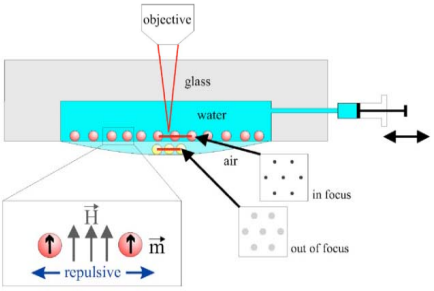
Diplom- / Staatsexamensarbeit

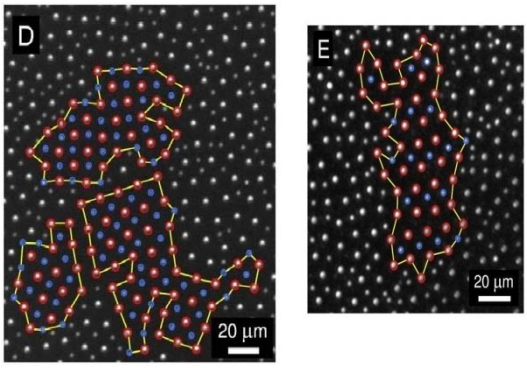
Temporal and spatial heterogeneities of the aging dynamics in a 2D colloidal system

Glassy systems are like liquid with a desorganized structure but present macroscopic behavior which is more close to the one of solids. This property can be explained by the fact that above a certain density / or below a certain temperature the particles to be jammed by its neighborgs and can not easily move and rearrange anymore.
Nethertheless in some cases the system continues to involve very slowly even for high density. Internal stress stored during glass formation try to relax and particles rearrange to reach progressively the equilibrium. Such process, called aging takes can take several days to years and in fact the system remains out-of-equilibrium over experimental investigation times.

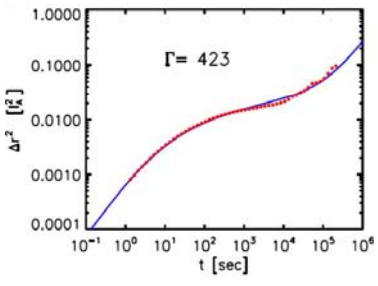
Soft glassy systems such as colloidal gels, pastes, foams, emulsion attract a wide interest. On the one hand, they are ubiquitous in industrial applications, for example in the food, cosmetic, paint, pharmaceutical, and oil
recovery industry. For most applications, understanding and controlling their dynamical and rheological properties, as well as their long term evolution and stability, is of fundamental importance. On the other hand, soft glasses are much studied at a more fundamental level.
That's why it is necessary to observe directly and locally microscopic phenomena to understand how can takes place a aging dynamics. On this purpose we propose to study the dynamical properties of a nearly ideal 2 dimensional colloidal system with controlled temperature and density by direct visualization of particles to evidence both the spatial and temporal heterogeneities of the system evolution.
The work will consist in main experimental part using 2D colloidal system observation setup, followed by data analysis and scientific interpretation.



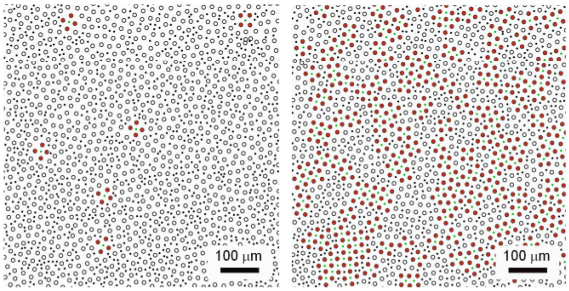
With superparamagnetic colloids at the air water interface we are able to realize a quasi ideal 2D colloidal system (less than 1μm Deviation from perfect flatness of the surface). This system is very powerfull to modelise large variety of situations concerning hot physics topics.



In systems with 2 sizes of particles, clusters appears and shows the same caracteristics as in crystalline solids with order and orientation properties.



Displacement of particles can be evaluated and analized to follow the dynamics and investigate its evolution with time. Aging phenomena are known to exhibit very uncommon feature s and rich microscopic mecanisms.



Some cristalline zones can be identified and their evolution can be followed with time. Thus we can hope to determine what are Mechanisms responsible for aging of the system.

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