

复旦大学物理系 Colloquium

Time: 14:00, Tuesday, 2026.10.27

Location: C108, Jiangwan Physics Building

Glass Formation as Frustrated Ordering Structural Correlations and Emergent Ising Physics

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Abstract: Why the dynamics of a liquid slows down so dramatically on approaching the glass transition remains a central problem in condensed-matter physics. Our studies have shown that slow dynamics is closely linked to the growth of static structural correlations associated with locally favoured angular or packing order. The corresponding correlation length tracks dynamic heterogeneity and the increase of the structural relaxation time, and exhibits critical-like scaling close to the Ising universality class. I will first review the numerical and experimental evidence for this structural origin of glassy dynamics. I will then present a new framework for understanding why Ising-like behaviour emerges despite the continuous character of the underlying orientational order. The key idea is that geometric or energetic frustration generates a local anisotropic response that reduces the effective orientational symmetry to two symmetry-related branches, producing an emergent Ising-like degree of freedom. Within this picture, the same structural correlation length controls both static organisation and slow dynamics. Its growth leads to an increasing activation barrier and super-Arrhenius relaxation, while frustration ultimately limits the growth of structural coherence. This provides a unified perspective on dynamic heterogeneity, fragility, and the competition between crystallisation and vitrification.



Biography: Hajime Tanaka is Professor Emeritus at the Research Center for Advanced Science and Technology, The University of Tokyo. He is widely recognized for his pioneering contributions to soft matter physics and liquid-state science. His research has advanced understanding of phase transitions, pattern formation, nonlinear rheology, water physics, liquid – liquid transitions, glass transitions, crystallization, gels, and other nonequilibrium phenomena in complex fluids and soft materials. Professor Tanaka combines physical insight with experimental, theoretical, and computational approaches to reveal how microscopic interactions and structural ordering shape macroscopic behavior. He received the Society of Polymer Science Award in 1997 and the Humboldt Research Award in 2006, and was elected Fellow of the Institute of Physics in 2007.