Jamming

Jorge Kurchan

PMMH-ESPCI, Paris
jorge@pmmh.espci.fr
http://www.pmmh.espci.fr/∼jorge

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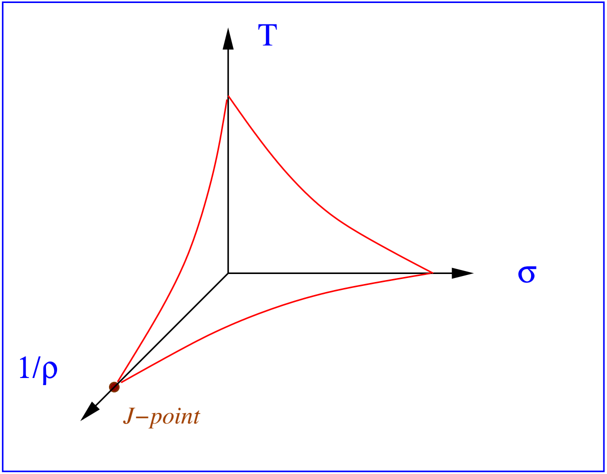
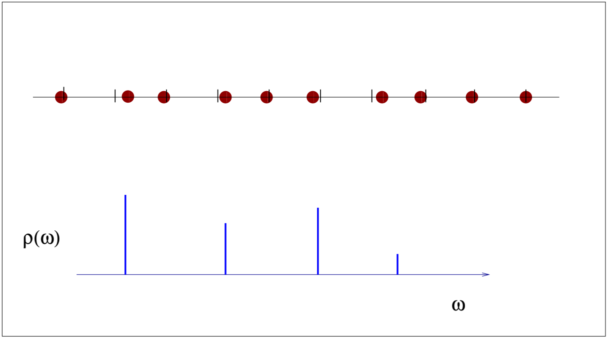
Jamming 'phase' diagram



What is a solid?



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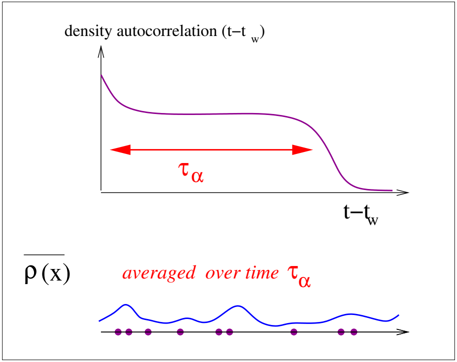
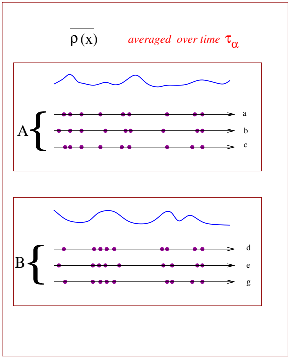




Permanent density modulations $\tau_\alpha \to \infty$

J-Point

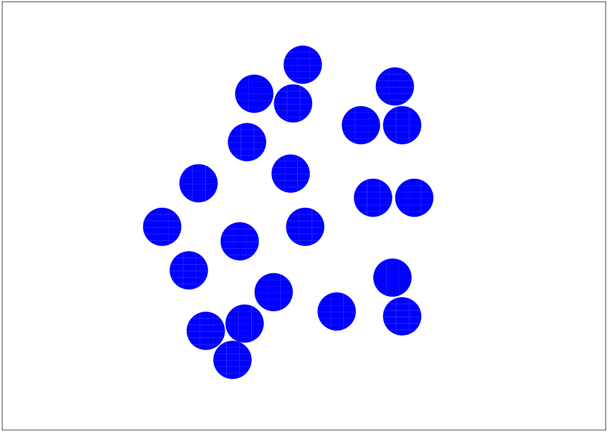
Procedure: increase the radius of the spheres gradually, infinitesimal overlaps are removed through repulsion. Continue until the pressure is infinite: this is the J-Point.

(O'Hern et al., Lubachevsky-Stillinger,...)

