

Participant	Title	Abstract
Dirk Aarts	Phase separation of colloidal mixtures in confinement	We study the demixing of a fluid-fluid phase separating colloid-polymer mixture confined between parallel plates, where one of the phases completely wets both walls. Using confocal scanning laser microscopy we are able to obtain real space images both parallel and perpendicular to the confining walls. We observe rich and complex behaviour. Three distinct morphologies are observed: the formation of a bicontinuous network, which coarsens into cylindrical tubes bridging the plates, and finally develops into a network structure in two dimensions. Through image analysis of the system as a whole, and the tracking of individual domains, we are able to perform a detailed study of the mechanisms of phase coarsening at each stage. We are able to directly test the condition for which bridges connecting both confining walls are stable. Finally, we consider the role of hydrodynamics and of thermal interface fluctuations in our system.
José Bico	From elastocapillarity to delamination and cracks	Washing our hair teaches us how capillary forces may be strong enough to deform slender structures. Such elasto-capillary interactions are usually considered as a limitation for the development of micro-devices. Conversely capillary forces may be regarded as a useful tool for micro-fabrication. We shall consider how the concepts derived for elasto-capillary systems can be generalized to other surface interactions such as adhesion or fracture. In particular we shall describe different experiments involving delamination and cracks.
Kurt Binder	Simulation Approach for Computing the Surface Excess Free Energies of Vapor-like, Liquid-like and Solid-like Phases in Colloid-Polymer Mixtures	Kurt Binder, D. Deb, A. Statt, P. Virnau and A. Winkler Institut für Physik, Johannes Gutenberg-Universität Mainz, Staudinger Weg 7, D-55099 Mainz Abstract Colloid-Polymer mixtures are model systems, where the entropy-driven attraction between colloids can be tuned (with respect to its range and strength) via the size and the concentration of polymers in the suspension. Similarly, the attraction to planar walls can be modified by coating the latter with a suitable polymer brush layer. As a result, one expects that wettability of the walls (both at vapor-liquid and at liquid-solid type phase coexistence) can be controlled, at least in principle. We present Monte Carlo simulations to provide a theoretical guidance to this problem. It is shown that accurate estimates for the excess free energies due to walls in the various phases can be obtained via the "ensemble switch method", where a Hamiltonian mixed from a system with walls and without walls (and periodic boundary instead) is considered. The method is tested for the hard sphere fluid, where many estimates from alternative methods are available [1]. For vapor-liquid type coexistence in an Asakura-Oosawa model, where the liquid-vapor surface tension is known, Young's equation is used to demonstrate that conditions all the way from complete drying to complete wetting can be reached [2]. For liquid-solid coexistence, a comparison of the resulting prediction for the contact angle with observations from wall-attached crystalline "droplet" is made. References [1] D. Deb et al., J. Chem. Phys. 134, 214706 (2011) [2] A. Statt, A. Winkler, P. Virnau, and K. Binder, J. Phys.: Cond. Matter (in press) [3] D. Deb, A. Winkler, P. Virnau, and K. Binder, J. Chem. Phys. 136, 134710 (2012)
Lydéric Bocquet	Fluid transport: strange phenomena at the nanoscale	« There is plenty of room at the bottom ». This visionary foresight of R. Feynman, introduced during a lecture at Caltech in 1959, was at the root of numerous scientific and technological developments, taking benefit of the "strange phenomena" occurring at the smallest scales. There remains however a lot to explore, in particular in the context of fluids at the nanoscales and their specific transport properties. In this talk, I will discuss some theoretical and experimental results obtained in our group on the fluid transport at small scales. I will in particular report experimental results for fluid transport inside a single Boron-Nitride nanotube, obtained in a specifically developed trans-membrane nanofluidic device. Experiments show unprecedented energy conversion from salt concentration gradients. Applications in the field of sustainable energy harvesting will be discussed.
Fernando Bresme	Wetting phenomena of soft ultrathin films	Newton Black Films (NBFs) are soft ultrathin films that are formed in foams and emulsions. This observation shows that their existence is closely linked to surfactant activity, with the non-polar phase (air – foams, oil – emulsion) plays a secondary role. Overall, the stability of NBFs depends on a wide range of variables; amphiphilic molecule chemical composition, temperature, salt concentration or disjoining pressure. Understanding the microscopic mechanisms governing the formation and the physical properties of NBFs is an important objective, both to explain the physical origin of the surface forces operating in these ultra thin nanometer structures, and to design soft materials of interest in industry and nanotechnology, where NBFs can be used to assist the two dimensional assembly of complex materials. I will discuss computer simulation studies on the structure and stability of NBFs. Computer simulations and recent methodological advances in the computation of the structure of interfaces provide a powerful approach to visualize the structure and formation of these films, making feasible the development of microscopic models to interpret their stability in the framework of wetting theory.
