DY 41: Poster - Pattern/ Nonlinear Dyn./ Fluids/ Granular/ Critical Phen.

In this poster session there are contribution to the topics
- Pattern Formation
- Nonlinear Dynamic Effects
- Fluids/ soft matter / granular
- Critical Phenomena

Time: Thursday 17:00–19:00 Location: P3

DY 41.1 Thu 17:00 P3

Formation of salt polygons on salt playas — •Antoine Fourrière and Lucas Goehring — Max Planck Institut for Dynamics and Self-organization, Göttingen, Germany

On the grounds of natural salt deserts or in evaporation pools for industrial salt extraction, one can see some self-organized polygonal network of 1-2m diameter. The edges of these periodic structures are formed by salt crystal ridges, that is the reason why we call them 'salt polygons'. In this work, we analyze three different potential mechanisms to explain the formation and the scaling of salt polygons: (i) dessication cracks, (ii) non-linear wrinkling of an elastic layer and (iii) porous medium convection cells in the soil. We built a 2D experiment to test these ideas and most particularly the third one. A Hele-Shaw cell is filled with a porous medium saturated with a salty solution and heated from the side. Surface evaporation causes a steady upward flow of salty water, which leads to precipitation near the surface. Hence, a vertical salt gradient builds up in the porous medium and causes a overturning of denser saltier water. An appropriate Rayleigh number (cf. Lapwood 1948) controls the onset of convection in the porous medium. We change the Rayleigh number by varying the evaporation rates or the permeability of the model soil and measure the wavelength of the salt features that form at the surface. We also visualize the water movements into the Hele-Shaw cell during the experiment. Finally, by using our experimental observations, we revisit the natural formation of these patterns with a pinch of salt.

DY 41.2 Thu 17:00 P3

Growth of Hair Ice — •Christina Inninger[1], Lorenz Eichler[1], Christian Mätzler[2], and Thomas Grillenbeck[1] — [1]Ignaz-Günther-Gymnasium Rosenheim, Rosenheim, Germay — [2]University of Bern, Institute for Applied Physics, Switzerland

The hair-like or cotton-like ice formations known as hair ice are sometimes to be observed on rotten and humid beech wood or oak. Its origin is not quite clear. The supposition that an active fungus causes the growth to the strange phenomenon rests on some physical and wooden-anatomical facts: Saprophytic fungi feed on organic nutrients which they diminish enzymatically. The end products CO_2 and H_20 as well as some warmth originate during the enzymatic degradation of starch and fat stored in the wooden body above all the wooden rays. The gas pressure of the CO_2 expels the water stored in the wooden body as well as the water produced in the degeneration process through the radial channels of the rays to the wood surface. On the surface it freezes at temperatures slightly below melting point due to the crystallization germs. We study the growth process and distinguish hair ice from related forms, such as ice ribbons and needle ice.

DY 41.3 Thu 17:00 P3

Phenomenological simulations of metal layer formation during sputter deposition — •Sven-Jannik Wöhnert[1], Gunthard Benecke[1,2], Matthias Schwartzkopf[1], and Stephan V. Roth[1] — [1]DESY, Notkestr. 85, D-22607 Hamburg, Germany — [2]Max Planck Institute of Colloids and Interfaces, Department of Biomaterials, Am Mühlenberg 1 OT Golm, D-14476 Potsdam, Germany

Sputter deposition is one high-throughput method to install with highest rates patterned nanostructures on surfaces. Grazing incidence small-angle X-ray (GISAXS) scattering nowadays delivers a wealth of information during in-situ processes and real-time observations [1,2]. To analyze the data, simulation of GISAXS pattern based on realspace structures is indispensable. Based on the results of [1], we therefore simulate the in-situ experiments by continuous deposition of gold atoms on a silicon surface and follow their arrangement into clusters using Monte-Carlo methods. As boundary conditions, we impose the successful geometric model of [1]. Therefore, we are able to image the cluster layer built-up during the continuous depostion of Au atoms during the sputter process. We present quantitative visualization of the different growth modes of the real-time experiment. Especially we are able to observe coalescence, contact angle and diffusion on the nanoscale.

[1] Schwartzkopf et al., Nanoscale 5, 5053-5062 (2013)
[2] Shun et al., J. Phys. Chem. Lett., 3170-3175 (2013)

DY 41.4 Thu 17:00 P3

Non-equilibrium dynamics of ordered modulated phases — •Christian Riesch, Günter Radons, and Robert Magerle — Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz

We have performed numerical simulations of simple models for modulated phases, with the focus on 2D stripe-forming systems. The system is initially prepared in an ordered state without topological defects, and the subsequent evolution at a finite noise strength is monitored. This results in a rich non-equilibrium dynamics. In particular, we find aging in the two-time correlation function of the local stripe orientation, which is explained in terms of a growing correlation length perpendicular to the stripes. We also discuss the effects of system size, aspect ratio and a possible cross-over to 1D behavior.

DY 41.5 Thu 17:00 P3

Optical birefringence in dried laponite films — •Pawan Nandakishore, Anupam Sengupta, and Lucas Goehring — Max Planck Institute for Dynamics and Self-Organization (MPIDS)

The emergence of anisotropy in a material can be attributed to either the structure of the materials or the buildup of internal stresses within a material. Using Optical polarization microscopy we study dried laponite suspensions under ambient conditions. We observe birefringence in the bulk and on the edges of dried laponite films. Laponite is know to transition from an isotropic liquid to an isotropic gel and finally to a nematic gel as a function of the initial concentration and changing salinity. We observe that dried samples of laponite are birefringent even when the laponite concentration before drying is in the isotropic gel phase regime. The birefringence scales with concentration before drying and reaches a maximum when it is in the nematic phase regime. Bulk birefringence in the dried samples can be attributed to ordering of laponite disks due to drying where as the birefringence in the edge is stress induced. We observe similar stress induced birefringence at edges of a crack opening and along the edge of laponite thick films (millimeter-centimeters films). Dried laponite films are model systems to study stress induced birefringence and birefringence due to structural anisotropy.