The actual volume fraction reached is very close to the one quoted as Random Close Packing

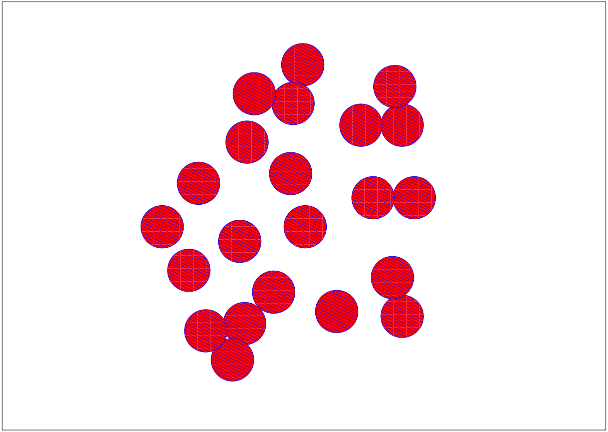
The J-Point so defined has criticality properties (soft modes, diverging lengths and susceptibilities, isostaticity).

A given configuration

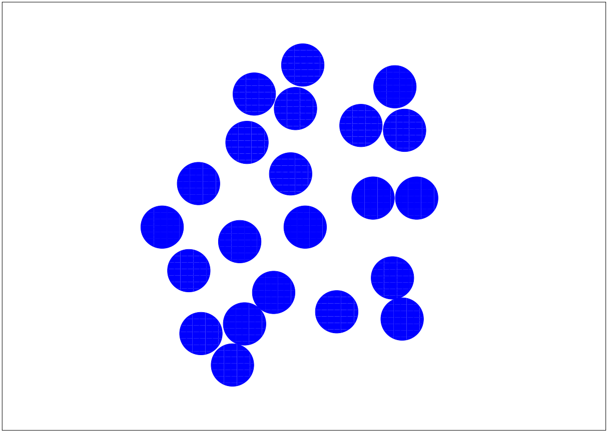


PACKING

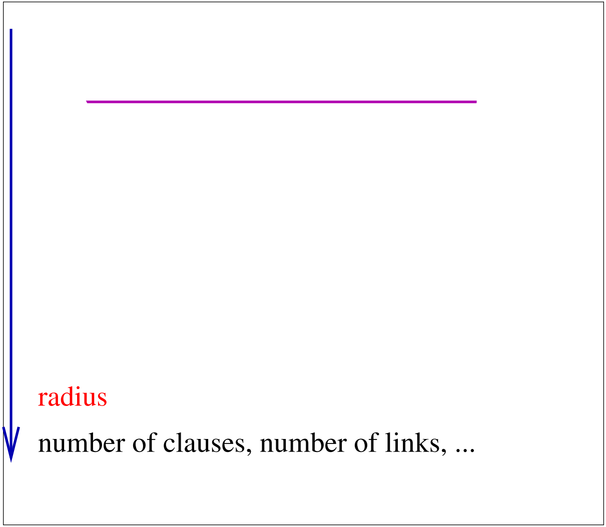
Inflate slightly



Displace particles to resatisfy



Landscape conjugated to pressure for hard particles



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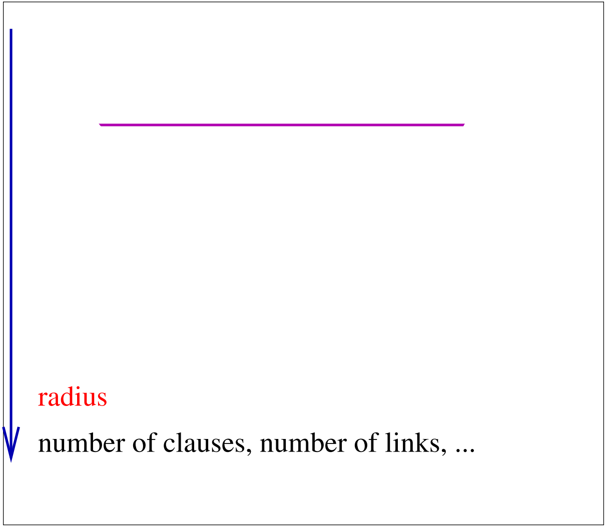

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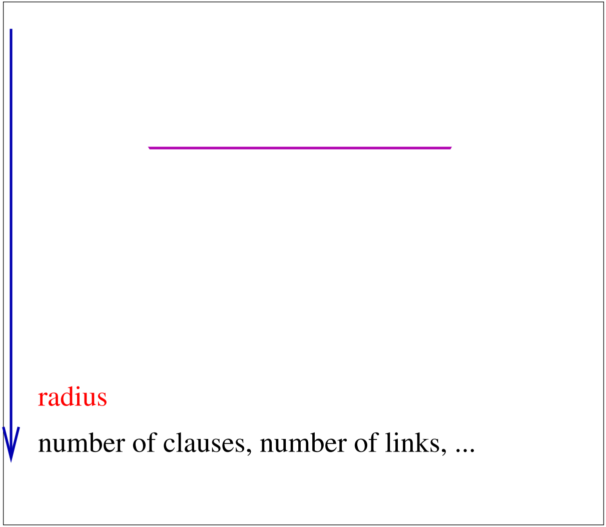

