Kolloquium
Theoretische Physik

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P603

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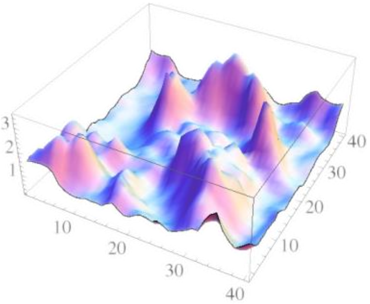
Scaling laws for aging in glasses



Glasses are out-of-equilibrium materials and thus prone to aging effects: produced by a rapid quench in thermodynamic control parameter(s), the dynamics of the system is characterized by a slow structural relaxation dynamics whoe time scale τ continues to evolve and grows with increasing waiting time after the quench. As a result, a glass is a material that encodes its production history, and its properties are not just quantified by the thermodynamic control parameters only.

The age-dependent evolution after a quench is an example of a non-equilibrium transient process whose full description in terms of statistical mechanics remains elusive. I will discuss how under certain assumptions the integration-through-transients (ITT) framework combined with a mode-coupling theory (MCT) closure allows to predict scaling laws for the evolution of the relaxation time τ after a quench. These encompass regimes of "normal aging" (τ grows linear with age), "hyper-aging" (τ grows faster than the system age) and a "sub-aging" crossover (τ increases slower than the age). They describe computer-simulation results quantitatively. Further, the inclusion of non-mean-field-like fluctuations through a recent extension of MCT explains that hyper-aging is cut off at long times.

[1] T. Rizzo and Th. Voigtmann, Qualitative features at the glass crossover, EPL 111, 56008 (2015); Solvable Models of Supercooled Liquids in Three Dimensions, Physical Review Letters 124, 195501 (2020).
[2] L. F. Elizondo-Aguilera et al, Arrested dynamics of the dipolar hard sphere model, Soft Matter 16, 170 (2020).
[3] R. Peredo-Ortiz, M. Medina-Noyola, Th. Voigtmann, and L. F. Elizondo-Aguilera, "Inner clocks" of glass-forming liquids, Journal of Chemical Physics, in press (2022); DOI:10.1063/5.0087649