Alvaro Domínguez	CAPILLARY INTERACTIONS IN COLLOIDAL MONOLAYERS AT FLUID INTERFACES	Colloidal monolayers at a fluid-fluid interface are nowadays routinely realized in experiments, while the technological improvements in the last years have rendered these systems a useful testbed experimental model of questions of fundamental or technological relevance, respectively. Under generic conditions the dominant interaction between the particles of the monolayer is a capillary force due to the induced deformation of the fluid interface -- a specificity of colloids at fluid interfaces as opposed to colloids in bulk. This presentation will focus on the theoretical modelling of this capillary force and its effect on the static and dynamic properties of the monolayer. The mathematical description of the capillary interaction is formally analogous to two-dimensional screened Newtonian gravity, whereby the range of the interaction is the capillary length λ . In typical monolayers there is a good separation of scales (λ – millimeter, particle size – micrometer). Thus, the properties of a capillary-dominated monolayer can exhibit a crossover from those of a Yukawa fluid to those of a self-gravitating fluid. The signature of this crossover on the equilibrium states and the dynamic evolution has been studied with the help of theoretical analysis and numerical simulations, including an assessment of the relevance of the capillary interaction in comparison to the other interparticle forces that have been observed in monolayers (electric forces between charged particles, magnetic forces between magnetized particles, elastic forces in fluid-nematic interfaces).
Oleg Gang	Nanoscale Self-Assembly Guided by DNA and Geometry: Structures, Transformations and Rational Design	The structural plasticity and tunable interactions provided by DNA chains offer a broad range of possibilities to direct the organization of nanoscale objects into well defined systems, as well as to induce the structural transformations on demand. We have studied the assembly of clusters and extended 2D and 3D array architectures from nanoscale components of multiple types driven by DNA recognition, chain effects and geometrical factors. Our work explores how DNA-encoded interactions between inorganic nano-components can guide the formation of well-defined superlattices, how the morphology of self-organized structures can be regulated in-situ, and what molecular factors govern a phase behavior. The role of flexible chains, particle anisotropy, and external stimuli on a structure formation and its transformation will be discussed in details. Research is supported by the U.S. DOE Office of Science and Office of Basic Energy Sciences under contract No. DE-AC-02-98CH10886.
Piotr Garstecki	Flow of droplets in microchannels - from fundamentals to applications	In the talk I will discuss the fundamental and applied aspects of flow of droplets in microchannels. The fundamental questions include the apparently simple problem of predicting the speed of a droplet provided the cross-section of the fluidic duct, the viscosities of the droplet liquid and the continuous fluid, the interfacial tension between them and the rate of flow of the carrier liquid. Automated experiments allow to characterize in detail the complex dynamics of this simple system and to uncover an unexpected change of the topology of the field of flow inside the droplet upon a change of its speed. I will also show the use of the capillary effects and of the bypassing flow of the continuous liquid around the droplets in construction of geometric microfluidic modules that allow to trap, meter, merge, shift and array droplets completely passively, with minimum requirements on the precision of operating the device, while execute precise liquid-handling protocols.

Ramin Golestanian	Collective Behavior of Thermally Active Colloids	
Stephan Herminghaus	A Universal Phase Diagram for Wetting on Mesoscale Roughness	The wetting properties of solid substrates with mesoscale (between van der Waals tails and the capillary length) random roughness are considered as a function of the microscopic contact angle of the wetting liquid and its partial pressure in the surrounding gas phase. It is shown that the well-known transition occurring at Wenzel's angle is accompanied by a transition line at which a jump in the adsorbed liquid volume occurs. This should be present generally on surfaces bearing homogeneous, isotropic random roughness. While a similar abrupt filling transition has been reported before for certain idealized groove or trough geometries, it is identified here as a universal phenomenon. Its location can be analytically calculated under certain mild conditions.