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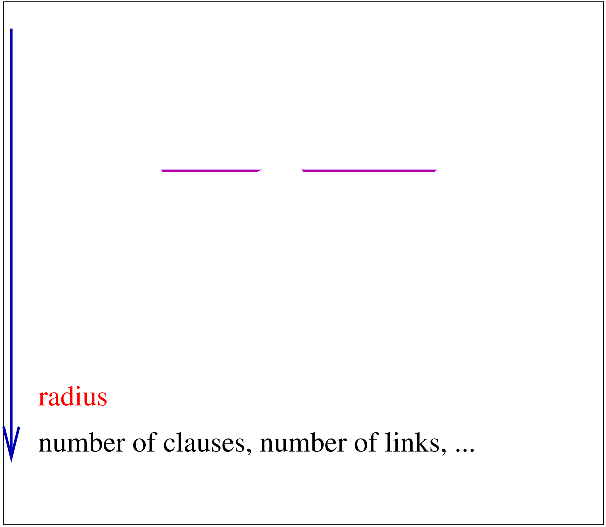

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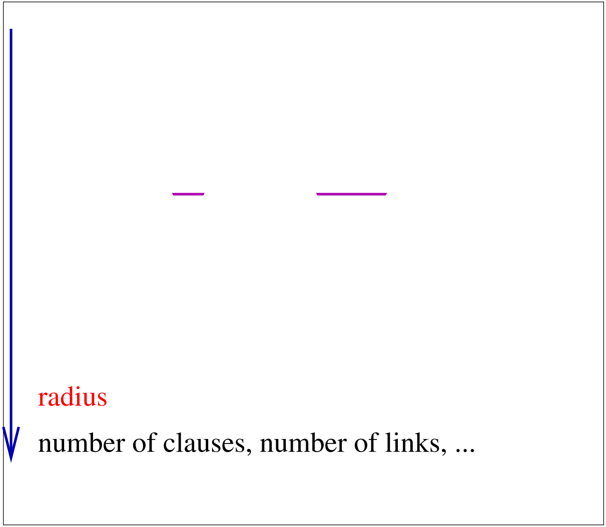

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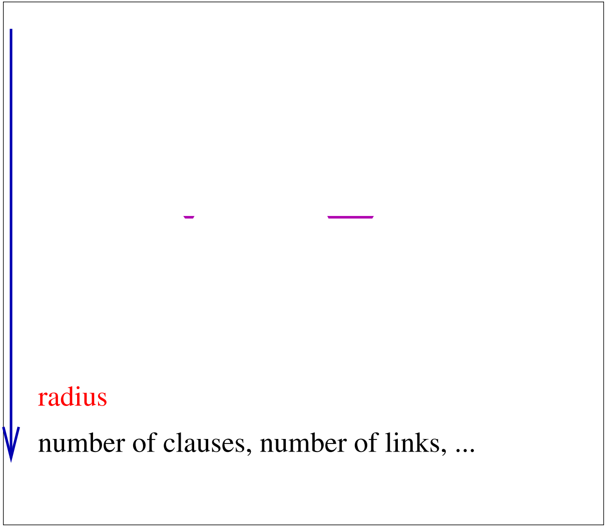

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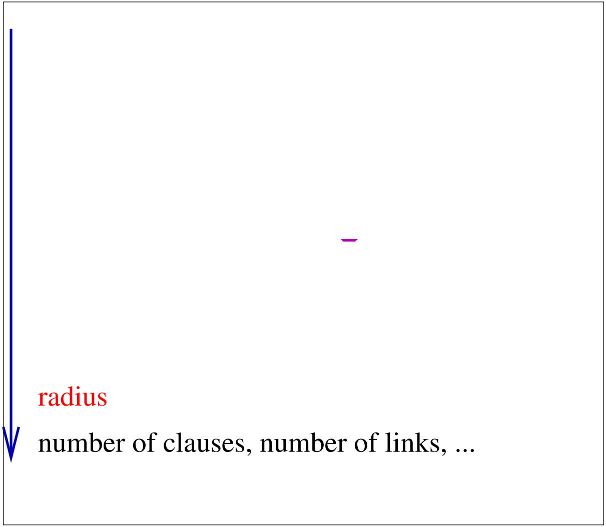

