr. Tyler Harmon

Hong Kong University of Science and Technology (HKUST) *08/19 - 06/22*
MPhil in Chemistry (Theoretical biophysics)

University of Science and Technology of China (USTC) *08/15 - 06/19*
BSc in Chemistry (Chemical Physics)

PUBLICATIONS

Zhouyi He, *et al.* and Tyler S. Harmon. "Born to Condense: Polysomes Drive Co-Translational Condensation of Biomolecular Condensate Proteins." bioRxiv (2025).

Zhouyi He, Jens-Uwe Sommer, and Tyler S. Harmon. "The Impact of Coiled-Coil Domains on the Phase Behavior of Biomolecular Condensates." ACS Macro Letters (2025).

M. Hasan*, **Zhouyi He***, *et al.* "Dynamic expedition of leading mutations in SARS-CoV-2 spike glycoproteins." Computational and Structural Biotechnology Journal (2024). *: Equal contribution.

Xiaolong Yang, **Zhouyi He**, and Xiao Zheng. "Unit cell consistency of maximally localized Wannier functions." Electronic Structure (2020).

RESEARCH EXPERIENCE

Harvard University, Prof. Eugene Shostakovich Visiting scholar
Probing the role of spacer length in multi-component condensate organization *08/25 - now*

· Employing coarse-grained (CG) molecular dynamics and Monte Carlo (MC) simulations of sticker-spacer proteins to elucidate how spacer length governs internal condensate architecture and heterogeneity. Aims to understand mechanism and establish design principles for spatial patterning in synthetic and biological multicomponent condensates.

IPFDD, Prof. Jens-Uwe Sommer, Dr. Tyler Harmon Doctoral Study
Co-translational condensation (CTC) of polysome and protein *12/23 - 08/25*

· Developed a CG MC and reaction-diffusion modeling framework to understand the co-localization of polysomes and condensates. Found that protein domain architecture controls CTC, polysomes are drivers of condensation and CTC could facilitate post-translational modifications. Our work provides a theoretical framework for understanding condensate interactions with translation machinery.

Connecting protein architecture to their emergent condensate properties *05/23 - 12/24*

· Systematically investigated how coiled-coil domains control the phase behavior and the material properties of condensates via CG MC simulations. Provided a physical basis for how specific domain architectures can tune phase separation ability and internal organization.

HKUST, Prof. Haibin Su MPhil Thesis
Sequence-dependent target search and binding dynamics of CRISPR Cas9 *01/21 - 03/22*

· Modeled Cas9 target search as facilitated diffusion, combining 3D diffusion with 1D sliding to map the binding free energy landscape.
· Integrated bioinformatics and kinetic modeling to link protein mutations to specificity, guiding the design of high-fidelity variants.

Dynamic expedition of leading mutations in SARS-CoV-2 spike glycoproteins *05/21 - 01/22*

· Developed *deLemus*, a novel time-resolved statistical method, to analyze spike protein evolution dynamics. With single amino-acid polymorphisms and decomposition of mutation matrix, identified dominant mutation patterns and emergent variants to inform spike-targeting therapeutic and vaccine design.

Evolution of CRISPR Cas9 systems in Streptococcus genus *06/20 - 05/21*

· Applied statistical coupling analysis to identify co-evolving sectors in 3D protein structures.Revealed an evolutionary trade-off between horizontal gene transfer benefits and antiviral defense levels through analysis of bacterial-viral interaction networks.

USTC, Prof. Xiao Zheng BSc Thesis
Unit cell consistency (UCC) of maximally localized wannier functions (MLWFs) *09/18 - 07/19*

· Investigated UCC of MLWFs, a critical property for accurate electronic structure calculations in solids. Derived analytical and numerical constraints, introducing a symmetry-based criterion to ensure UCC, enhancing the reliability of MLWFs across diverse solid-state systems.

CONFERENCE PRESENTATIONS

19th Dresden Polymer Discussion Biomolecular Condensates and Polymer Phase Transitions (2025).

EMBO Workshop CELLULAR MATTERS: A deeper look into the complex cytoplasm (2025).

"Co-translational (polysome-protein) condensation." German Physical Society (DPG) meeting (2025).

"Connecting protein architecture to their emergent droplet properties." DPG meeting (2024).

"Impact of mutations in CRISPR Cas9 in kinetics and off-targets effects." The 1st International Symposium on Marine Science and Engineering for Young Scientists and Postgraduates (2021)

TECHNICAL SKILLS

Methods: Coarse-Grained Monte Carlo Simulations, Molecule Dynamics, Reaction-Diffusion Models, Bioinformatics, Machine leaning (basics)
Programming: FORTRAN, Python, MATLAB, C, Bash, LaTeX, Git, HPC, LAMMPS, VMD, etc.
Expertise: Polymer Physics, Statistical Mechanics, Phase Separation, Biophysics, Biomolecular Condensates, Reaction Kinetics, etc.

AWARDS & ADDITIONAL ACTIVITIES

Awards: Research Full Scholarship (HKUST), Outstanding Graduate (USTC), National Endeavor Scholarship (USTC), 3rd prize in China High School Chemistry Olympic Competition
Academic Service: PhD Council Representative (IPFDD), Teaching Assistants (Soft condensed matter physics, Physical chemistry, etc.)
Leadership: Church Youth Group Leader, Basketball Team Captain, Rural Teaching Program Leader

HOBBIES

Cycling, Basketball, Photography, Literature, Music, Movie, Hiking, etc.