Frank Jülicher	Dynamics of active films	Dynamic processes in cells are governed by the cell cytoskeleton, a network of elastic protein filaments. This gel-like network is inherently active, driven by force-generating processes on the molecular scale such as the action of motor molecules. Of particular importance for cell mechanics and the control of cell shape is the cell cortex, a thin layer of actin cytoskeleton below the cell membrane. The cortical layer has a thickness of several hundred nanometers and filaments turn over within 30s. Therefore, on time-scales beyond 30s, the cortex can be viewed as a thin film of an active fluid which can be described by continuum theories. We will discuss the physics of such active films and present a quantitative theory for spontaneous flow patterns which are generated during cell division in the cortex by gradients of active stresses. Finally, we discuss the effects of chiral active processes in the filament network. Such chirality arises because filaments of the cytoskeleton are helices. The interactions of motor molecules with such filaments gives rise to torque dipoles in the fluid that lead to large-scale flow patterns in the cell with chiral asymmetries. Such broken chiral symmetry has particularly rich effects near surfaces. Chirality in thin active films provides a key example for chiral asymmetries on the cellular scale.
Alexei Kornyshev	Ultra low voltage electro-wetting and beyond	Ultra low voltage electro-wetting and beyond A.A.Kornyshev *, A.Kucernak *, C.W.Monroe *,#, M.Marinescu *, A.Sleightholme*,#, and M.Urbakh ** *Department of Chemistry, Imperial College London, SW7 2AZ UK #School of Chemistry, Tel Aviv University, Ramat Aviv, 69978 Israel **Department of Chemical Engineering, University of Michigan, Ann Arbor, MI 48109-2136, USA Electrowetting – the use of electric fields to regulate the shape and dynamics of interfaces in contact with solids – has recently been applied in a number of current technologies, such as "liquid lenses" for mobile-phone cameras and microdisplays. These applications have reinvigorated the study of three-phase electrocapillarity. Working in the area of functionalized liquid-liquid interfaces our group has theoretically predicted and experimentally realized a novel electro-wetting system, based on interfaces between two immiscible electrolytic solutions (ITIES). These interfaces are being used in a number of electrochemical applications, including phase-transfer catalysis and surface cleaning of metals, but their unique electro-wetting properties have not been recognized before. We discovered a new, ITIES-based, electro-wetting system with unique properties, which can change the shape of the lens at operating voltages, by less than ½ Volt of variation of the electrode potential relative to the bulk, which is orders of magnitude smaller than those used in the existing electro-wetting devices ¹⁻⁶ . As we showed, ITIES are extremely well suited for electro-wetting: applied potentials can be varied over a range of 1V, subject to electrochemical control, but this is sufficient to achieve contact angle variation, that is obtained in conventional electro-wetting devices typically only at voltages >60 V; bulk and interfacial properties can be independently varied by adjusting the solution compositions, which gives additional opportunities for the modification of system properties. We presented several theoretical results that showed how charge is distributed within a droplet under an applied potential and how the contact angle between the droplet and a planar electrode depends on this potential. The theory hinges on two features that distinguish electro-wetting with ITIES from other liquid/liquid configurations: both solutions screen charge and the droplet boundary is impermeable to ions. A linear theory has first been developed for small applied potentials ¹ , later extended over a broader potential range. ²⁻⁴ The latter rationalizes the puzzling contact-angle saturation phenomenon observed in many electro-wetting systems. Experiments performed in our group ⁵ using standard ITIES at sputtered gold electrode have qualitatively approved the theory. However, we detected a substantial contact angle hysteresis and pinning of the three-phase contact line on the atomically rough and, perhaps, energetically inhomogeneous sputtered-gold electrodes ⁵ . To overcome that difficulty, i.e. to make those 'sticky' surfaces 'slippery', we have used a method of microsecond voltage pulses, short enough not to start electrochemical reactions at the interface, but powerful enough to de-pin the contact line and move the shape of the surface, i.e. the contact line to its 'final destination' ⁵ . These experiments have revealed interesting electro-wetting dynamics, that was worth of independent attention. We developed a successful theory of the system dynamic response to successive pulsing ⁶ , well reproducing experimental data, and rationalizing the principles of the pulsing technique for hysteresis-free electro-wetting devices on nonideal surfaces. This and several later developments will be overviewed at the conference. 1. C.W.Monroe, L.I.Daikhin, M.Urbakh, A.A.Kornyshev, "Principles of electro-wetting with two immiscible electrolytic solutions," J. Phys.: Condens. Matter 18 (2006) 2837–2869. 2. C. W. Monroe, L.I.Daikhin, M.Urbakh, A.A.Kornyshev, "Electro-wetting with Electrolytes," Phys. Rev. Lett. 97 (2006) 136102. 3. C. W. Monroe, M.Urbakh, A.A.Kornyshev. "The distinctive properties of electro-wetting with ITIES", J. Phys. Cond.Matter 19, #375113 (2007). 4. C.W. Monroe, M.Urbakh, A.A.Kornyshev, "Double-Layer Effects in Electro-wetting with Two Conductive Liquids", J. Electrochem. Soc. 156 , P21-P28 (2009). 5. A.A.Kornyshev, A.R.Kucernak, C.W.Monroe, A.E.S.Sleightholme, M.Urbakh, Ultra-low voltage electro-wetting, J. Phys. Chem. C 114, 14885-14890 (2010). 6. M.Marinescu, T.Barnea, M.Urbakh and A.A Kornyshev, Electro-wetting dynamics assisted by pulsing, J. Phys. Chem. C 114, 22558-22565 (2010).
