CPP 37: Poster: Colloids and Complex Liquids

Time: Wednesday 17:30–19:00 Location: Poster B2

CPP 37.1 Wed 17:30 Poster B2

Organization of Colloids in Ferrofluids — •Ayan Ray and Thomas Fischer — Universität Bayreuth, 95440 Bayreuth, Germany

Colloidal particles (magnetic and non-magnetic) are the basic building blocks of complex structures with unique optical properties. When these mono-disperse particles with controlled shape, size, volume, and concentration are dispersed in a ferrofluid in a static magnetic field they self-assemble into symmetric arrangements. Here we try to demonstrate the dynamical behavior of a mixture of paramagnetic and non magnetic colloidal particles in a ferrofluid under the influence of a rotating magnetic field.

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Pearl chain to cluster transition dynamics of paramagnetic colloids in a rotating magnetic field — •Nebojsa Casic and Thomas Fischer — Univesitaet Bayreuth 95440 Bayreuth Germany

In a static magnetic field paramagnetic colloids form pearl chains, while the equilibrium conformation in a rotating field is a two dimensional cluster. When switching from a static to a rotating magnetic field a transient dynamics from a pearl chain to a two-dimensional cluster is observed. Two different dynamical regimes of cluster formation are observed. At low frequencies of the magnetic field the colloidal pearl chains fragment into rotating doublets that reassemble into clusters. At high frequencies each pearl chain curls up into two spirals wrapping the chain into a cluster. Attempts to explain the behavior in both regimes are presented.

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Liquid-gas phase transition in a ferrofluid monolayer in an external field — •Heiko Schmidle and Sabine H.L. Klapp — Technische Universität Berlin, Institut für Theoretische Physik, Hardenbergstr. 36, 10623 Berlin

We present the results of a theoretical study of a ferrofluid monolayer in an external field. Magnetic films attract a great dels of interest in experimental studies and they reveal a variety of interesting structures. In order to model the ferrofluid we use a Stockmayer fluid. The particles interact via a Lennard-Jones potential, combined with a dipole moment. The particles are confined to a plane, whereas the dipoles can rotate in three dimensions. This model represents in an accurate way nanoparticles like colloids that are on an plane. We investigate the influence of an external field on the liquid-gas phase transition. We use extensive Monte-Carlo simulations in the grand canonical ensemble. Long range-interactions are handeled by Ewald summation techniques. Histogram reweighting and preweighted multicanonical simulations are used in order to determine the exact transition curve of the ferrofluid monolayer.

CPP 37.4 Wed 17:30 Poster B2

Pearl chain to cluster transition dynamics of paramagnetic colloids in a rotating magnetic field — •Nebojsa Casic and Thomas Fischer — Universität Bayreuth Bayreuth Germany

Duplicate of poster CPP 37.2.

CPP 37.5 Wed 17:30 Poster B2

2D versus wire-like structures: exploring the deposition conditions for self-assembling polystyrene nanoparticles — •Matthias Schwartzkopf[1], Mottakin Abul Kashem[1], Adeline Buffet[1], Gerd Herzog[1], Volker Körstgens[2], Peter Müller-Buschbaum[2], Jan Perlich[1], Stephan V. Roth[1], Stephan Förster[3], and Rainer Gehrke[1] — [1]HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany — [2]Physik-Department E13, TU München, James-Franck-Str. 1, D-85748 Garching, Germany — [3]Universität Hamburg, Institut für Physikalische Chemie, Grindelallee 117, D-20146 Hamburg, Germany

Installing regular arrays on mesoscopic length scales plays an important role in nanoscience. Different techniques of self-assembly via solvent evaporation have been used to obtain highly ordered colloidal structures. We used Langmuir-Blodgett (LB) technique and spray deposition, representing the most attractive tools for the formation of larger homogeneous colloidal arrays. During their different deposition and boundary conditions, the assembly behaviour of polystyrene nanoparticles changes, resulting in two-dimensional layers with LB-technique and stripe-like pattern by spray deposition. We present our first results from atomic force microscopy and microbeam grazing incidence small-angle x-ray scattering.

