The Glass Transition

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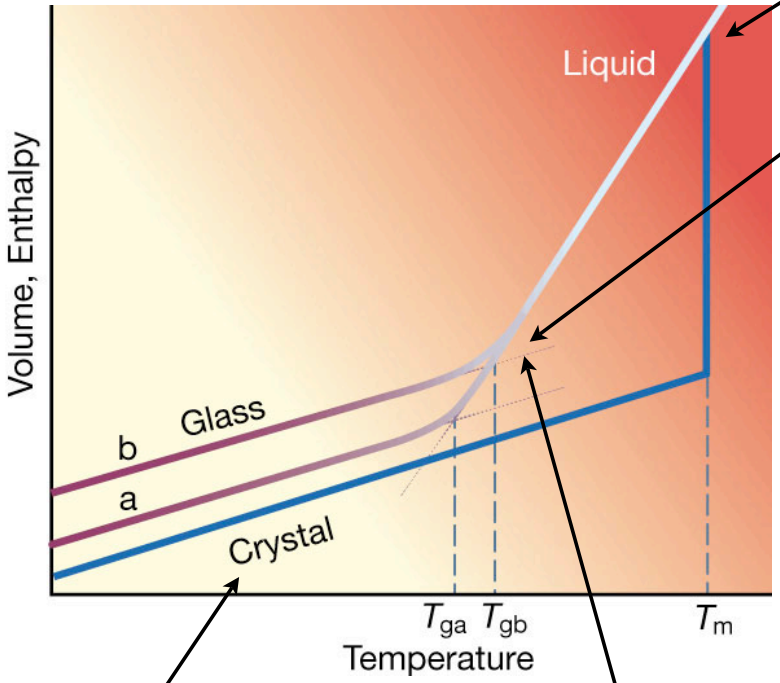
The glass 'transition'

$\eta \propto 10^{-2} Pa \cdot s$

$\eta \propto 10^{12} Pa \cdot s$

A tiny molecule moves of few Angstroms in a second!



$$\eta \propto \tau \propto \exp\left(D\frac{T_0}{T - T_0}\right)$$

from experiments

Amorphous rigid material

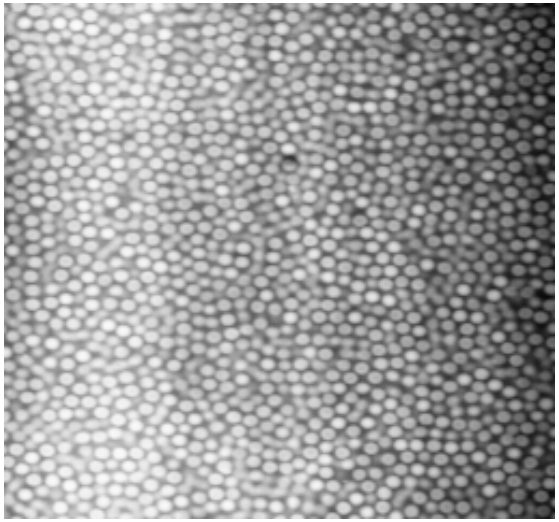
At T_g $\eta = 10^{12} Pa \cdot s$ by definition

Questions

- *Is it a order-disorder transition?* May be yes, but the order that is growing is 'disordered'
- *What kind of order? Amorphous order? How to define it? How to measure it?* Huge number of amorphous ground states; how to handle this?
- *How to build a theory? New techniques?*
- *What are the real space signatures of the collective-critical phenomenon?*

Ubiquity of glass transitions

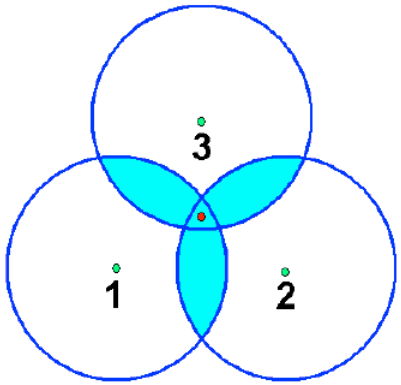
Not only molecular liquids but also...