Oleg Lavrentovich	Liquid crystal enabled dynamics of colloidal particles	We explore electrically-induced dynamics of colloidal inclusions in a liquid crystal. In the uniform electric field, the dynamics is caused through two prime mechanisms, dielectric reorientation of the director (backflow effect [1]) and through electrophoresis [2]. In addition to the classic Smoluchowski linear term in the velocity vs. field dependency, there is also a nonlinear contribution to the velocity that is quadratic in the field; its direction is generally different from the direction of the electric field [2]. In a non-uniform electric field, the particles can be moved by the dielectrophoretic effect; as an example, we demonstrate a formation of a liquid crystal from elongated gold nanorods dispersed in an isotropic fluid [3]. References [1] O. Pishnyak, S.V. Shiyankovskii, O.D. Lavrentovich, Phys. Rev. Lett. 106, 047801 (2011). [2] O. D. Lavrentovich, I. Lazo and O.P. Pishnyak, Nature 467, 947-950 (2010) [3] A.Golovin et al, Materials 4, 390-405 (2011).
Yan Levin	Ions at Interfaces: Surface Tensions and Surface Potentials of Electrolyte Solutions.	Availability of highly reactive halogen ions at the surface of aerosols has tremendous implications for the atmospheric chemistry. Yet neither simulations, experiments, nor existing theories are able to provide a fully consistent description of the electrolyte-air interface. In this talk a new theory will be presented which allows us to explicitly calculate the ionic density profiles, the surface tension, and the electrostatic potential difference across the solution-air interface [1,2]. The theory takes into account both ionic hydration and polarizability [3]. The theoretical predictions are compared to experiments and are found to be in excellent agreement. The theory is then extended to study general hydrophobic surfaces [4]. Finally, the implications of the present work for stability of lyophobic colloidal suspensions will be considered [5], shedding new light on one of the oldest puzzles of physical chemistry --- the Hofmeister effect. \\ \\noindent [1] Y. Levin, A.P. dos Santos, and A. Diehl, Phys. Rev. Lett. 103, 257802 (2009). \\ \\noindent [2] A. P. dos Santos, A. Diehl, and Y. Levin, Langmuir 26, 10778 (2010).\\ \\noindent [3] Y. Levin, Phys. Rev. Lett. 102, 147803 (2009). \\ \\noindent [4] A. P. dos Santos, and Y. Levin, Langmuir 28, 1304 (2012). \\ \\noindent [5] A. P. dos Santos and Yan Levin, Phys. Rev. Lett. 106, 167801 (2011)

Hartmut Lowen	Collective dynamics of self-propelled particles	<p>We explore active rod-like colloidal particles by computer simulation and theory. First of all, the Brownian motion of self-propelled particles is described. Then Brownian dynamics simulations are used to explore the nonequilibrium dynamics of concentrated self-propelled rods which are interacting via a Yukawa segment model. In a linear channel, transient hedgehog-clustering at the system boundaries is found [1]. In the two-dimensional bulk, anomalous turbulence emerges [2] in agreement with recent experimental data on bacterial motion [3]. We then discuss possibilities to trap self-propelled particles efficiently [4]. Finally we study the freezing transition for very dense self-propelled particles and find differences to equilibrium freezing [5,6].</p> <p>[1] H. H. Wensink, H. Lowen, Phys. Rev. E 78, 031409 (2008).</p> <p>[2] H. H. Wensink, H. Lowen, Emergent states in dense systems of active rods: from swarming to turbulence, J. Phys.: Condensed Matter (in press), see also http://arxiv.org/abs/1204.0381</p> <p>[3] H. H. Wensink, J. Dunkel, S. Heidenreich, K. Drescher, R. E. Goldstein, H. Lowen, J. M. Yeomans, PNAS 109, 14308-14313 (2012).</p> <p>[4] A. Kaiser, H. H. Wensink, H. Lowen, Physical Review Letters 108, 268307 (2012).</p> <p>[5] J. Bialk'ev, T. Speck, H. Lowen, Physical Review Letters 108, 168301 (2012).</p> <p>[6] A. M. Menzel, H. Lowen, Traveling and resting crystals in active systems, submitted</p>
Igor Musevic	Wetting and Topology in Liquid Crystal Colloids	
