

The mystery of the glass transition

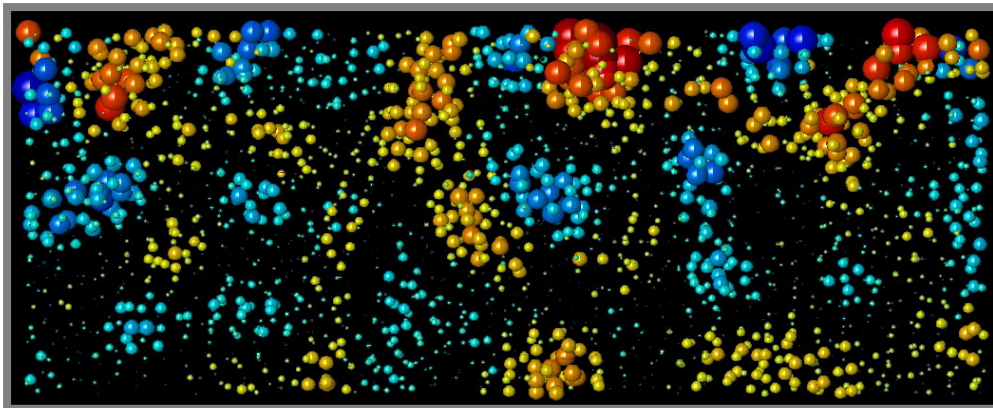
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A glass has the structure of a liquid, but it behaves like a solid and does not flow. How can we understand this mystery? Its understanding is of great importance for many materials around us: think of a pile of sand or sugar, where the grains can roll over each other just like atoms do in a liquid, but can also arrest like a solid. Plastics and biological tissue are other examples, consisting of disordered long filaments rather than spherical units, but still portraying similar glassy behaviour. New theories are developed that aim at a universal understanding of all of these everyday materials, but the problem is far from being solved.

We use a three-dimensional model that allows direct microscopic insight: Colloidal particles have sizes between atoms and sand grains and are small enough to exhibit Brownian motion, but large enough to be seen with an optical microscope. We can follow these particles and reconstruct 3D particle motions with time. This allows direct insight into the mystery of the glassy state: We analyze patterns of particle displacements in large systems, and, together with theory (B. Nienhuis), look for scaling and universal behaviour in these patterns. Our systems can be considered a powerful “analogue computer”, which allows modelling of atomic processes on scales much larger than with regular digital computation.

See also: P. Schall *et al.*, Science 318, p. 1895 (Dec. 2007).



Structural rearrangements in a colloidal glass

Sphere size indicates particle mobility, and sphere colour direction of particle motion.

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