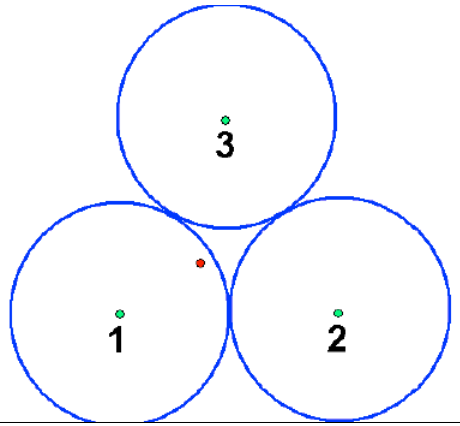


colloids and soft matter systems and...

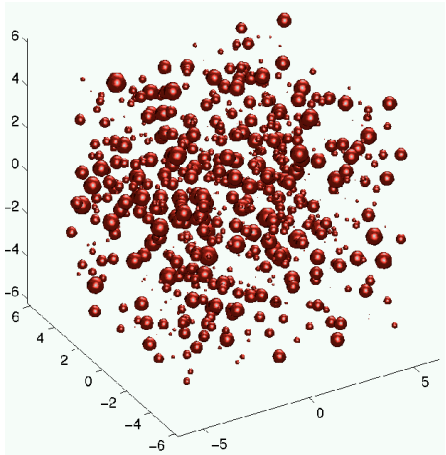
granular materials and...

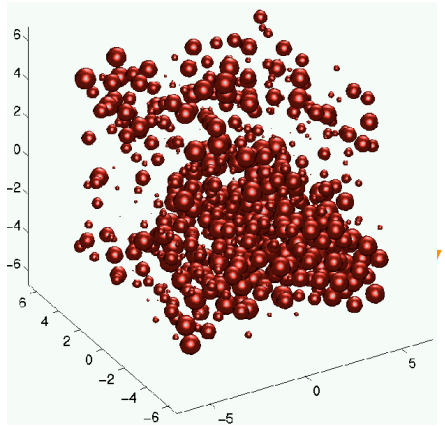
...error correcting codes and computer science





Dynamical correlations





- *Dynamical field or overlap function as order parameter:*

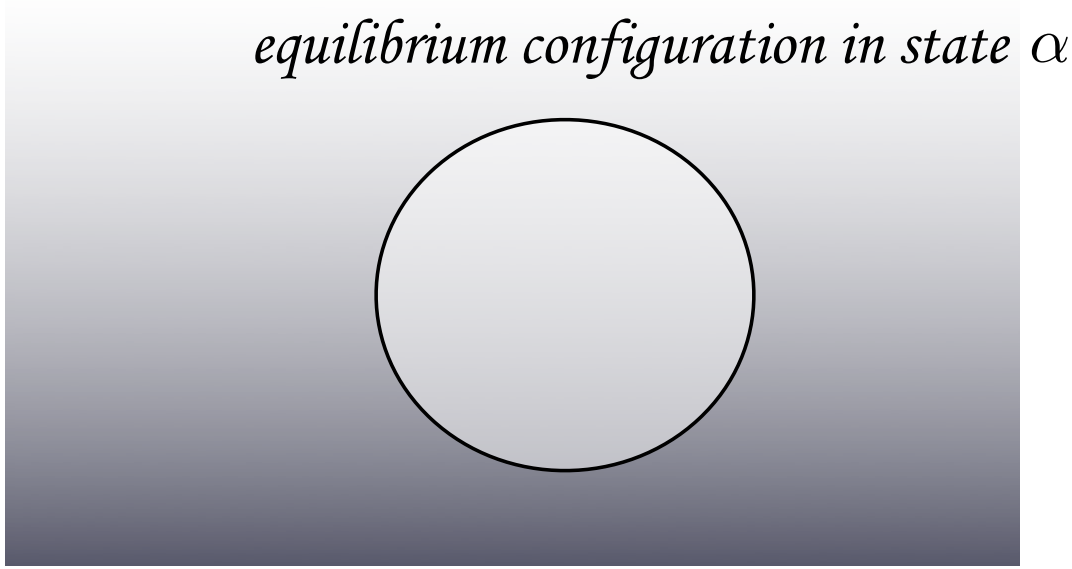
$$o(\mathbf{r}, t, 0) = \delta\rho(\mathbf{r}, t)\delta\rho(\mathbf{r}, 0)$$

Mean field theory, Field theory, simulations, effective models.

Ideal thermodynamic glass transition

How to unveil the existence of amorphous order and do quantitative computations?

Thermodynamics inside the cavity with the quenched boundary condition provided by α.



Order Parameter: overlap with α

Replica, Mean Field Theory (1 RSB), Simulations, Kac Models, Renormalization Group.