DY 41.6 Thu 17:00 P3

Stability of Binary Patterns in Optomechanical Arrays — •Christian Brendel, Roland Lauter, Steven Habraken, Max Ludwig, and Florian Marquardt — Institute for Theoretical Physics, Friedrich-Alexander University, Staudtstraße 7, 91058 Erlangen, Germany

We focus on two-dimensional arrays of mechanically coupled, laser-driven, optomechanical cells. Consisting of both an optical mode and a mechanical (vibrational) mode, those cells can be driven into self-sustained oscillations. A non-linear set of differential equations, that describe the evolution of the phases thereof, can be derived [1]. The parameters of this classical model can be tuned by the laser drives. We concentrate on binary patterns in which all oscillators are initialized to phases of 0 or pi. Being fixpoints of the equations of motion, the stability of these configurations is observed in limiting cases of the model. Moreover, we study the stability and time evolution of domain configurations within binary patterns and give an overview of the effects occurring in the parameter space.

[1] G. Heinrich, M. Ludwig, J. Qian, B. Kubala and F. Marquardt, Phys. Rev. Lett. 107, 043603 (2011)

DY 41.7 Thu 17:00 P3

Functional connectivity of distant cortical regions: role of remote synchronization and network symmetry — •Philipp Hövel[1,2] and Vesna Vuksanović[1,2] — [1]Technische Universität Berlin, Germany — [2]Bernstein Center for Computational Neuroscience Berlin, Germany

We aim to reproduce resting-state functional-connectivity (FC) networks modeling (neural and BOLD) activity of the interacting cortical regions. We focus on the topology of the network interactions as a main ingredient of our model based on experimental data taking into account both anatomical and functional connectivity. Hence, important information about the presence/absence of direct neural connections within functionally connected nodes is included in the model. Controlling for direct neural links in functional networks allows us to test hypothesis that remote synchronization of the neural activity, arising from the underlying topology of the network interactions, accounts for the FC between distant cortical regions.

Using Kuramoto oscillators with frequencies in gamma frequency range, we explore emergence of the synchronization between pairs of the neural network nodes for different interactions topologies obtained via thresholds to the empirically derived FC matrix. We show that pronounced synchrony between nodes reflects symmetry of the coupling matrix, i.e., the strong overlap in the respective neighborhoods. We also illustrate that symmetry of the interactions drives remote nodes into synchronized activity and therefore plays central role in emergence of the functional connections between distant cortical regions.

DY 41.8 Thu 17:00 P3

Aging in systems of classical oscillators — •Florin Ionita, Darka Labavić, and Hildegard Meyer-Ortmanns — School of Engineering and Science, Jacobs University Bremen, PO Box 750561, D-28725 Bremen, Germany

Aging is a familiar phenomenon from glassy systems, in particular from spin glasses and materials with slow relaxation processes after a perturbation, breaking of time-translation invariance, and dynamical scaling. We study these effects in systems of classical oscillators, active rotators and Kuramoto oscillators that are coupled with frustrated bonds. The induced multiplicity of attractors of fixed-point or limit cycle solutions leads to a rough potential landscape. When the system is exposed to additive noise, the oscillator phases migrate through this landscape and escape from one metastable state to another, generating a multitude of different escape times [1]. When the system is quenched from the regime of a unique fixed point towards the regime of multistable limit-cycle solutions, the autocorrelation functions depend on the waiting time after the quench and show dynamical scaling for an intermediate regime of time periods between the two measurements. We point out parallels between oscillatory systems and spin glasses in the physical origin of aging.

[1] F. Ionita, D. Labavić, M. Zaks, and H. Meyer-Ortmanns, Order-by-disorder in classical oscillator systems, Eur. Phys. J. B (2013), in press.

DY 41.9 Thu 17:00 P3

Heteroclinic snaking near a heteroclinic chain in dragged meniscus problems — •Mariano Galvagno[1], Dmitri Tseluiko[1], and Uwe Thiele[1,2] — [1]Department of Mathematical Sciences, Loughborough University, UK — [2]Institut für Theoretische Physik, Universität Münster, Germany

We study the deposition of a non-volatile liquid film onto a flat heated inclined plate extracted from a bath at constant speed. We analyse steady-state meniscus solutions of a 2d long-wave mesoscopic hydrodynamic description that incorporates wettability via a Derjaguin (disjoining) pressure as the plate velocity is changed. We observe snaking behaviour when the plate inclination angle is above a certain critical value. Otherwise, the bifurcation curve is monotonic. The solutions along these curves are characterised by a foot-like structure [1] formed close to the meniscus. The foot is preceded by a thin precursor film further up the plate. We show that the snaking is related to the existence of infinitely many heteroclinic orbits close to a heteroclinic chain in an appropriate 3d phase space connecting the fixed points of the system [2]. [1] A. Münch, P.L. Evans, Phys. D 209, 2005. [2] M. Galvagno, D. Tseluiko, U. Thiele, arxiv.org/abs/1307.4618

DY 41.10 Thu 17:00 P3

Effects of empowerment-driven spins in the 2D-Ising model — •Lukas Everding[1] and Daniel Polani[2] — [1]Ludwig-Maximilians-Universität, München/Deutschland — [2]University of Hertfordshire, Hatfield/UK

Recent work has increasingly focussed on large-scale non-equilibrium systems. Especially interesting are systems which are pushed away from equilibrium by active ("driven") particles where the driving forces may arise from various principles. We specifically investigate large-scale systems with particles driven by a principle belonging to the class of 'intrinsic motivation' drives called "empowerment". Empowerment-driven particles are given a limited freedom of choice in their behavior and they act with the goal of getting the largest possible perceivable influence onto the system, basically maximizing an information-theoretic criterion for combined controllability/observability. We investigate the effects of seeding a 2-d Ising model with a small number of empowerment-driven particles: using Monte-Carlo methods, we first show that these particles stabilize the system at finite magnetization, even well above the critical temperature. The system is dragged away from the unordered equilibrium state and kept in a more ordered state. Second, we show that the second-order phase transition of the classical Ising model at T_c is smoothed out to a slow and gradual transition from the ordered state to the unordered one with increasing temperature. An analogous effect is seen in a quite different Nagel-Schreckenberg model which indicates that empowerment-driven particles seem to push the bounds of ordered regimes into the disordered regimes.