CPP 37.6 Wed 17:30 Poster B2

Transient melting of binary glasses by hot gold colloids — •Florian Schwaiger and Werner Köhler — Universität Bayreuth, Physikalisches Institut, 95440 Bayreuth

Gold colloids with a diameter of 250 nm can be heated by laser irradiation and have been used as microscopic heat sources in near-critical polymer blends (poly(ethyl-methyl siloxane)/poly(dimethyl siloxane)) and in concentrated polystyrene/toluene solutions close to the glass transition. Due to the high absorbance at the plasmon resonance wavelength ($\lambda \approx 532\,\mathrm{nm}$), significant temperature gradients $\nabla T \propto 1/r^2$ can be achieved in the close vicinity of the particles on length scales below the diffraction limit. As a consequence of the Soret effect, there is a strong coupling to the order parameter, the local composition of the binary system. Colloids immobilized at a surface have been used to induce composition patterns in the polymer blend. In the binary glass former, a bubble of high mobility due to local toluene enrichment, accompanied by a lowering of T_g, is formed around and moves together with the colloidal particle.

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A new experimental setup for microscopic studies of confined colloids in quasi-2d — •Alexander Reinmüller, Thomas Palberg, and Hans Joachim Schöpe — Institut für Physik der Universität Mainz, Staudingerweg 7, D-55099 Mainz, Germany

Both equilibrium and non-equilibrium behaviour of confined many particle systems is of great scientific interest. To investigate confined colloidal model systems we constructed a new experimental high-precision setup. The confinement consisting basically of flat quartz plates can be adjusted precisely by use of special Piezo drives allowing a variable plate to plate distance (contact - 100 micrometers) and the application of compression and shear forces. The experimental setup is designed for observations using common optical scientific microscopes. The goal of our experiments is the investigation of the phase behaviour of mono-disperse and bi-disperse Yukawa systems as well as their non-equilibrium behaviour. We present the new setup as well as first interesting results of fully deionized charged spheres in confinement.

CPP 37.8 Wed 17:30 Poster B2

Colloidal suspensions of magnetic particles in time-dependent external fields — •Sebastian Jäger — Institut für Theoretische Physik, Technische Universität Berlin

We investigate colloidal suspensions of magnetic particles in 3 dimensions that interact with time-dependent external fields. The particles are modelled by dipolar soft spheres, whose dipolar coupling strength is such that it enables chain and cluster formation even if no external field is present. We choose the coupling of the dipoles with the external field to be even stronger than the dipole-dipole coupling strength. The states under scrutiny include low density dilute states as well as high density fluid states. Our methods include Molecular Dynamics simluations at fixed temperature and Brownian Dynamics simulations. In these simulations, we utilize the Ewald summation method to treat the long-range dipolar interactions.

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Suppression of Multiple Scattering in Colloidal Model Systems — •Achim Lederer and Hans-Joachim Schoepe — Johannes Gutenberg-Universität Mainz, Institut für Physik, Staudinger Weg 7, 55099 Mainz, Deutschland

Light scattering is one of the most power full tools in soft matter physics to study the structure, kinetics and dynamics of the system of interest. Unfortunately the evaluation of conventional light scattering data is often complicated due to multiple scattering effects. In colloidal model systems multiple scattering can often be suppressed in particle form factor measurements by dilution or index matching methods, whereas it is a difficult task determining the structure factor. By a new designed Two Colour Dynamic Light Scattering setup, multiple scattering free dynamic and static light scattering data are obtained and compared to other multiple scattering free methods.