Marek Napiorkowski	Wetting on structured substrates	Morphologies of selected wetting layers on structured substrates are discussed within mesoscopic approach with emphasis on the role played by linear inhomogeneities of the order parameter and their mutual interactions. As a particular example, the mesoscopic analysis of the Gibbs criterion is presented.
Benjamin Ocko	Drops and Wetting on Nanopatterned Surfaces: AFM, X-ray and Theory	<p>In this talk I will review x-ray scattering and non-contact AFM measurements from equilibrium liquid films and drops on nanopatterned surfaces, both chemical and topographical. Here the features are as small as 20 nm with a periodicity as small as 40nm are utilized. For studies on chemical patterns, the height and shape of the condensed drops have been measured using AFM. For sufficiently small drop sizes, the surface energy associated with the curvature reduces the nanodrop's height relative to a flat wetting film. Under saturated conditions, our results show that the height of the drops scales as the square root of the width of the chemical features, in good agreement with theory. The stability of thin wetting films has also been investigated on chemically patterned surfaces. Our results show that films spanning the entire pattern are only stable for thicknesses in excess of a critical value h_c whereas thinner films spontaneously dewet the partially wettable regions of the substrate. The critical thickness h_c increases linearly with the width of the partially wettable stripes in good agreement with an interface displacement model derived from microscopic density functional theory. The equilibrium filling/wetting of nanogrooves with an organic liquid have also been investigated using x-ray scattering methods, both in transmission and reflection geometries. Our results show deviations with respect to a simple geometric filling model based on the Kelvin Equation and are in good agreement with DFT calculations. A new surface x-ray scattering technique for studying topographical surfaces that eliminates the strong refraction and reflection terms inherent in grazing incidence x-ray scattering measurements will be discussed and this should allow a direct determination of the meniscus shape. I will also show how similar nanopatterned surfaces can be used to make ultrahydrophobic surfaces. These in-situ x-ray results clearly show that air must be trapped in the cavities and that the penetration of the water into the cavities is 7 ± 3 nm, independent of the cavities depth. In collaboration with Antonio Checco, Tommy Hofmann, Chuck Black and Kevin Yager (BNL) and Mykola Tasinkevych and Siegfried Dietrich (Max-Planck-Institute, Stuttgart)</p>
David Quéré	A tribute to Leidenfrost	Leidenfrost discovered in 1756 "the spheroidal state of water", where this common liquid behaves very differently owing to the presence of a hot material below it. We discuss several properties of the Leidenfrost state, among which the possibility of levitating solids, the ability of drops or solid platelets to self-propel on asymmetric patterns, and the "cold" Leidenfrost regime recently described by Vakarelski et al.
Elie Raphaël	Profile shape and energy dissipation in stepped bilayer thin polymer films	A liquid surface with non-constant curvature is unstable, as the Laplace pressure drives a flow that is mediated by the viscosity. We present the results of atomic force microscopy experiments on one of the simplest possible non-flat surfaces: stepped bilayer thin polymer films. In the first set of experiments, height profiles are measured as a function of time for a variety of molecular weights. Additionally, the dependence of the flow on the geometry of the sample is examined. To understand the experimental results, we derive expressions for the energy dissipation as a function of time and film geometry which are in agreement with the experiments. The results indicate the ideality of stepped bilayer polymer systems as a use for nanometric rheological probes, and provide a conceptual framework in a simple system with which to understand highly viscous surface tension driven flows.