DY 41.11 Thu 17:00 P3

How Markovian is a time series? — •Pedro Lencastre[1,2], Frank Raischel[3], and Pedro G. Lind[4] — [1]ISCTE-IUL, Av. Forças Armadas, 1649-026 Lisboa, Portugal — [2]Mathematical Department of Faculdade de Ciências of University of Lisbon, Campo Grande 1749-016 Lisboa — [3]Instituto Dom Luiz, CGUL, 1749-016 University of Lisbon, Lisbon, Portugal — [4]ForWind and Institute of Physics, Carl-von-Ossietzky University of Oldenburg, DE-26111 Oldenburg, Germany

We describe a simple procedure for testing if a series of measurements is non-markovian or not for a particular time-lag. Our procedure is based in a quantitative measure of non-markovianity and is particular suited for short time series. The error of the test can be estimated. Further, we briefly discuss how to apply this procedure to real data in geophysics and interdisciplinary topics.

DY 41.12 Thu 17:00 P3

Multi-point description and time series reconstruction — •Ali Hadjihosseini — ForWind, Oldenburg,Germany

We proposed a method that allows a reconstruction of time series based on multi-point statistics given by hierarchical process. This method is able to model water wave time series including extreme events. We extend the stochastic cascade description by conditioning on wave height value itself, and find that the corresponding process is also governed by a Fokker-Planck equation, which contains as a leading term a simple additional wave height-dependent coefficient in the drift function. As a main result it is shown that this method is able to reproduce the extreme events in time series.

DY 41.13 Thu 17:00 P3

Wind Farm Optimization with Monte Carlo Methods — •Klaus Nagl and Ingo Morgenstern — Universität Regensburg

We determine the optimal layout of the turbines inside a wind farm, taking the wake effects into account. We show the differences between the N.O Jensen and the Larsen Wake Models.

For this purpose we use a simulated annealing algorithm adapted to this specific problem. Two different objective functions are considered: the Annual Energy Production and the Profit, which lead to different optima. A detailed analysis is presented to help determining the best objective function to choose in each case.

DY 41.14 Thu 17:00 P3

Bayesian Analysis of Non-Gaussian Long-Range Dependent Processes — Tim Graves[5], •Nicholas Watkins[1,2,3,4,8], Bobby Gramacy[6,5], and Christian Franzke[7,8] — [1]MPIPKS, Dresden, Germany — [2]CFSA, Physics, University of Warwick, Coventry, UK — [3]MCT, Open University, Milton Keynes, UK — [4]CATS, LSE, London, UK — [5]Statistics Laboratory, University of Cambridge, Cambridge, UK — [6]Booth School of Business, The University of Chicago, Chicago, USA. — [7]Meteorologisches Institut, Universität Hamburg, Germany — [8]British Antarctic Survey, Cambridge, United Kingdom

We have used MCMC algorithms to perform a Bayesian anal-

ysis of Auto-Regressive Fractionally-Integrated Moving-Average ARFIMA(p, d, q) processes, which are capable of modeling LRD [Graves, Ph.D, 2013]. Our principal aim is to obtain inference about the long memory parameter, d, with secondary interest in the scale and location parameters. We have developed a reversible-jump method enabling us to integrate over different model forms for the short memory component. We initially assume Gaussianity, and have tested the method on both synthetic and physical time series. We have extended the ARFIMA model by weakening the Gaussianity assumption, assuming an α-stable distribution for the innovations, and performing joint inference on d and α. We will present a study of the dependence of the posterior variance of the memory parameter d on the length of the time series considered. This will be compared with equivalent error diagnostics for other measures of d.

DY 41.15 Thu 17:00 P3

Simulating single-molecule pulling experiments: coupling transport and molecular dynamics simulations — •Alessandro Pirrotta[1], Ignacio Franco[2], and Gemma C. Solomon[1] — [1]Nano-Science Center and Department of Chemistry, University of Copenhagen, 2100, Copenhagen Ø, Denmark — [2]Department of Chemistry, University of Rochester, Rochester, NY 14627-0216 USA

We aim to develop a method that would allow us to simulate single-molecule pulling experiments using molecular dynamics (MD) simulations coupled to transport. In order to do this, we have worked to extend the force field employed in the MD simulation to explore a wider range of molecules. The DFTB+ code is employed to compute the transmission function for the system and simulate the electrical properties, in order to investigate correlations between the conformational changes of a molecular system and the conductance. In particular, we apply this to a hydrogen-bonded dimer with a range of bonding motifs as the system is extended.

DY 41.16 Thu 17:00 P3

POCLMD: A Flexible GPU Accelerated Molecular Dynamics Code — •Chuanfu Luo[1] and Jens-Uwe Sommer[1,2] — [1]Leibniz-Institut für Polymerforschung Dresden, Germany — [2]Technische Universität Dresden, Germany

Recently, heterogeneous computing becomes a trend in high performance computing. Many newly built super-computers are equipped with powerful GPUs or coprocessors, which can deliver up to 5 Tflops per unit. The OpenCL is an open standard programing language which is supported by all vendors of GPU or coprocessor. Code written in OpenCL can run on multiple-core CPUs, GPUs, and coprocessors without any changes. POCLMD is designed to be a fast, flexible and easy-to-use MD code, which is programed in Python and OpenCL through PyOpenCL [1]. All time-consuming calculations are performed on GPU, and CPU only deals with data transfer and pre-/post- processing. The first released version of POCLMD will support basic simulations of NVE/NVT/NPT for coarse-graining polymeric models, including bond, angle and pair-wised LJ potentials. Further potentials of dihedral and long-range electric interactions will be supported later. The performance of POCLMD can catch up >80% of HOOMD-blue [2] (the fastest CUDA based MD code as we know) on the same NVIDIA's GPUs. POCLMD on one AMD's HD7970 card runs 60-80 times faster than LAMMPS on a single core Q6600 CPU (2.4GHz).