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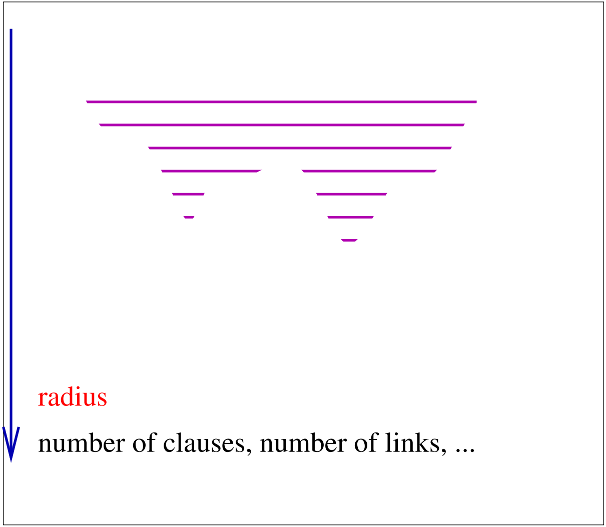

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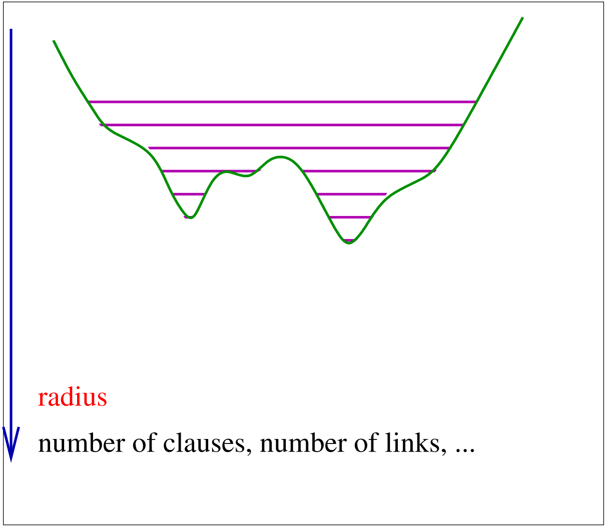

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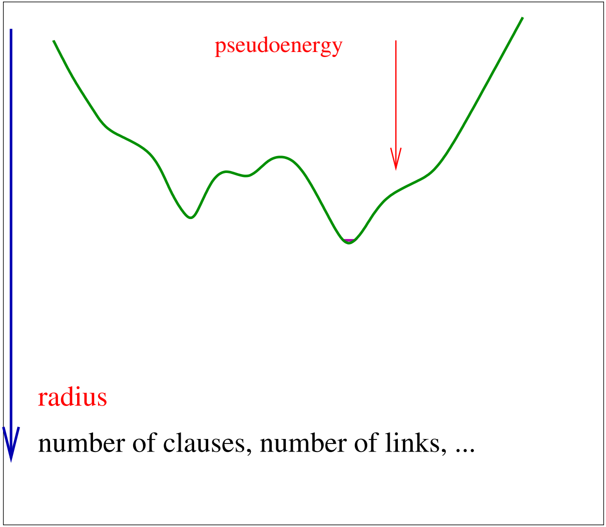
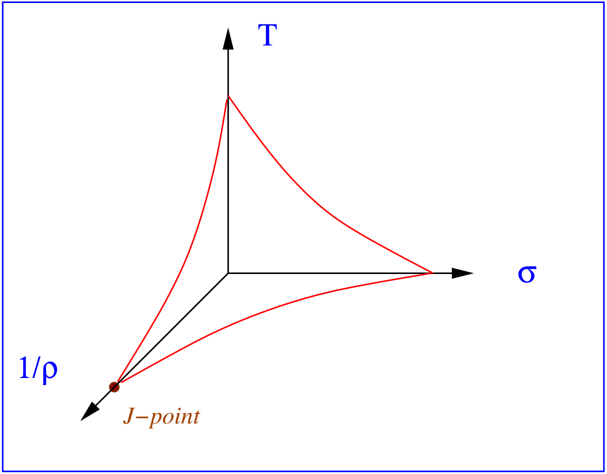