Markus Rauscher	Nanofluidics: Dynamics of thin films and nano-droplets	<p>Fluids on the nanoscale behave qualitatively different from macroscopic systems. This becomes particularly evident if a free liquid-liquid or liquid-vapor interface is close to a solid surface such as in the case of nanodrops or ultrathin films. Hydrodynamic slip, thermal fluctuations, the molecular structure of the fluid, and the range of the intermolecular interactions are important for the structure and the dynamics of such open nanofluidic systems.</p> <p>Here we focus on a top-down approach to the theoretical description of fluids on the nanoscale: mesoscopically augmented hydrodynamic equations. We discuss their application to the dynamics of dewetting on homogeneous substrates as well as on the dynamics of nanodroplets and rivulets on topographically or chemically structured substrates.</p>
Paddy Royall	The colloidal corral : a model system for nanoconfinement	Nanoconfinement has profound implications for system behavior. Salient features such as melting point depression and influence on structure are important in fields ranging from aerosols to drug discovery. Here we introduce a two-dimensional colloidal model system of nearly hard discs in soft confinement. A ring of colloidal particles is defined using holographic optical tweezers and the interior of this ring is populated with similar particles. Confinement in the third dimension is achieved by gravitational sedimentation. The structure of this system differs from similar systems with hard walls in that at sufficient density, local hexagonal ordering is observed to compete with the concentric layered structure, leading to melting point depression and anisotropic dynamics. Additionally, through comparing the behaviour of the soft wall for populated and unpopulated confining rings, the radial pressure is found as a function of area fraction, leading to a direct measurement of the equation of state. Rotating the trapped particles leads to a novel model geometry to explore phenomena such as shear banding at the single-particle level.
Eduardo Saiz	Kinetics of high-temperature spreading	Even though low- and high-temperature liquids share some characteristics, they also have important fundamental differences: While the viscosities can be similar, molten metals and oxides have typically 1–2 orders of magnitude larger surface tensions and works of adhesion. In addition, spreading at high temperature is often accompanied of chemical reactions and interdiffusion while most model low temperature systems can be considered non-reactive. The comparison of high- and low-temperature data will help to determine the relative weight of the different physicochemical factors viscosity, solid-liquid interactions, surface tensions, etc. that affect the movement of the liquid front. In this work we will review recent spreading data that suggests that for high-temperature non-reactive systems the mechanism controlling the dynamics of wetting is the friction dissipation at the three-phase line where the substrate, liquid and gas meet. We use the Molecular Kinetic Theory (MKT) to describe this channel of dissipation and compare the experimental results with molecular dynamic simulations that allow us to understand and model the mechanisms that control spreading at the atomic scale. A possible extension to reactive systems is also discussed.

Kathleen Stebe	Microparticle at interfaces of isotropic and anisotropic liquids	When microparticles are placed on the interface of an isotropic liquid, they interact owing to capillarity. Microparticles with complex shapes can orient and assemble to form regular structures. Geometry can be used to fine tune near field interactions, to create elastic or brittle structures, to create near field repulsions or enhanced attractions. On curved interfaces, particles migrate owing to capillarity to sites of high curvature. We demonstrate these phenomena at interfaces of isotropic liquids using confining geometries to mold the interface shape. Recent results for microparticles at interfaces of nematic liquid crystals are then described, in which the director field can influence the particle interactions, trajectories and structures.