[1] http://mathema.tician.de/software/pyopencl
[2] http://codeblue.umich.edu/hoomd-blue/

DY 41.17 Thu 17:00 P3

Importance of asymmetry for cross-streamline migration of bead spring models in oscillating shear flows — •Matthias Laumann, Diego Kienle, and Walter Zimmermann — Theoretische Physik, Universität Bayreuth, 95440 Bayreuth, Germany

We investigate cross-streamline migration of bead-spring polymers in time-dependent linear shear flows in the limit of small Reynolds numbers. Dumbbells and ring polymers are used as base models and it is shown that cross-streamline migration in time-dependent linear shear flow exists only if the deformable dumbbell or the ring polymer have an intrinsic asymmetry. Once the asymmetry being in place, the migration efficiency can be controlled by adjusting the amplitude and the period of the oscillating shear gradient. Our findings suggest that small deformable objects of different asymmetry and elasticity may be separated by switched shear flows via the process of cross-streamline migration.

DY 41.18 Thu 17:00 P3

Dynamics of Bound States in a real-valued Swift-Hohenberg Equation induced by Delayed Feedback — •Felix Tabbert and Svetlana Gurevich — Institut für theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Straße 9, 48149 Münster

We are interested in the stability-properties of stationary bound state solutions of the real-valued Swift-Hohenberg Equation, subjected to time-delayed feedback. We show that the change in delay-time and delay-strength leads to various dynamical solutions including the formation of travelling waves, labyrinth-like patterns, as well as moving and rotating bound states.

We provide a linear stability analysis of the delayed system and obtain an analytical expression for the delay-induced instability-threshold. Numerical calculations are also carried out, showing good agreement with the analytical predictions.

DY 41.19 Thu 17:00 P3

Quasiperiodic and chaotic motion of active particles in Poiseuille flow — •Igor Dudas, Andreas Zöttl, and Holger Stark — TU Berlin

Active particles have an intrinsic propulsion mechanism which constantly keeps them out of equilibrium. They swim with a constant velocity while the swimming direction can be manipulated by an external field. In this contribution we demonstrate that an active particle swimming in Poiseuille flow exhibits typical nonlinear dynamics mainly driven by the cross-streamline migration due to activity [1,2]. Our model system can be mapped onto a Hamiltonian system equivalent to the nonlinear pendulum. Bounding surfaces introduce dissipation while swimmers in Poiseuille flow with elliptic cross section exhibit quasiperiodic and chaotic behavior depending on the flow velocity and initial conditions.

[1] A. Zöttl and H. Stark, Phys. Rev. Lett. **108**, 218104 (2012).
[2] A. Zöttl and H. Stark, Eur. Phys. J. E **36**, 4 (2013).

DY 41.20 Thu 17:00 P3

Vorticity distributions in two dimensional forced turbulence — •Markus Blank-Burian — Institut für Physikalische Chemie, WWU Münster, Deutschland

In statistical fluid dynamics, turbulent flows can be characterized by probability density functions (PDFs). Within the framework of the Lundgren-Monin-Novikov hierarchy, one can derive time evolution equations for the PDFs as summarized in [1]. The closure problem arises herein by coupling multi-point PDFs of different order. These equations can also be rewritten using conditional averages.

Until now, the PDFs have been approximated by gaussian distributions. Looking at numerical data, one finds that the shape of the vorticity PDF and also the conditional averages over the vorticity field depend strongly on the strength of the forcing. The shape of the one-point as well as the two-point PDF can be modeled by a convolution of two multivariate stable distributions.

As a result of this, one can describe the force dependence of the one-point conditonal average of the vorticity field as an interpolation between a strongly oscillating function and a smooth function. It turns out, that the former function is associated with a gaussian distribution and can be attributed to the forcing. It dominates at small vorticity strength around $\omega < 2\sigma$. The other function is associated with a lorentz distribution and dominates clearly at large vortices $\omega > 5\sigma$.

[1] Friedrich,Daitche,Kamps,Lülff,Voßkuhle,Wilczek: The Lundgren-Monin-Novikov Hierarchy: Kinetic Equations for Turbulence, C. R. Acad. Sci

DY 41.21 Thu 17:00 P3

Evolution equations for two dimensional elliptic shaped gaussian vortices — •Markus Blank-Burian — Institut für Physikalische Chemie, WWU Münster, Deutschland

The easiest model to describe two dimensional vortices in turbulent flows is the point vortex model. This model has an inherent problem, as it can not describe either attraction or repulsion of two vortices. By studying numerical and experimental data, one can see, that in first approximation two interacting vortices maintain a nearly elliptic gaussian shape for a rather long time. Vortices with the same sign attract each other and orientate themselves parallel with an angle of approximately 45° to their connecting vector. Vortices with different sign orient themselves nearly perpendicular to each other while moving in the same direction.

Based on an idea in [1], one can derive equations of motion for two interacting elliptically shaped gaussian vortices, describing their evolution in time. This model then correctly predicts attraction and repulsion of two vortices, depending on the strenth and orientation of the vortices. The characteristic angles of 45° are found stable as well. The famous Lamb-Oseen vortex is contained as a limiting case of symmetric shape.
[1] Friedrich, Friedrich: Generalized vortex-model for the inverse cascade of two-dimensional turbulence, http://arxiv.org/abs/1111.5808

DY 41.22 Thu 17:00 P3

Fluctuations of orientational order and clustering in a two-dimensional colloidal system under quenched disorder — •Tobias Horn[1], Sven Deutschländer[2], Hartmut Löwen[1], Georg Maret[2], and Peter Keim[2] — [1]Institut für Theoretische Physik II: Heinrich-Heine-Universität Düsseldorf, D-40225 Düsseldorf, Germany — [2]Fachbereich für Physik, Universität Konstanz, D-78464 Konstanz, Germany

Using both, video-microscopy of superparamagnetic colloidal particles confined in two dimensions and computer simulations of repulsive parallel dipoles, we study the formation of fluctuating orientational clusters and topological defects with respect to the KTHNY-like melting scenario under quenched disorder. We analyze cluster densities, average cluster sizes, the population of non-cluster particles as well as the development of defects as a function of system temperature and disorder strength. In addition, a probability distribution of clustering and orientational order is presented. We find that the well known disorder-induced widening of the hexatic phase can be traced back to the distinct characteristics of clustering and defect formation along the melting transitions from the solid phase via the hexatic phase to the isotropic fluid.