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Optical Tweezers to Measure the Interaction Forces between Poly(2-vinylpyridine) Brushes — •Mahdy M. Elmahdy[1,3], Alla Synytska[2], Astrid Drechsler[2], Christof Gutsche[1], Petra Uhlmann[2], Manfred Stamm[2], and Friedrich Kremer[1] — [1]Institute of Experimental Physics I, Leipzig University, Linnéstrasse 5, 04103, Leipzig, Germany — [2]Leibniz Institute of Polymer Research Dresden, Hohe Str. 6, 01069 Dresden, Germany — [3]Department of Physics, Mansoura University, Mansoura 35516, Egypt

Forces of interaction within single pairs of poly(2- vinylpyridine) (P2VP) grafted colloids have been measured by optical tweezers (OT) with an extraordinary resolution of *0.5 pN. Parameters to be varied are the concentration and type of salt (KCl, CaCl2, and LaCl3) of the surrounding medium as well as its pH. The observed force-distance relation is quantitatively described by the Jusufi model [Colloid Polym. Sci. 2004, 282, 910-917] for spherical polyelectrolyte brushes which takes into account the entropic effect of the counterions and enables one to estimate the ionic concentration inside the brush. The transition from an osmotic to the salted brush regime is analysed in detail. For the scaling of the brush height a power law is found having an exponent of 0.24*0.01 which ranges between the values expected for spherical and planar brushes. At pH 4 a strong transition from a brush to a pancake conformation takes place.

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Interactions in Thin Aqueous Film of Colloidal Suspensions — •Yan Zeng and Regine von Klitzing — Stranski-Laboratorium, Department of Chemistry, TU Berlin, Strasse des 17.Juni 124, D-10623 Berlin

Colloidal suspensions are omnipresent in daily life and have many technical applications. To understand the interactions between particles in thin film of colloidal suspensions, we perform force measurements by using Colloidal Probe Atomic Force Microscopy (CP-AFM), in which particles show oscillatory force due to the layer formations of particles under spatial confinement. The distance of layers can be figured out from the force profiles and compared with the mean particle distance obtained from Small Angle X-Ray Scattering (SAXS). Thus we know the structuring of colloidal suspensions can be survived from 3D to 2D or not? Particle concentration, particle size and ionic strength of suspensions have been studied both by CP-AFM and SAXS. The effects of Surface charge and surface elasticity have been studied as well by replacing the solid silicon wafer with mica sheet, air/liquid interface, and modified silicon with polyelectrolyte adsorbed layers. Those are measured by CP-AFM and compared with results from Thin Film Pressure Balance (TFPB) in which particle suspensions form thin films between fluid interfaces and shows no dependency of step size on the particle concentrations. The effect of charge on nanoparticles is studied by adding non-ionic surfactants into particle suspensions and by using non-ionic surfactant itself at concentrations above CMC. Latter case shows significant different result as that of charged particles.

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Photothermal Correlation Spectroscopy and Hot Brownian Motion — •Romy Radünz[1], Daniel Rings[2], Klaus Kroy[2], and Frank Cichos[1] — [1]Molecular Nanophotonics Group, University of Leipzig — [2]Soft Matter Theory Group, University of Leipzig

Photothermal correlation spectroscopy (PhoCS) is a recently developed tool to explore the diffusion of non-fluorescent tracers of only a few nanometers in size in solution in an equivalent way as it is done in fluorescence correlation spectroscopy. As a key feature of photothermal detection techniques the tracers and their intermediate surrounding are heated up. Although small temperature rises at the particles surface of a few Kelvin are sufficient to detect a single particle, in the case of gold nanoparticles surface temperature rises up to a few 100 K can be achieved with moderate heating intensities exploiting the high absorption cross sections near the plasmon resonance. To interpret the results of PhoCS correctly it is crucial to describe the diffusion of hot particles in a cold surrounding accurately. A model is presented for this Hot Brownian Motion that handles not only the influence of the inhomogeneous viscosity around the particle on the drag coefficient but gives also a first approach to quantify the impact of the non-uniform temperature distribution on the strength of thermal fluctuations that drives Brownian motion. To validate the theoretical description we have studied the diffusion of gold nanoparticles in water. Comparison with the theoretical estimates shows good agreement for temperature rises below 100 K leading to a robust basis for photothermal tracer techniques.