Howard Stone	Wetting and drying of fibers	To be determined
Yutaka Sumino	Emergence of Droplet Motion Induced by a Chemical Flux of Surfactant.	Spontaneous translational motion of a mm-sized droplet is generated by a transfer of surfactant from one phase to the other phase even in an isotropic condition. Such motion can be realized because the increase of the surfactant concentration results in the change of the wettability, interfacial tension, and rheology. Interestingly, macroscopic regular motion is caused through the spontaneous symmetry breaking. In this talk, we show the examples of such droplet motion induced by wettability difference[1, 2], and difference in rheology [3-6]. The system, in which a droplet moves by wettability difference, is composed of an aqueous phase and an oil droplet set on a glass surface. A cationic surfactant, stearyltrimethylammonium chloride (STAC), is dissolved into the aqueous phase. Iodine solution of nitrobenzene saturated with potassium iodide is used as the oil droplet. In this system, STAC initially dissolved in the surrounding aqueous phase continuously flows into the oil droplet through an oil-water interface and a glass surface. When STAC molecules adhere on the glass surface, the surface becomes more hydrophobic. If the oil droplet pass through the glass surface, the adhered STAC molecules dissolves into the oil droplet results in the hydrophilic surface. Thus, the surface underneath the oil droplet is always more hydrophilic than the outside of the oil droplet. Consequently, the oil droplet propels itself with infinitesimal perturbation. Since the droplet prefers to travel at a fixed velocity, the droplet shows regular rotational motion under the attractive centrifugal force. A droplet can move by the generation of a surfactant aggregate around the oil droplet. The system composed of an aqueous phase containing STAC, and an oil droplet floating on the aqueous phase. The oil droplet is composed of palmitic acid solution of tetradecane. In this system, palmitic acid dissolved in the oil droplet flows into aqueous phase. Palmitic acid in the aqueous phase forms aggregate with STAC, which possesses polarized lamellar structure. Continuous formation of such surfactant aggregate on the oil-water interface, results in the blebbing-like instability of oil-water interface. The correlation between size of the instability and the size of the oil droplet is explained with a simple mathematical model, adopting the elastic nature of the aggregate.
		References [1] Y. Sumino et al., Phys. Rev. Lett. 94, 068301 (2005). [2] Y. Sumino, K. Yoshikawa, Chaos 18, 026106 (2008). [3] Y. Sumino et al., Phys. Rev. E 76, 055202 (2007). [4] Y. Sumino et al., J. Phys. Chem B 113, 15709-15714 (2007). [5] Y. Sumino et al., Softmatter 7, 3204-3212 (2011). [6] Y. Sumino et al., Langmuir 28, 3378-3384 (2012).
Hajime Tanaka	Glassy slow dynamics of confined hard spheres	Critical concentration fluctuations give rise to critical Casimir force between colloids immersed in a critical binary mixture via their couplings to colloid surface fields. The force has so far been considered for a quiescent situation. However, because of critical slowing down toward a critical point, the order parameter profile around a particle can easily be perturbed by any motion of colloidal particles or flow, which leads to a significant change in the force. This problem is far beyond previous treatments based on the static Hamiltonian. Here we study Casimir force under such a nonequilibrium situation, using the fluid particle dynamics method, by incorporating kinetic couplings between the order parameter field, the fluid velocity field, and the particle motion. We show the intrinsic importance of dynamical effects on critical Casimir interactions. Because of much faster momentum diffusion compared to mutual concentration diffusion near a critical point, dynamical nonequilibrium effects are of intrinsic importance. The effects cannot be ignored even when two particles are attracted by the critical Casimir force itself. This suggests intrinsic and universal importance of the nonequilibrium nature of critical Casimir interactions.
Margarida Telo da Gama	Wetting by Complex Fluids	We address the wetting phase diagram of complex fluids. We focus on two classes of such fluids: structured and orientationally ordered fluids. Using mesoscopic (Landau type) theories for structured (equilibrium polymers, microemulsions, patchy colloids) and ordered(nematic liquid crystals) fluids we discuss the wetting phase diagram on various surfaces. The interplay of length scales leads to novel results for the stable wet phases, even on structureless substrates. On structured substrates nematic wetting and filling may be suppressed through the nucleation of topological defects which dominate the switching dynamics between filled states.