DY 41.23 Thu 17:00 P3

Packing of hard spheres in cylinders and applications — •Adil Mughal[1], Denis Weaire[2], Ho Kei Chan[2], and Stefan Hutzler[2] — [1]Institut fur Theoretische Physik, Friedrich-Alexander Universitat Erlangen-Nurnberg, Staudtstr. 7, D-91058 Erlangen, Germany — [2]School of Physics, Trinity College, Dublin 2, Republic of Ireland

We study the optimal packing of hard spheres in an infinitely long cylinder. Our simulations have yielded dozens of periodic, mechanically stable, structures as the ratio of the cylinder (D) to sphere (d) diameter is varied. Up to D/d=2.715 the densest structures are composed entirely of spheres which are in contact with the cylinder. The density reaches a maximum at discrete values of D/d when a maximum number of contacts are established. These maximal contact packings are of the classic "phyllotactic" type, familiar in biology. However, between these points we observe another type of packing, termed line-slip.

An analytic understanding of these rigid structures follows by recourse to a yet simpler problem: the packing of disks on a cylinder. We show that maximal contact packings correspond to the perfect wrapping of a honeycomb arrangement of disks around a cylindrical tube. While line-slip packings are inhomogeneous deformations of the honeycomb lattice modified to wrap around the cylinder.

Beyond D/d=2.715 the structures are more complex, since they incorporate internal spheres. We review some relevant experiments with hard spheres, small bubbles and discuss similar structures found in nature. We discuss the chirality of these packings and potential applications in photonics.

DY 41.24 Thu 17:00 P3

Ab-initio Calculations Show which Metal Melts are Simple Liquids — •Felix Hummel[1], Jeppe Dyre[2], Georg Kresse[1], and Ulf Pedersen[1,3] — [1]University of Vienna, Austria — [2]Roskilde University, Denmark — [3]Technical University of Vienna, Austria

Simple liquids or strongly correlated liquids (SCL) exhibit identical thermodynamical behaviour up to unit scaling for states on isomorph curves. Melting lines and lines of constant excess entropy follow isomorph curves for simple liquids.

We performed ab-initio calculations for all metal melts at the triple point, testing the degree of isomorphic behaviour. We find that most melts are indeed simple to a high degree, at least at PBE-DFT level.

We also show that an inverse-power-law (IPL) model - forming fully correlated liquids - gives an excellent approximation for retrieving thermodynamic properties of the simple metal melts. For those metals, the IPL approximation even allows to predict the ambient pressure crystal structure solely from liquid data.

DY 41.25 Thu 17:00 P3

Shapes of branched polymer networks — •Christian von Ferber[1] and Marvin Bishop[2] — [1]AMRC, Coventry University, Coventry, UK — [2]Department of Computer Science and Mathematics, Manhattan College, New York, USA

We investigate the shapes of polymer networks embedded in two- and three-dimensional space as function of their architecture. To this end we employ both analytical methods as well as the Monte Carlo pivot algorithm to investigate continuum, tangent hard-sphere branched polymers both in the ideal and the excluded volume regimes.

The mean square radius of gyration, the g-ratio, and the form factors are evaluated. The MC data agree well with the exactly determined form factors. The form factors reveal the influence of the polymer structure at short distances.

DY 41.26 Thu 17:00 P3

A hydrodynamic approach to driven granular systems — •Mathias Hummel, James Clewett, and Marco G. Mazza — Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen, Deutschland

We study a hydrodynamic approach to vibrated granular gases. We use a modification of the compressible Navier-Stokes equation in 3D. To handle the shockwaves in our simulations we use high-order WENO methods and the Multi-Stage approach(MUSTA) flux is used to calculate the convective fluxes. The integrations in our finite-volume method is performed through Gaussian integration points. Our results are compared with molecular dynamics simulations. We study and characterise the shockwaves traveling through the system and the nonequilibrium pattern that emerges in the steady state.

DY 41.27 Thu 17:00 P3

Vertically vibrated granular gas with van der Waals Interactions — •Qiong Bai, James P. D. Clewett, and Marco G. Mazza — Max Plank Intstitute for Dynamics and Self-Organization, Bunsen Str. 10, 37073 Goettingen, Germany

As a classical thermodynamic non-equilibrium system, granular matter is still a field full of unexplored static and dynamic behaviour. Here we focus on a vertically vibrated granular system. We also consider van der Waals interactions between particles. By means of molecular dynamics simulations, we study and characterize the different phase separations that emerge from the interplay of dissipative and conservative interactions. We observe new states with intriguing dynamics.

DY 41.28 Thu 17:00 P3

Scaling of Wet Particle Collisions — •Thomas Müller, Ingo Rehberg, and Kai Huang — Experimentalphysik V, Universität Bayreuth, 95440 Bayreuth, Germany

For the description of natural phenomena like debris flow or the formation of planetary rings as well as for the development of industrial applications, a thorough knowledge about the dynamics of granular matter is crucial. In many of these systems, the surfaces of the interacting particles are covered with a thin liquid film. Consequently, compared to the description of dry systems, additional energy losses due to the wetting liquid have to be taken into account.

We investigate macroscopic spheres bouncing on a flat surface that is covered with a liquid film. The coefficient of normal restitution e_n, defined as the ratio between the relative rebound and impact velocity of a binary impact is used to characterize the amount of energy dissipation during the collision. Our primary goal is to understand how various parameters, such as impact velocity, particle and liquid properties, influence e_n. Experiments with glass spheres have already shown, that e_n can be rescaled with the Stokes number which depends on the ratio between inertia forces and viscous forces, as long as the ratio between sphere size and liquid film thickness is kept constant. Here, we present further experimental results with spherical particles of different materials, in order to test the universality of such a scaling behavior and to understand the associated energy dissipation mechanisms.

DY 41.29 Thu 17:00 P3

Contact angle hysteresis of an evaporizing droplet: control with inkjet printing — Simeon Völkel, Thomas Müller, Ingo Rehberg, and •Kai Huang — Experimentalphysik V, Universität Bayreuth, 95440 Bayreuth, Germany

Wetting is ubiquitous in nature and of tremendous importance in industries such as mining, enhanced oil recovering, pharmaceutics, paint-

ing, and inkjet printing. Understanding the dynamics of wetting, such as contact angle hysteresis and pinning of the three phase contact line, can help to enhance the efficiency of various applications. Toward this goal, the challenge arises from the fact that most real life wetting phenomena are not in thermodynamic equilibrium. For example, the evaporation of a drop on a flat surface may lead to various drying patterns.

