CPP 27: Glasses and Glass Transition I (joint session DY/CPP)

Time: Tuesday 14:00–15:00 Location: ZEU 147

CPP 27.1 Tue 14:00 ZEU 147

Dynamical phase transitions in trap models and universality classes of aging — •Diego Tapias[1] and Peter Sollich[1,2] — [1]Institute for Theoretical Physics, University of Göttingen, Germany — [2]Department of Mathematics, King's College London, London, UK

We investigate how aging and driving by trajectory biasing interact in two mean field models of glassy dynamics, widely known as trap models. We show that similarly to kinetically constrained models, the equilibrium state of the unbiased system above the glass transition temperature is located at the coexistence of two dynamical phases (active and inactive). In contrast, below this temperature, we find two different nonequilibrium scenarios: energetic (or activated) aging that is destroyed by any dynamical bias towards low activity, which we call "fragile aging", and entropic aging that is stable against the existence of such a dynamical bias, which we refer to as "robust aging". We conjecture that these categories have broader relevance as universality classes for aging dynamics in glassy systems.

CPP 27.2 Tue 14:15 ZEU 147

Fragile to strong crossover as general glassy feature — •Anshul Deep Singh Parmar and Andreas Heuer — Institute of Physical Chemistry, University of Münster, Corrensstrasse 28/30, 48149 Münster, Germany

As a liquid is cooled below the melting temperature, the dynamics become increasingly sluggish with the degree of supercooling, known as fragility. The fundamental question is whether the liquid ceases to flow at some finite temperature, the material undergoing the glass transition, or dynamics diverge smoothly to zero temperature. This is a central question of pivotal importance for unraveling the nature of glass and theoretical understanding, concealing with astronomical long observation times.

We circumvent this infeasibility by taking advantage of swap Monte Carlo with multi-billion speedups for equilibration well beyond the glass transition. Our investigation of a wide range of system sizes and temperatures across the experimental glass transition unveils the nature of the energy landscape. We observe a notable deviation from the Gaussian nature of the potential-energy landscape. Rapid depletion of states is associated with the glassy bottom of the landscape, unveiling the fragile to strong crossover is the general glassy behavior. Our result ultimately rules out the finite-temperature divergence and establishes the conceptualized Arrhenius description of the dynamics at low temperatures. Our findings are critical in advancing the investigation of glass in an experimental and theoretical framework.

CPP 27.3 Tue 14:30 ZEU 147

A solution to the plasticity of glasses based on topological physics — •Alessio Zaccone — Department of Physics, University of Milan, 20133 Milano, Italy

I will start by reviewing the microscopic theory of linear elasticity in amorphous solids which, from first-principles consideration of non-centrosymmetry in the particle contact environment, leads to mathematical predictions of elastic moduli in quantitative parameter-free agreement with numerical simulations of random jammed packings [1]. This theory fully accounts for the extra non-affine displacements which arise due to the lack of centrosymmetry in disordered solids. I will then show that non-affinity of particle motions gives rise to well-defined topological defects (dislocation-like topological defects, DTDs) which have recently been discovered in the displacement field of glasses [1] and later confirmed in [2]. The norm of the associated Burgers vector of these defects can be used as an accurate predictor of the onset of plastic flow and yielding of glasses, and, in combination with Schmid's law, it can explain the phenomenon of shear banding via self-organization of DTDs in slip systems at 45 degrees with respect to flow direction [4]. Broader implications of a unifying topological field theory of liquids and the glass transition will also be mentioned. [1] A. Zaccone and E. Scossa-Romano, Phys. Rev. B 83, 184205 (2011) [2] Z. W. Wu, Y. Chen, W.-H. Wang, W. Kob, L. Xu, arXiv:2209.02937 (2022)

CPP 27.4 Tue 14:45 ZEU 147

Confinement induced relaxations and phase behavior of a nanoconfined ionic liquid crystal — •Mohamed Aejaz Kolmangadi[1], Andreas Schönhals[1], Li Zhuoqing[2], and Patrick Huber[2] — [1]Bundesantalt für Materialforschung und -prüfung (BAM), Berlin, Germany — [2]Technical Univeristy Hamburg TUHH and DESY

We investigate the molecular dynamics and electrical conductivity of a linear shaped guanidinium based ILC confined in self-ordered nano porous alumina oxide membranes of pore size ranging from 180nm down to 25nm by employing broadband dielectric spectroscopy (BDS) and calorimetry. Calorimetric investigation reveals a complete suppression of the columnar - isotropic transition, while the plastic crystalline - columnar transition temperature decreases with inverse pore size and deviates from the Gibbs - Thomson equation. For the bulk case, BDS detects two relaxation modes in the crystalline phase, the gamma relaxation and the $\alpha 1$ relaxation, and two relaxation modes in the columnar phase, the $\alpha 2$ and $\alpha 3$ relaxation. For the confined case, all relaxation modes slow down compared to the bulk. However, for the least pore size (25 nm), the $\alpha 2$ relaxation is absent. We discuss the possible molecular origins of the different relaxation modes observed. For the bulk ILC, a clear jump of 4 orders of magnitude in the absolute values of DC conductivity occurs at the transition from the plastic crystalline to hexagonal columnar phase, for the confined ILC, this transition is smooth. DC conductivity is reduced for the confined case, except for the 25nm, where the values is similar to the bulk.