Scaling between Structural Relaxation and Particle Caging in a Model Colloidal Gel

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Figure 1: Universal scaling of the structural relaxation time vs the reduced Debye-Waller factor $\langle u^2 \rangle$ of polymers [1], soft binary mixtures (Soft BM) [2] and colloidal gel [3]. $\langle u^2 \rangle$ is the value of the Debye-Waller factor at the glass transition. Dashed line is the same universal curve originally found in [1].

In glassy dynamics, the rattling of particles in a cage formed by their neighbors is typically limited to a length scale of the order of the particle diameter but is nevertheless strongly coupled to the overall structural arrest of the system (solidification). Furthermore, the rattling amplitude and the structural relaxation time $\tau_\alpha$ (or equivalently the viscosity $\eta$ of the system, according to the Maxwell relation $\eta = G_\infty \tau_\alpha$) have been recently shown to follow the same scaling form in various polymer melts and supercooled liquids [1, 2]. More recently we also analyzed within this perspective for the first time the glassy dynamics emerging from the formation of a persistent network in a model colloidal gel at very low density [3]. The structural relaxation time $\tau_\alpha$ of the gel network has been compared with the mean squared displacement evaluated at short times $\langle u^2 \rangle$ (i.e. the Debye-Waller factor), corresponding to the localization length associated to the presence of energetic bonds. Interestingly, we found that the same type of scaling as for the dense glassy systems holds (see Figure 1). Latter findings elucidate the strong coupling between the cooperative rearrangements of the gel network and the single particle localization in the structure, and support the general nature of the scaling proposed.

**References**

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