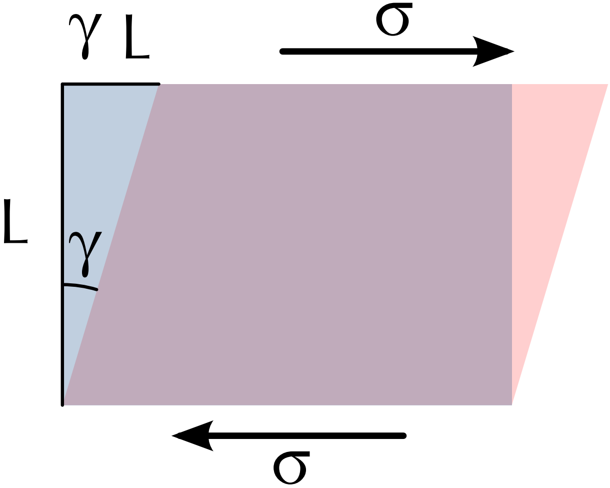
The J-Point procedure is a zero-temperature descent in pseudo-energy, starting from a random configuration

i.e. the J-point is analogous to an infinite temperature inherent structure.

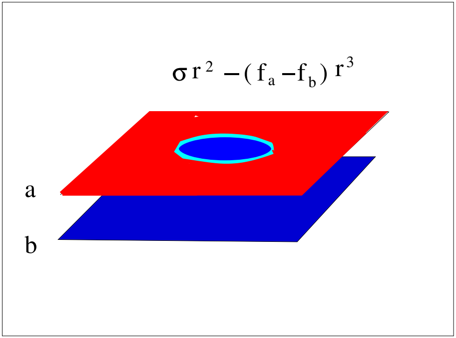
Jamming 'phase' diagram

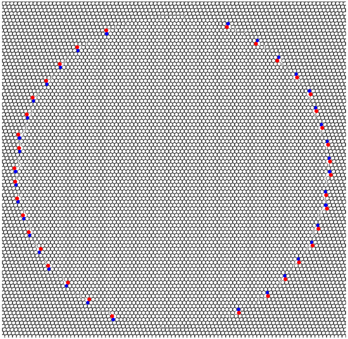


Can σ remain non-zero at fixed γ?



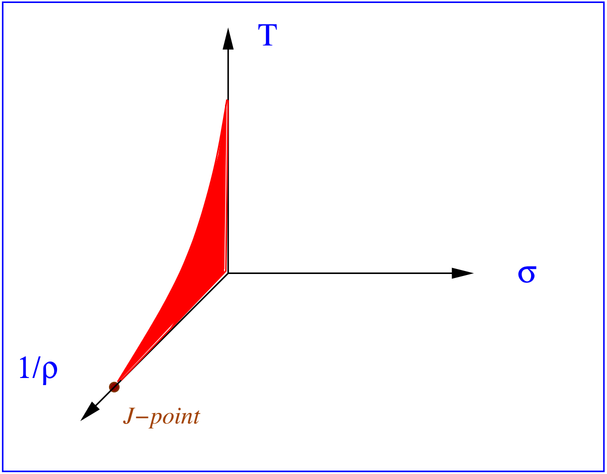
No, this is not possible at finite temperature



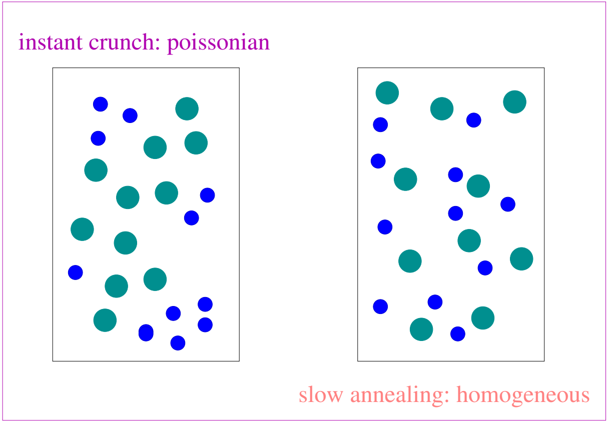


Sausset, Biroli, JK

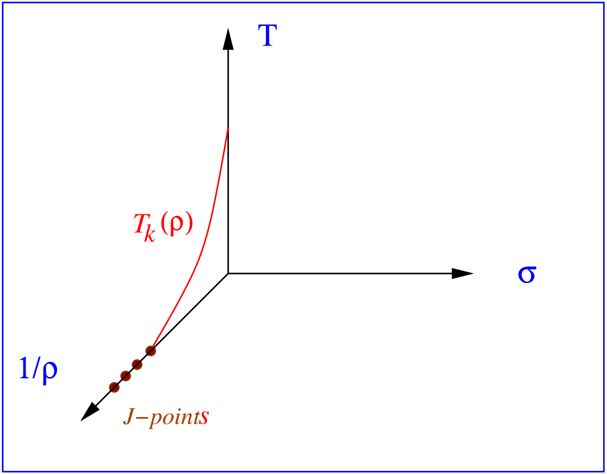
if we insist on infinite timescales ...