Here, we focus on the evaporation of a water drop on a surface of various materials and measure associated change of contact angle and drop size. In addition to evaporation, we employ an inkjet printing device to control the volume of the drop with an accuracy of nanoliter, in order to investigate the hysteresis of the contact angle and related pinning of the contact lines. It is found that the contact angle decays linearly with time during evaporation, provided that the contact line is pinned. In case of a smooth Polytetrafluoroethylene (PTFE) surface, the depinning drop shrinks with a fixed contact angle of around 90 degrees. Possible mechanisms accounting for such a phenomenon will be discussed.

DY 41.30 Thu 17:00 P3

Measuring contact forces in 3D inside granular packing — •Junaid M. Laskar[1], Stephan Herminghaus[1], Matthias Schröter[1], and Karen E. Daniels[2] — [1]Dynamics of Complex Fluids, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — [2]Department of Physics, North Carolina State University, Raleigh, USA

Knowing the contact forces and their statistical distributions inside a granular packing is a central question in granular physics. Measurement of contact force distributions and force chains till now have been possible only in 2D [1,2]. However, measurement inside a 3D granular packing, where the physics is expected to be different, still remains an experimental challenge.

An intrinsic property of ruby is linear change of its fluorescence signal as a function of applied stress [3]. By making use of this property, an experimental technique is developed to measure contact forces inside the packing of ruby spheres. The results obtained by this technique, which is based on aplanatic solid immersion lens optics and two photon fluorescence spectroscopy, will be discussed.

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DY 41.31 Thu 17:00 P3

Structural and mechanical properties of random packings of spherocylinders: a simulation study — •Pascal Wieland and Claus Heussinger — Georg-August-Universität Göttingen, Institut für Theoretische Physik

An energy-minimization technique is developed to study random packings of soft spherocylinders in the vicinity of the jamming point.

We are interested in structural and mechanical properties as a function of the aspect ratio of the cylinders. In particular, we determine the average number of inter-particle contacts as well as their types (side-side, tip-side, tip-tip).

The simulation data is compared with experimental results obtained from x-ray tomography of spaghetti packings (in collaboration with C. Lewandowski and M. Schröter, also see their contribution).

DY 41.32 Thu 17:00 P3

How do spaghetti make contacts? — •Cyprian Lewandowski[1,3], Christian Brosowski[2], Max Neudecker[1], Claus Heussinger[2], and Matthias Schröter[1] — [1]Max Planck Institute for Dynamics and Self-Organization (MPIDS), 37077 Goettingen, Germany — [2]Institute of Theoretical Physics, University Goettingen, 37077 Goettingen, Germany — [3]Department of Physics, Imperial College London, SW7 2AZ London, United Kingdom

The aim of this study was to understand stability of random packings of cylinders based on an analysis of inter-particle contacts. Three aspect ratios (L) of cylinders were prepared from uncooked spaghettini strands. Samples were compacted with a vertical shaking apparatus and data was gathered using X-ray microtomography. Image analysis was carried out with algorithms implemented in MATLAB, achieving precision of length fit better than 0.5%. The scaling of the average global contact number with packing fraction was observed to follow the asymptotic scaling relation $\phi L = \text{constant}$ [Philipse 1996]. By carrying out a nearest-neighbour transformation, Voronoi cells for each particle were obtained. These are the first measurements that allow to elucidate the relation between local contacts and local packing fraction.

DY 41.33 Thu 17:00 P3

Plant roots growing in granular media: intelligent penetrators? — •Caroline Bauer[1,4], Rebecca Liese[2], Ina Christin Meier[2], Kai Huang[3], and Matthias Schröter[1] — [1]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen — [2]Albrecht-von-Haller-Institut für Pflanzenwissenschaften, Universität Göttingen — [3]Experimentalphysik V, Universität Bayreuth — [4]Institut für Experimentelle Physik, Universität Magdeburg

A root growing in the soil viewed from a granular physics perspective is a penetration experiment, where the tip of the root exerts shear stress on the granular medium at its front. Depending on its initial packing fraction, disordered granular matter subjected to shear either compacts (low packing fraction), dilates (high packing fraction) or does not change its packing fraction (dilatancy onset). The differences of root growth to a classical penetration experiment are a certain flexibility of the root and, more importantly, the involvement of a living organism that underwent an evolutionary process.

Thus the question we want to address is the following: Do roots grow in a different way when they encounter dense vs. loose granular material, and if so, does the transition happen at the point of dilatancy onset? To answer this question we plant seeds of Sinapis alba L. in a cell filled with a monodisperse granular aggregate. They are grown in a climate chamber where they are kept moist continuously with a modified Hoagland's solution. The growth of the roots and the changes in the granulate are monitored by regular scans with an X-ray tomograph.

DY 41.34 Thu 17:00 P3

Statitistics of 2D granular assemblies comprised of polygonal particles — •Volker Becker and Klaus Kassner — Institut für theoretische Physik, Otto-von-Guericke-Universität Magdeburg, Germany

A possible approach for the statistical description of granular assemblies is Edwards assumption that all blocked states which occupy the same volume are equally probable[1]. Assemblies prepared by the same process, result to packages of the same volume fraction, except fluctuations. In the context of Edwards theory the dependency of the fluctuation strengths on the volume fraction is linked to the compactivity by a granular version of fluctuation dissipation theorem. Provided that the fluctuation strength is a function of the mean volume only one can compute the compactivity by measuring the fluctuations. We performed computer simulations using two dimensional polygonal particles excited periodically by short acceleration pulses and found that the volume fraction is a non-monotonic function of the pulse strength. This allows us to test whether or not the fluctuations are a function of the volume fraction only or not. In the second case an extended version of Edwards theory, containing the angoricity tensor as second state variable, has to be considered[2]. We will calculate the compactivity and if necessary the angoricity. We will compare the results with assemblies prepared by a different process on an otherwise identical systems. Due to Edwards theory, the results should only depend on the granular state variables, but not on details of the protocol. [1] Physica A 157, 1080 (1989) [2] PRL 109,238001 (2012)

