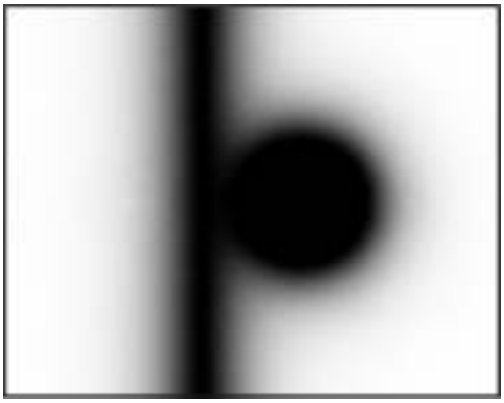
The Physics and Chemisty of Colloids

At the "Soft Condensed Matter" Institute we focus on colloidal systems. The group was founded in January 2000. The aim of our research is to understand:

- ***macroscopic, non-equilibrium phenomena*** of colloidal dispersions on a microscopic basis, both with and without external fields such as shear flow, electric fields and confinement.
- ***dynamics, microstructural order and phase behaviour*** of suspensions in bulk and at interfaces in equilibrium.

For the research in the soft condensed matter group it is essential that model colloidal systems can be synthesized with the appropriate, tailored properties needed to give rise to the physical phenomena of interest. Besides the synthesis of well-known model systems, new colloidal materials are designed. The following gives an overview of the various topics that are being studied at the moment :

Phase behaviour and microstructure

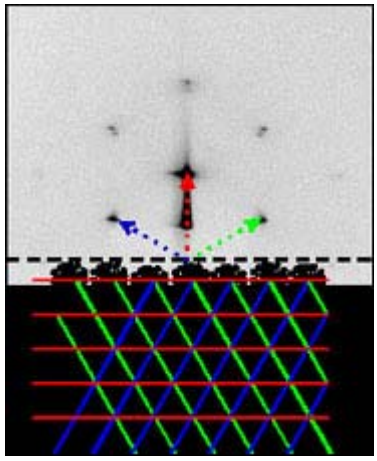


A prerequisite for the study of the non-equilibrium behaviour of colloidal dispersions is an understanding of the equilibrium structure and phase behaviour of the systems we are interested in. Besides, the equilibrium properties as such are of interest. In many biological systems such as the living cell, blood and food biopolymers are mixed together, which may lead to a phase separation. We investigate the structure and phase behaviour of model systems of such mixtures. This allows a better quantification of the structure and improved prediction of the stability of such systems.

Interfaces

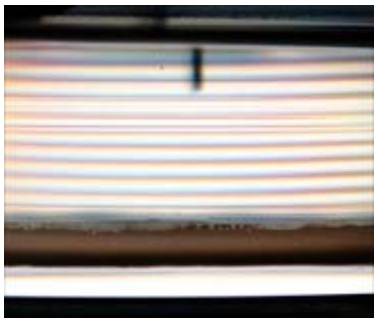
In atomic or molecular systems it is well known that macroscopic interfaces and spatial confinements may have a strong impact on the structure, the phase behaviour

and the particle dynamics. We are studying these interfacial and confinement effects on colloidal suspensions both experimentally and theoretically



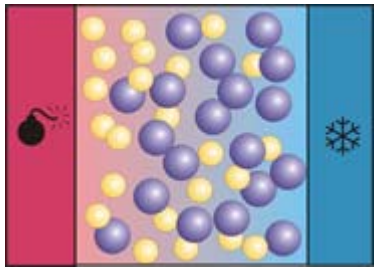
Shear Flow

When shear flow is applied to a colloidal dispersion, it will change the phase behavior of the dispersion and distort or induce structures in the system. This non-equilibrium phase behavior is studied in our group for several systems. The non-equilibrium Isotropic-Nematic phase transition is studied for rod like viruses, which is connected to the shear induced structure formation. Shear induced deformation of "hairy" colloids is also expected to induce the formation of structures since the deformed polymer brush particles induces an anisotropic interaction potential. The distortion by shear flow of the critical structure factor of colloid-polymer dispersions and crystals of charged colloidal spheres, including nucleation and cystal growth kinetics,is the other field of interest.



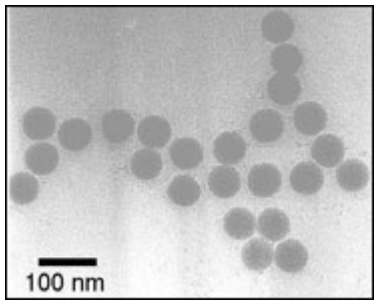
Transport Properties

Diffusion is the most relevant transport mechanism in colloidal and polymeric systems. A variety of diffusion processes can occur, depending on the system under study and on the externally imposed equilibrium or non-equilibrium conditions. Our experimental and theoretical studies include thermodiffusion induced by an imposed temperature field, interdiffusion in colloidal mixtures driven by local composition



fluctuations, electrolyte friction in charge-stabilized colloidal dispersions produced by the diffusive motion of microionic clouds, self- and collective diffusion of spherical colloidal particles in suspensions of rod-like viruses, and colloidal/polymeric diffusion and phonon transport under ambient and high pressures.

Synthesis of Colloids and Nanostructured Materials



Colloidal dispersions like paint, ink, milk, blood and wet clay play an important role in everyday life, but due to their great complexity are often difficult to study. Fundamental research in soft matter science relies on the availability of well-defined particles with respect to their shape, size and size distribution as well as their interaction potential and optical and electrical properties. We synthesize monodisperse particles of different morphology such as spheres, rods and plates and modify their surface properties. Besides precipitation from homogeneous solutions, the formation of particles and nanostructured materials is studied in surfactant self-assembled systems.