Next: the ’J-points’ do not occur at a single density



Pinaki Chaudhuri, Ludovic Berthier, Srikanth Sastry we are left with

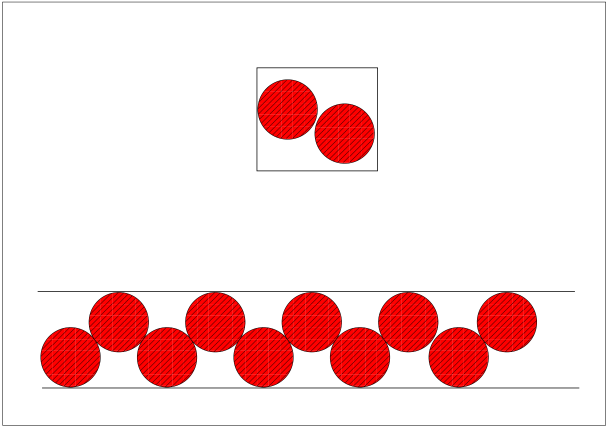


$T(\rho)$ **is the glass transition line, if such a thing exists**

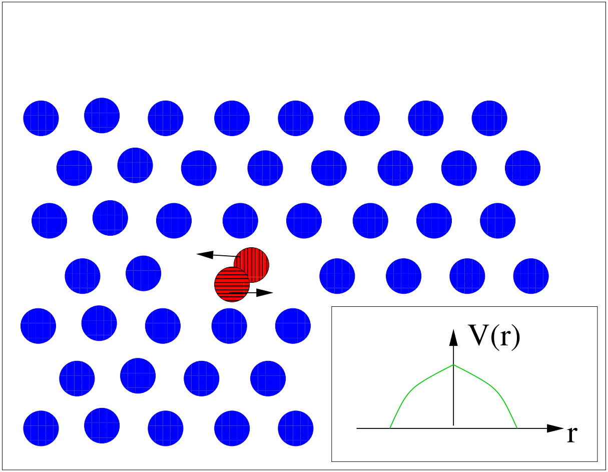
Two types of solidity:

- non-macroscopic Zero temperature or infinite pressure. Hard particles.
- macroscopic Finite temperature, soft particles. Crystal, ideal glass.

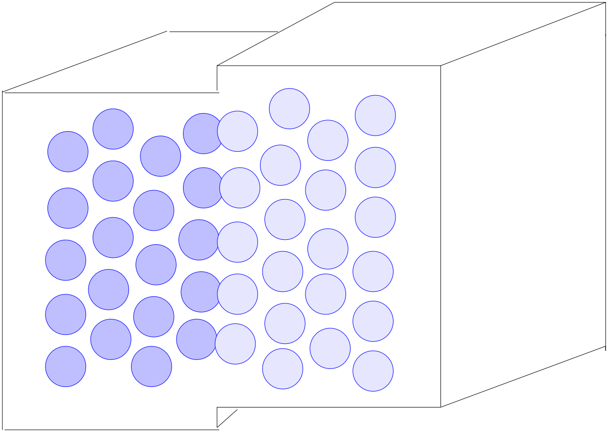
Non Macroscopic



Macroscopic requires the thermodynamic limit, particles may and will swap positions



Barriers are infinite only in the thermodynamic limit, or, equivalently, there has to be a diverging correlation length

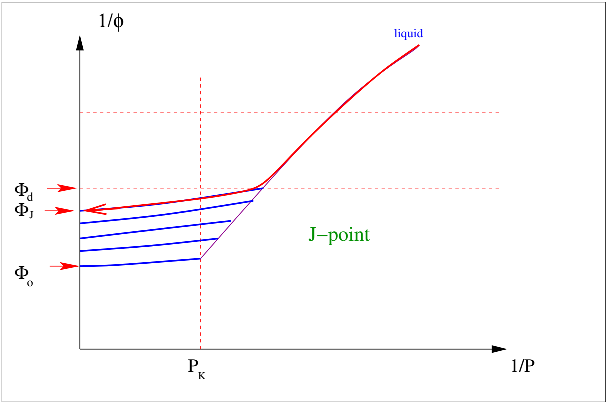


TWO WAYS TO JAM A SYSTEM

- Fast an dramatic to $P \sim \infty$
- infinitely slow and subtle to finite P

Both yield diverging timescales caused by underlying diverging lengths (as seen in χ_4), which are I argue of a different nature.

