

PHYSICS COLLOQUIUM

Speaker: **Prof. Arash Nikoubashman**
Leibniz-Institut für Polymerforschung Dresden &
Technische Universität Dresden



Topic: **Plastic life: What polymer physics can teach us about living cells**
Inaugural lecture

Time and place: Tuesday, June 25, 2024, **2:50 pm** – hybrid event
The colloquium will be held in REC/C213.

Online participation possible:

Zoom-Meeting: Meeting-ID: 631 3817 8900 / passcode: PC-SoSe24

<https://tu-dresden.zoom-x.de/j/63138178900?pwd=am9nSzYyeUhh3SWxMdnNBWkpUaXl5UT09>

Host: Dean Prof. Gesche Pospiech

Abstract: The cytoplasm of living cells typically contains high concentrations of macromolecular components, such as semiflexible filaments that enhance mechanical stability and (partially) folded proteins that can spontaneously form biomolecular condensates. These condensates are crucial for signal transduction, stress response, and regulated reactions. The functions of these macromolecular building blocks are closely linked to their conformations, and misfolded proteins are increasingly implicated in neurodegenerative diseases like amyotrophic lateral sclerosis (ALS). Given the conceptual similarities between biological macromolecules and classical polymers, physics-based theories and computer simulations are valuable tools for understanding, predicting, and engineering the properties of both natural and synthetic proteins. In this talk, I will present key insights from our coarse-grained molecular simulations and discuss the complexities and limitations of these models. Our findings reveal that unfolded proteins exhibit weak, heterogeneous interactions distributed along the chain contour. Additionally, proteins at the condensate-water interface are collapsed and tangentially oriented. We have also discovered that the phase behavior and material properties of biomolecular condensates can be accurately predicted from the conformations of single protein chains in solution. These insights advance our understanding of cellular processes at a biomolecular level and have potential implications for developing "digital twins" of living cells and new therapeutic strategies.

Bio: From 2004 to 2010, Arash Nikoubashman studied physics and computer science at the University of Düsseldorf, followed by doctoral studies at the Vienna University of Technology. After earning his PhD in 2012, he was a postdoc at Princeton University. In 2015, he started his own research group at the University of Mainz with an Emmy-Noether Fellowship. Since 2019, he has been a

Guest Associate Professor at Keio University. In 2023, he became a Heisenberg Professor at the Leibniz-Institute for Polymer Research Dresden and Technical University of Dresden, leading the "Theory of Biologically Inspired Polymers" division.