DY 41.35 Thu 17:00 P3

Contemplating coincidences: Rigorous testing for synchrony between event-related time series — •Reik V. Donner[1,2] and Jonathan F. Donges[2,3] — [1]Max Planck Institute for Biogeochemistry, Jena, Germany — [2]Potsdam Institute for Climate Impact Research, Potsdam, Germany — [3]Stockholm Resilience Centre, Stockholm University, Sweden

Studying temporal point processes like the timings of extreme events is a common problem in various fields of sciences. When series of distinct types of events are available in a common time frame, assessing their statistical interrelationships can be valuable for testing theories proposing specific causal relationships. Here, we introduce a simple statistical framework for computing the probability that the observed number of simultaneous events in two series is due to chance. While in the case of rare events and no serial correlations, this probability can be well approximated analytically, introducing short- or long-range correlations as typical in real-world data can result in substantial deviations from this theory. We systematically study these deviations based on numerical results for some generic stochastic processes as well as real-world examples related to climate and ecosystem variability. Formal links to other techniques like Ripley's cross-K function

from spatial statistics, or event synchronization and cross-recurrence rate from nonlinear time series analysis are briefly addressed.

DY 41.36 Thu 17:00 P3

Loop Percolation with non standard critical behavior — •Matthias J. F. Hoffmann, Susan Nachtrab, Gerd E. Schröder-Turk, and Klaus Mecke — Friedrich-Alexander-Universität Erlangen-Nürnberg

Loop percolation refers to a wide class of percolation models, that change the coordination of randomly selected vertices, rather than deleting bonds or sites. Bond and site percolation are included as special cases. Starting from a regular fully connected network each node is split with probability p. By introducing asymmetry into the splitting process the percolation threshold and the percolation critical exponents can be changed. The two dimensional square lattice and the three dimensional diamond lattice are shown as examples for this model class, each exhibiting different critical behavior to the stardard universality class of bond/site percolation.

DY 41.37 Thu 17:00 P3

Percolation threshold on planar Euclidean Gabriel Graphs — •Christoph Norrenbrock — Carl-von-Ossietzky Universität Oldenburg

Planar proximity graphs such as the Gabriel Graph (GG) [1] are of potential interest in the context of wireless ad hoc networks, since the embedded edges provide proximity information regarding their adjacent nodes. Furthermore, the edge-sets ensure that the graph is connected, i.e. nodes are able to communicate to each other via intermediate ones. Using the highly efficient, union-find based algorithm by Newman and Ziff [2], we simulate the bond and site-percolation problem on planar Gabriel graphs of size $N = 1024$ to $N = 36864$ (N refers to the number of nodes) for Poisson point processes. Previously, it has already been shown that non-trivial percolation thresholds exist and rough estimates for their location has been made [3]. By means of finite-size-scaling techniques, we determine the precise location of the bond and site percolation thresholds and deduce the common percolation critical exponents from the GG data. The associated universality class is that of standard $2D$ percolation.

[1] Gabriel and Sokal, Systematic Biology 18, 259 (1969)
[2] Newman and Ziff, Phys Rev. Lett. 85, 4104 (2000)
[3] Bertin, Billiot, Drouilhet, Adv. Appl. Prob. 34, 689 (2002)

DY 41.38 Thu 17:00 P3

Kinetic Growth Random Walks — •Johannes Bock, Niklas Fricke, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100920, 04009 Leipzig, Germany.

Random walks are investigated since the 1950s and there are quite a number of different models for them, e.g. the self-avoiding walk and the kinetic growth walk. Here the kinetic growth walk is investigated in comparison to existing and up-to-date knowledge and results for the self-avoiding walk. These comparisons were done on regular lattices as well as on diluted lattices including the limiting case of percolation clusters where fractal properties become important.

DY 41.39 Thu 17:00 P3

Domain growth and coarsening of liquid droplets in vapor medium in a phase separating van der Waals fluid with SPH in three dimensions — •Martin Pütz and Peter Nielaba — University of Konstanz, Department of Physics, 78457 Konstanz, Germany

We study the dynamics of liquid-vapor phase separation of a van der Waals fluid induced by homogeneous nucleation and in later stage the domain growth and coarsening process towards equilibrated systems. Therefore we performed simulations in three dimensions with Smoothed Particlel Hydrodynamics (SPH) which provides the possibility to follow the dynamics through different time scales. The coexistence region and hence the process of homogeneous nucleation arises naturally by the implementation of the well known van der Waals equation as an equation of state and by a thermal conduction equation.

DY 41.40 Thu 17:00 P3

Melting of 2D solids under quenched disorder — •Sven Deutschländer[1], Tobias Horn[2], Hartmut Löwen[2], Georg Maret[1], and Peter Keim[1] — [1]Fachbereich Physik, Universität Konstanz, 78464 Konstanz, Germany — [2]Institut für Theoretische Physik II, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany

We investigate the effect of quenched random disorder on the melting transition of two-dimensional solids providing both colloidal experiments and monte carlo simulations of parallel repulsive dipols [1]. According to the KTHNY theory, we observe a two step melting process with an intermediate hexatic phase and studying the orientational order and correlation, we are able to investigate the detailed phase behavior for weak disorder strengths. By determining orientational correlation times and Frank's constant, we show that the solid-hexatic phase transition is strongly influenced by pinning, while the hexatic-isotropic transition remains rather unaffected. This is in agreement with theoretical predictions for solids with quenched random disorder, first discussed by D. R. Nelson and later by M.-C. Cha and H. A. Fertig. In addition, we observe critical-like orientational fluctuations on large time scales. These fluctuations are consistent with the continuous nature of the phase transitions and not locally affected by quenched disorder .