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Temperature mapping of gold nanostructures — •Marco Braun, Romy Radünz, and Frank Cichos — Molecular Nanophotonics Group, University of Leipzig, Linnéstraße 5, D - 04103 Leipzig

Local temperature control on the micro and nanoscale is of interest in many areas in nanotechnology. Heat generated in gold nanostructures when illuminated at their plasmon frequency is transferred into the surrounding medium, what causes a local temperature field and thus a change of physical properties. This is used e.g. in photothermal microscopy to image metal nano particles with the size of a few nano meter. For an application in engineering or biology this temperature fields must be quantified. As a first approach we present a method for rapid temperature mapping using steady-state fluorescence polarization anisotropy (FPA) of dye molecules in a viscous medium covering the plasmonic structures. Polarization anisotropy scales with rotation correlation time and hence with temperature. FPA is measured in a widefield microscope where the polarizations of the fluorescence light are separated. We demonstrate the temperature mapping with gold nano particles immobilized on a glass substrate forming different structures.

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Impact of droplets on thin free standing smectic films — •Sebastian Baumgarten, Thomas John, Kirsten Harth, and Ralf Stannarius — Institut für Experimentelle Physik, Universität Magdeburg, Universitätsplatz 2, 39106 Magdeburg

Free standing smectic films are stable quasi two-dimensional fluid objects. They have submicrometer thicknesses and consist of layers of smectic liquid crystals. The surface of the films is uniform on the order of single smectic layers.

Picoliter water/glycerol droplets are generated on demand with a piezoelectric dispenser. Their diameters are approximately 30 μm. The position controlled impact of the droplets on the films is observed with a microscope in reflection. Dependent on the materials used, we observe an integration of the droplets in the film structure or a rapid rupture of the free standing film. We record impact and subsequent motion of the droplets in the film with a high speed camera. On an oblique film, the motion of the droplets is gravity driven. This allows a study of hydrodynamics in quasi two dimensions and the viscous drag on the droplet. We plan to have results from variable gravity experiments from DLR parabolic flights at the time of the meeting.

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Single Colloid Electrophoresis in the Presence of Multivalent Counterions — •Shervin Raafatnia and Christian Holm — Institute for Computational Physics, Stuttgart University, Pfaffenwaldring 27, 70569 Stuttgart, Germany

We study the electrophoretic behaviour of a single colloidal particle by simulation. We take into account hydrodynamic interactions via a Lattice Boltzmann fluid. A raspberry-like model is used for the colloidal particle in order to couple it to the fluid.

The electrophoretic behaviour depends on the concentration and valency of counterions in the suspension. Charge inversion, that will lead to a mobility reversal, is expected for multivalent counter ions, because many oppositely charged counterions attach to the colloid.

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Event-driven simulation of spherical colloids with ultra short-ranged attractive interactions in a slit-pore geometry — •Helge Neitsch and Sabine Klapp — Institut für Theoretische Physik, TU Berlin, Hardenbergstraße 36, D-10623 Berlin, Germany

We have performed event-driven molecular dynamic investigations of a system consisting of colloidal particles with ultra short-ranged attractive interactions which are confined by two smooth, parallel walls. The pairwise interaction between the particles is modeled using a square-well potential with an attraction length of 4% of the particle diameter. We investigate structural and dynamical properties via quantities like cluster-mass distributions and mean square displacements for the bulk and the confined system using wall distances down to 3 particle diameters. We also present first data for a confined valence-limited model, where particles are allowed to form reversible bonds with a fixed maximum number of neighbors as described in detail in [1].

[1] E. Zaccarelli, J. Phys.: Condens. Matter 19, 323101 (2007)