Erio Tosatti	Colloids and nanofriction: a strange pair.	In a pioneer experiment, Bechinger's group in Stuttgart realized the controlled sliding of two-dimensional colloidal crystals over laser-generated periodic or quasi-periodic potentials.[1] I will describe realistic simulations and arguments which besides reproducing the main experimentally observed features, demonstrate the potential impact of colloid sliding in crystal nanotribology.[2] The free motion of solitons and antisolitons in the sliding of hard incommensurate crystals is contrasted with the soliton-antisoliton pair nucleation at the large static friction threshold when the two lattices are commensurate and pinned. The frictional work can be directly extracted from particles' velocities and analysed as a function of classic tribological parameters, including speed, spacing and amplitude of the periodic potential (representing respectively the mismatch of the sliding interface, and the corrugation, or "load"). These and other features suggestive of further experiments and insights promote colloid sliding to a novel friction study instrument. [1] T. Bohlein et al, Nat. Mat. 11, 126 (2012) [2] A. Vanossi et al, PNAS 109, 16429 (2012) 109-16433
Sandra M. Troian	Modulated Interface Lithography : The Nanoworld Beyond Bénard Instability	Experiments by several groups during the past decade have demonstrated that molten nanofilms whose surface is exposed to a large and uniform transverse thermal gradient undergo spontaneous formation of nanopillar arrays with a pitch on the order of tens of microns. These 3D arrays adopt various symmetries and shapes depending on local initial and boundary conditions. Once the thermal gradient is removed, the structures rapidly solidify in place resulting in nanostructures with extraordinarily smooth surfaces, particularly advantageous for optical and photonic applications. Control over structure formation, however, requires identification of the dominant physical mechanism which establishes the minimum lateral feature size as well the material and geometric properties affecting the growth rates. There are currently two prevailing explanations for this observed phenomenon: (i) electrostatic attraction between the molten film and overlying substrate due to induced surface image charge (Chou et al. 2002) and (ii) interface radiation pressure from coherent reflections of acoustic phonons (Schäffer et al. 2003). In this talk, we demonstrate instead that the fluid elongations are likely caused by a long-wavelength deformational instability caused by extremely large thermocapillary forces ("nano-Bénard-Marangoni flow") which rapidly outweigh stabilization by capillary forces. Linear stability and Lyapunov analyses of the governing interface equation for the parameter range relevant to experiments indicate that there is no critical number for instability and no steady states. If not mass limited, the nanopillars grow continuously until contact with the cooler substrate is achieved. We compare these predictions with ongoing experimental measurements in our laboratory of in-situ array formations. Although measurements indicate closest agreement with the thermocapillary model, there remain quantitative differences with theory. Time permitting, we will also examine resonant wavelength phenomena in these systems, which suggests alternative methods for achieving perfectly uniform arrays. In total, these results demonstrate the tremendous potential of this patterning technique for 3D lithography based on interface modulation.
Raphael Voituriez	Different aspects of cell motility in confinement	I will first present a phenomenological coarse-grained model of the cell cytoskeleton, viewed as a visco-elastic medium driven out-of-equilibrium by ATP hydrolysis. I will show that this model of "active gel", introduced by Kruse et al. leads to a rich phase diagram, and in particular to spontaneous hydrodynamic flows -- and therefore macroscopic motion -- in absence of external forcing. Next I will discuss applications to cell motility, and emphasize the role of geometric confinement. Based on recent experiments of cell motility in micro channels, I will show that even in conditions of reduced friction, motility can be restored by geometric confinement.
Edmund Webb III	Atomistic Scale Study of Cratering Induced Droplet Splashing	Results are presented from molecular dynamics models exploring impact of molten metal copper droplets onto solid metal aluminum substrates. Models employ energy absorbing mechanical boundary conditions that permit studies of high energy droplet impacts. For sufficiently high impact velocity, a transition to prompt splashing is observed and it is demonstrated that this results from a substrate cratering mechanism. Fundamental, atomic scale phenomena that drive cratering and the accompanying splashing transition are elucidated. Substrate material forms a ridge in front of the wetting liquid front and the liquid eventually spreads over this ridge. During this process, the spreading liquid front is given velocity away from the substrate. If the associated kinetic energy is sufficient to overcome surface energy contributions, splashing results. To our knowledge, these are the first data presented exploring cratering induced splashing at this fundamental length and time scale.

Julia Yeomans

Stirring by Microswimmers

Mixing by Microswimmers

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Because of their size bacteria and fabricated micro-swimmers swim at low Reynolds number, a regime where the effect of hydrodynamics can be counterintuitive. Moreover micro-swimmers provide experimentally accessible examples of active systems that create their own energy and operate out of thermodynamic equilibrium. The mechanisms by which bacteria interact with particles in their environment are relevant to their feeding strategies and may contribute to oceanic mixing. We discuss how passive tracers are advected by swimmers, and hence estimate the diffusion constant of particles in a bacterial suspension. We also examine encounters between a swimming bacterium and an inert spherical particle across a range of particle sizes, from tracers, through particles of intermediate size that are capable of deflecting the paths of the bacteria, to particles much larger than the swimmer that effectively behave as curved surfaces as a swimmer approaches.

Natsuhiko Yoshinaga

self-propulsive motion of a droplet driven by Marangoni effect

I shall send this later.