Evidence of growing spatial correlations at the glass transition from nonlinear response experiments

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Abstract

The ac nonlinear dielectric response $\chi_3(\omega, T)$ of glycerol was measured close to its glass transition temperature T_g to investigate the prediction that supercooled liquids respond in an increasingly non-linear way as the dynamics slows down (as spin-glasses do). We find that $\chi_3(\omega, T)$ indeed displays several non trivial features. It is peaked as a function of the frequency ω and obeys scaling as a function of $\omega\tau(T)$, with $\tau(T)$ the relaxation time of the liquid. The height of the peak, proportional to the number of dynamically correlated molecules $N_{corr}(T)$, increases as the system becomes glassy, and χ_3 decays as a power-law of ω over several decades beyond the peak. These findings confirm the collective nature of the glassy dynamics and provide the first direct estimate of the T dependence of N_{corr}.

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