The J-points(s) and the Glass phase.



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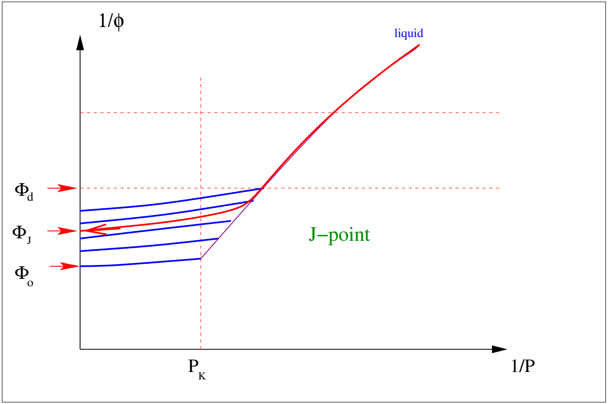

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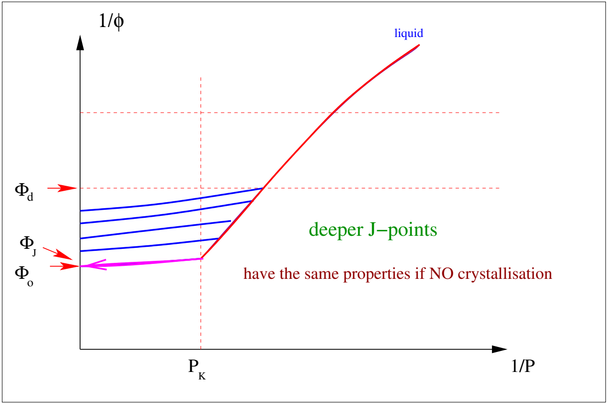
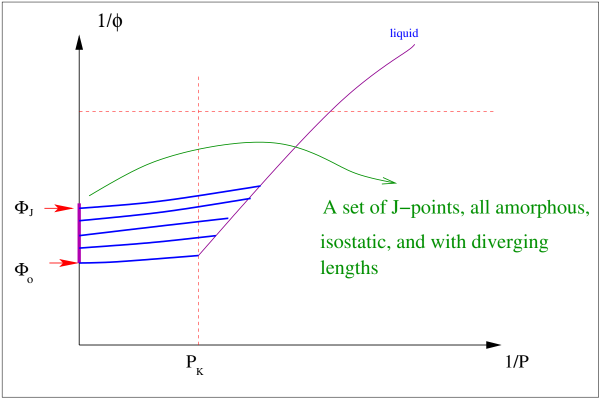


J Point(s). Isostaticity-related vs. glassy lengths.



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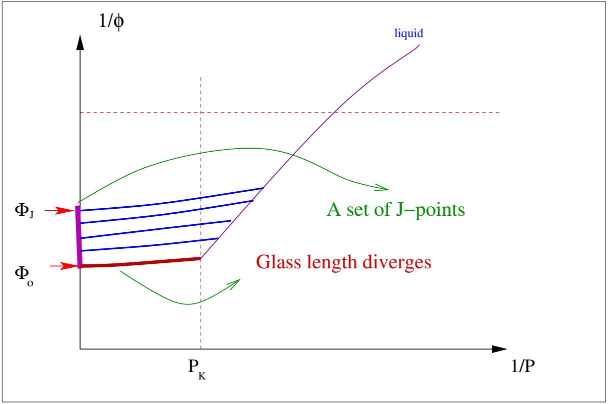
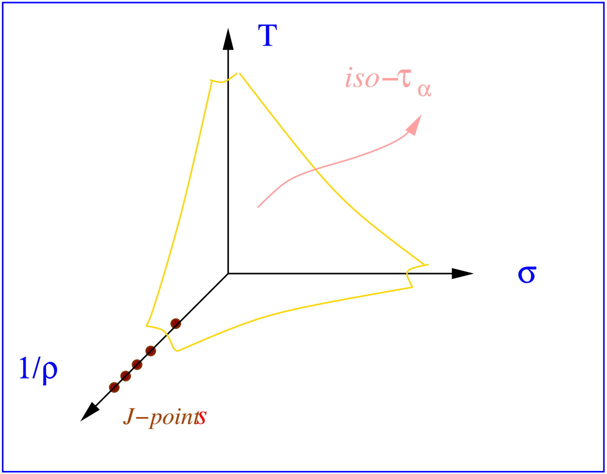


