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Einladung zum Vortrag

"The Glass Transition: Can New Data Resolve the Competition Between the Different Interpretations"

C. Patrick Royall

HH Wills Physics Laboratory, School of Chemistry, Centre for Nanoscience and Quantum Information, University of Bristol

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Ort: **Lise-Meitner-Hörsaal**
9. Boltzmanngasse 5, 1. Stock

Abstract:

Our understanding of the mechanism by which the viscosity of supercooled liquids increases by many orders of magnitude is a major challenge in condensed matter physics [1,2]. To resolve this challenge, it is necessary to discriminate between incompatible theoretical approaches which nevertheless provide equally good descriptions of experimental data. The competing theoretical approaches boil down to whether the glass transition is driven by an underlying thermodynamic phase transition, or whether it is predominantly dynamical [1]. To resolve this issue, we need to equilibrate samples of sufficiently high viscosity - and therefore long relaxation times - that experimental or numerical techniques can probe suitable quantities that enable discrimination of the theories.

Here we report new developments with experiments with soft matter, which provide significant insight into the nature of the glass transition. We use super-resolution microscopy techniques to track the coordinates of colloids with a resolution that is an order of magnitude better than the state-of-the-art. The small colloids, whose coordinates we track, sample phase space a thousand times faster than in comparable studies. This means that we access effective timescales three orders magnitude larger than in previous work. With this new technique, we are able to access a new dynamical regime in the supercooled liquid, and our results provide strong evidence in support of a thermodynamic phase transition underlying the dynamical arrest that is the glass transition [3]. We further investigate predictions of a structural-dynamical phase transition in trajectory space, which we verify with experiments [4], and provide a route to reconcile the competing theoretical descriptions of the glass transition [5].

[1] Royall, C. P. & Williams, S. R. "The role of local structure in dynamical arrest", *Phys. Rep.*, 560, 1-75 (2015).

[2] Royall, C. P., Turci, F., Tatsumi, S., Russo, J. & Robinson, J. "The race to the bottom: approaching the ideal glass?", *J. Phys.: Condens. Matter* 30 363001 (2018).

[3] Hallett, J. E., Turci, F and Royall, C. P. "Local structure in deeply supercooled liquids exhibits growing lengthscales and dynamical correlations", *Nature Commun.* 9 3272 (2018).

[4] Pinchaipat, R. Campo, M., Turci, F., Hallett, J., Speck, T. & Royall, C. P. "Experimental Evidence for a Structural-Dynamical Transition in Trajectory Space", *Phys. Rev. Lett.*, 119, 028004 (2017).

[5] Turci, F.; Royall, C. P. & Speck, T. "Non-Equilibrium Phase Transition in an Atomistic Glassformer: the Connection to Thermodynamics", *Phys. Rev. X,* 7 031028 (2017).

Im Rahmen des Vortrages findet eine Lehrprobe zum Thema „Brownian Motion: Theory and Experiment" statt.

Dekanat der Fakultät für Physik
A-1090 Wien, Boltzmanngasse 5
Tel.: +43/1/4277 51001 - Fax: +43/1/4277 9510