Glass transitions in 2D suspensions of colloidal ellipsoids

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Highlighted by "*Viewpoint in* ***Physics*" and "***Editor's Suggestion***"**
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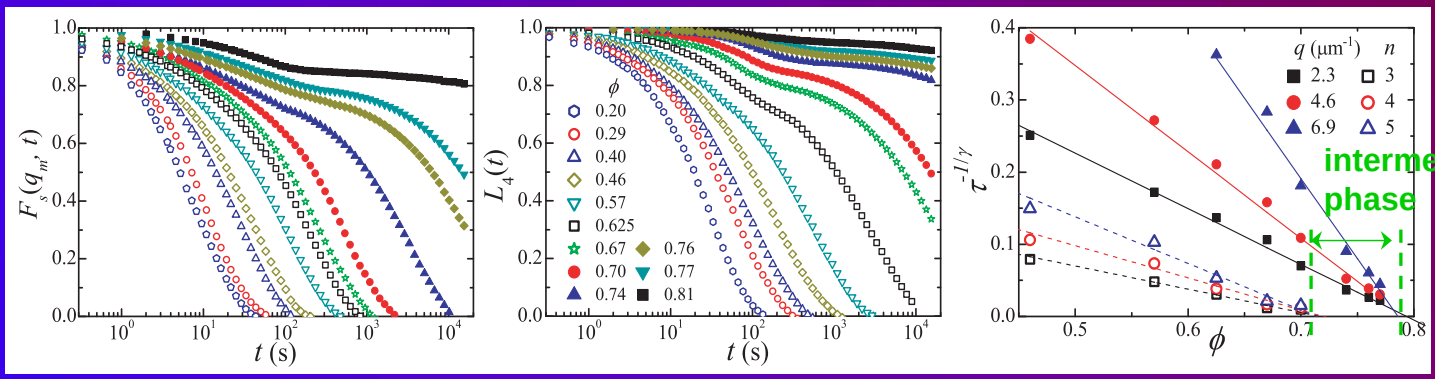
We report the first experiment about glass transitions in a colloidal suspension of anisotropic particles at the single-particle level. Video microscopy revealed that the rotational and translational motions become glassy at different densities, with a novel "orientational glass" phase in between. The orientational and translational structural relaxation times diverge at the two glass transitions, with increasing dynamic heterogeneity. Approaching the respective glass transitions, the rotational and translational fastest-moving particles in the supercooled liquid moved cooperatively and formed clusters with power-law size distributions. This spatial anticorrelation of translational and rotational fastest-moving particles and the two-step glass transition in 2D have not been predicted by theory or simulation.

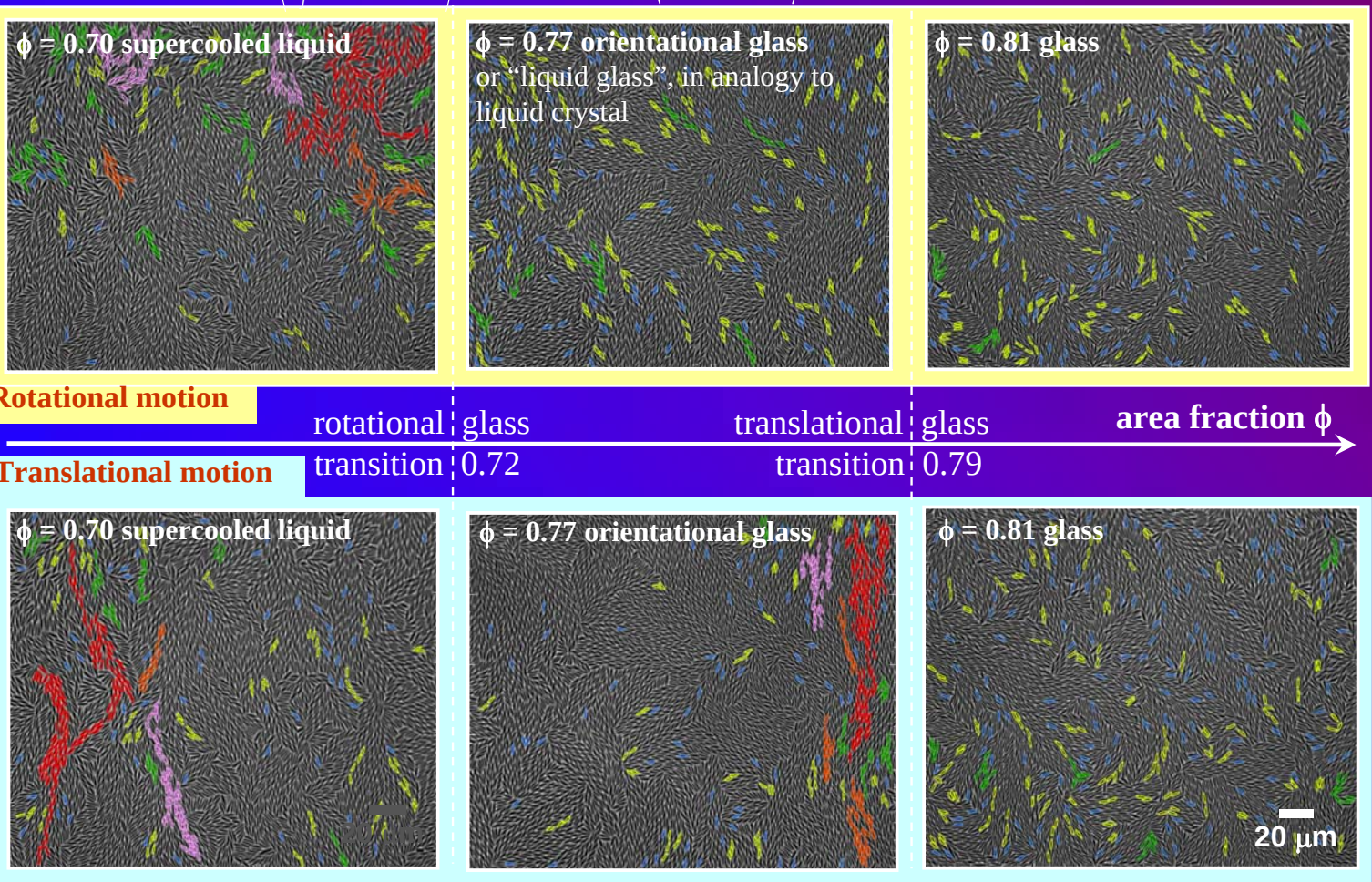
Experiment: stretching PMMA spheres ⇒ ellipsoids with aspect ratio 6 ⇒ a monolayer of ellipsoids in water confined between two glass walls ⇒ particle tracking by our image processing algorithm



intermediate scattering function $F(q,t)=\frac{1}{N}\left\langle \sum_j e^{i\mathbf{q}\cdot(\mathbf{x}_j(t)-\mathbf{x}_j(0))} \right\rangle$

orientational relaxation $L_n(t)=\langle \cos n\theta(t) \rangle$

diverging relaxation times



8% fastest particles (colored ellipses) moved cooperatively in clusters in liquid and were dispersed in glass.