Jamming 'phase' 'diagram'



but note: τ_α **at stationarity? In an aging process?**

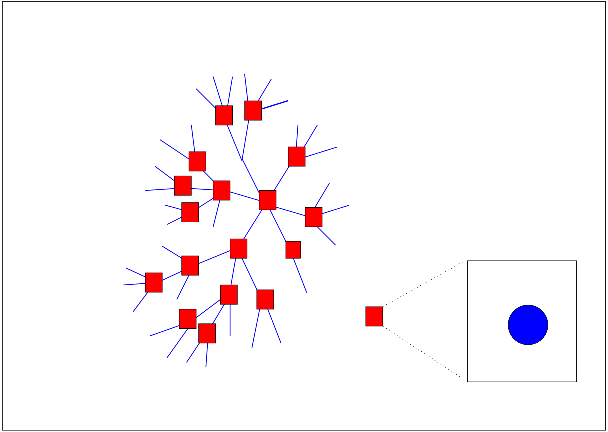
The notion of *jamming phase diagram*, just like humour, or poetry

The notion of *jamming phase diagram*, just like humour, or poetry

loses its charm when we attempt to explain it in detail.

A Model (hopeful ‘Rosetta stone’ to make contact with granular and *two level system* literature)

M

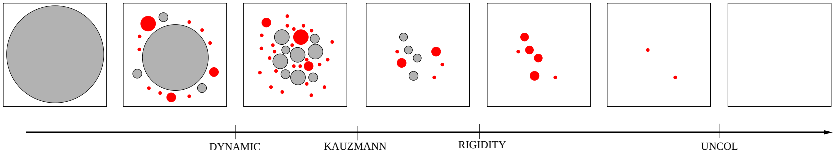


PERSPECTIVES

We may study the issues related to isostaticity in a model that has a glass transition à la Kauzmann

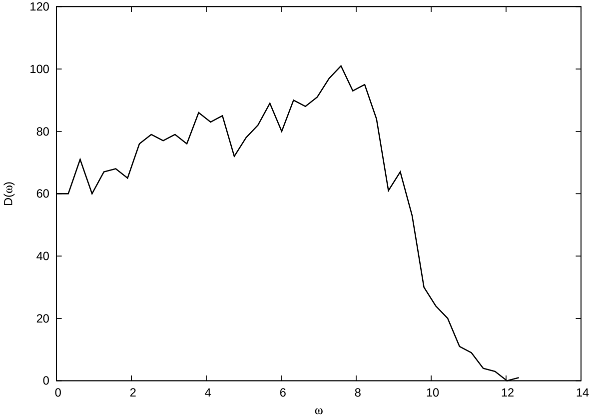
- Does frictionless granular matter flow?
- What is the relation between isostaticity-related length and glass correlation?
- An explicit counterexample to Stillinger's argument.
- Two-level systems and Gardner transition

A Sketch



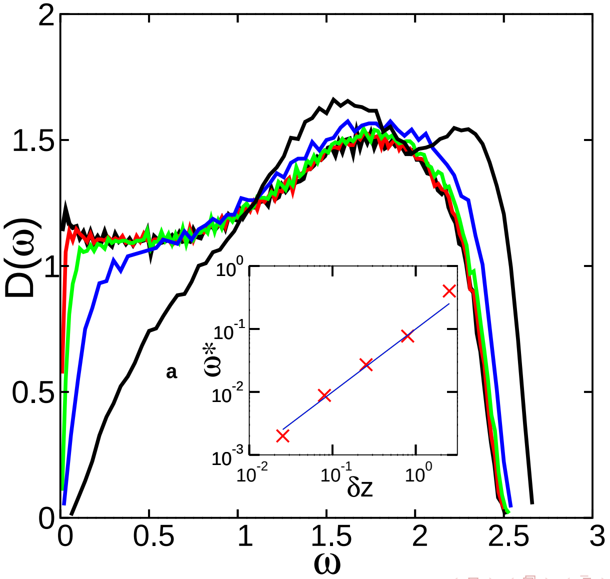
ISOSTATIC POINT

$g(\omega)$ model.



ISOSTATIC POINT

$g(\omega)$ Wyart et al.



ISOSTATIC POINT

M

Number of contacts