Strain correlations in colloidal glass formers

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Despite glassy materials are omnipresent to our everyday life and subject of continuing research, the nature of disordered materials and a corresponding glass transition stays unclear. Investigation of strain correlations in supercooled liquids near their glass transition reveals new and interesting phenomena, such as elastic signature. The focus here lies on the (2d) shear strain correlation function $C^S(\mathbf{r},t)$, which shows the $\cos(4\Theta)/r^2$-symmetry, characteristic for elastic response [2], even in liquids at correlation times well above their structural relaxation time τ [1].

In this talk, a mode-coupling theory [3] for the strain correlation functions in supercooled liquids and tests of it are presented, using data from video microscopy of a two-dimensional colloidal glass former [4,5] and from simulations of Brownian hard disks [6]. The theory captures the crossover from viscous to elastic dynamics at an idealized liquid to glass transition, and explains the emergence of rigidity in glass. Additionally, it provides a possible explanation for the occurence of long-time elastic signature of $C^S(\mathbf{r},t)$ in supercooled liquids.

Keywords: glass transition, colloids, Eshelby inclusion, mode-coupling theory

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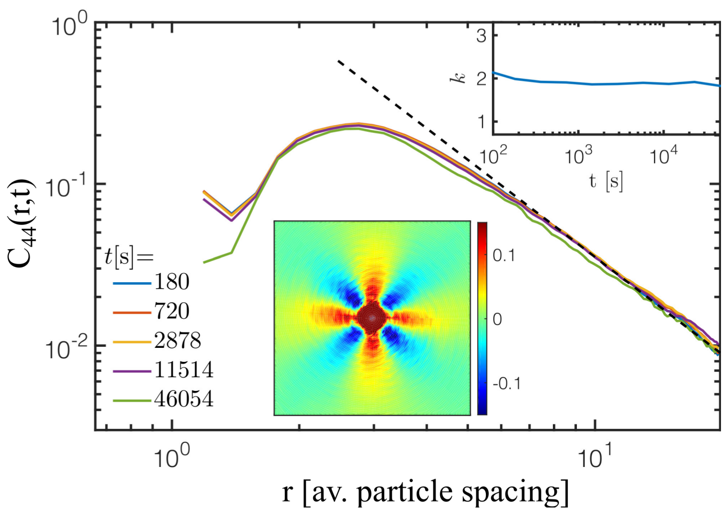

Figure: Experimental glass data. The $\cos(4\Theta)$-projected strain correlation function $C^{44}(r,t)$ (main panel) shows a $1/r^k$-power law decay (dashed black). Fitted exponents (upper inset) prove $k = 2$ as appropriate for elasticity. The contourplot (lower inset) of the long-time limit of $C^S(\mathbf{r},t)$ illustrates the corresponding $\cos(4\Theta)$-symmetry.