[1] S. Deutschländer, T. Kruppa, H. Löwen, G. Maret, and P. Keim, Phys. Rev. Lett. 111, 098301 (2013)

DY 41.41 Thu 17:00 P3

Transmuted finite-size scaling at first-order phase transitions with exponential degeneracy of ordered states — •Marco Mueller[1], Wolfhard Janke[1], and Desmond A. Johnston[2] — [1]Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany — [2]Department of Mathematics, School of Mathematical and Computer Sciences, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, Scotland, UK

We note that the standard inverse system volume scaling for finite-size corrections at a first-order phase transition (i.e. $1/L^3$ for an $L \times L \times L$ lattice in $3D$) is transmuted to $1/L^2$ scaling if there is an exponential low-temperature phase degeneracy. The gonihedric Ising model which has a four-spin interaction, plaquette Hamiltonian provides an exemplar of just such a system. We use multicanonical simulations of this model to generate high-precision data which provides strong confirmation of the transmuted finite-size scaling law. The dual to the gonihedric model, which is an anisotropically coupled Ashkin-Teller model, has a similar degeneracy and also displays the transmuted scaling.

DY 41.42 Thu 17:00 P3

Information-theoretic analysis of ground-state phase transitions for 2D and 3D frustrated spin systems — •Oliver Melchert and Alexander K. Hartmann — Universität Oldenburg

We consider standard information-theoretic observables [1] to analyze ground-state spin configurations for disordered and frustrated model systems. More precisely, we address the 2D random bond Ising model and the 3D random field Ising ferromagnet, which both exhibit a continuous transition from an ordered to a disordered ground state as a model parameter is varied [2]. The ground-state configurations for both setups can be obtained in polynomial time via exact combinatorial optimization algorithms.

By computing the three observables entropy, i.e. a measure of disorder, excess entropy and multi-information, i.e. measures of complexity, it is possible to detect changes in the spatial structure of the ground states as the respective critical point is approached. The finite-size scaling behavior of the information-theoretic observables in the vicinity of the critical points is shown to be in excellent agreement with existing results on critical properties reported in the literature. Finally, we characterize the results of both ground-state phase transitions in the entropy-complexity plane, i.e. in purely information-theoretic coordinates.

[1] J.P. Crutchfield and D.P. Feldman, CHAOS 13 (2003) 25
[2] OM and A.K. Hartmann, Phys. Rev. E 87 (2013) 022107

DY 41.43 Thu 17:00 P3

On the uniform sampling of ground states in the 2D $\pm J$ Ising spin glass model — •Hamid Khoshbakht[1,2] and Martin Weigel[1,2] — [1]Institut für Physik, Johannes Gutenberg-Universitaät Mainz, D-55099 Minz, Germany — [2]Applied Mathematics Research Centre, Coventry University, Coventry, CV1 5FB, UK

It is well known that the Edwards-Anderson Ising spin glass with discrete coupling distribution results in an extensive ground-state degeneracy. As the number of ground states hence grows exponentially with system size L, an exact enumeration is not practical, except for very small systems. This even applies to the otherwise well tractable model in two dimensions. There, exact ground states can be generated in polynomial time using one of several known mappings to minimum-weight perfect matching problems. While the resulting algorithm can be modified to generate random ground states in the presence of degen-

eracies, these are not in general produced with uniform probabilities. Here, we introduce an approach that achieves approximate uniform sampling. The algorithm is based on a cluster analysis of connected domains of free spins resulting from inputs generated by the matching approach which are then used as state space for a suitably adapted Markov chain sampling.

DY 41.44 Thu 17:00 P3

Analysis of localisation-delocalisation transitions in corner-sharing tetrahedral lattices — •Martin Puschmann, Philipp Cain, and Michael Schreiber — Institute of Physics, Chemnitz University of Technology, Chemnitz

The corner-sharing tetrahedral lattice appears as a sublattice in different materials, e.g. spinels and pyrochlore. We consider the transport of non-interacting electrons and analyse the localisation-delocalisation (LD) transition induced by random on-site potentials. Three different methods (multifractal analysis, Green resolvent method, energy-level statistics) are used to explore the phase diagram, which is then compared to the results of a recent study [1]. With particular emphasis we calculate the propagation of statistical errors within our results in order to get an accurate error estimate. Furthermore these methods yield detailed insight into the critical behaviour at the LD transition, i.e. the divergence of the correlation length, which is characterized by the value of the universal critical exponent.

[1] F. Fazileh, X. Chen, R. J. Gooding, and K. Tabunshchyk, Phys. Rev. B73, 035124 (2006)

DY 41.45 Thu 17:00 P3

Thermodynamic Casimir Forces between a Sphere and a Plate: Monte Carlo Simulation of a Spin Model — •Martin Hasenbusch — Humboldt-Universität zu Berlin, Deutschland

We study the thermodynamic Casimir force between a spherical object and a plate. We consider the bulk universality class of the three-dimensional Ising model, which is relevant for experiments on binary mixtures. To this end, we simulate the improved Blume-Capel model. Following Hucht, we compute the force by integrating internal energy differences over the inverse temperature. We demonstrate that these energy differences can be computed efficiently by using a particular cluster algorithm. Our numerical results for strongly symmetry breaking boundary conditions are compared with the Derjaguin approximation for small distances and the small sphere expansion for large distances between the sphere and the plate.

DY 41.46 Thu 17:00 P3

Critical Temperature of the Ising Ferromagnet on Proximity Graphs derived from Square Lattices by Site Displacement — •Hendrik Schawe, Christoph Norrenbrock, and Alexander K. Hartmann — Institut für Physik, Carl-von-Ossietzky Universität Oldenburg, Oldenburg (Germany)

We perform Monte Carlo simulations to determine the critical temperatures of an Ising Ferromagnet (IFM) located on the sites of different types of 2D proximity graphs. The graphs are derived from square lattices where nodes are displaced by a Gaussian distributed random variable. The deviation of the proximity graph from a square lattice is governed by the width σ of the Gaussian distribution. In our model, the coupling strength depends on the Euclidean distance between the coupled spins. The simulations are carried out on graphs with $N = 16^2$ to $N = 128^2$ nodes utilizing the Wolff cluster algorithm and parallel tempering in a wide temperature range around the critical point to measure the Binder Cumulant. The critical temperatures are shown to depend mainly on the average degree and the type of the underlying proximity graph. We further verify that the model lies within the universality class of the 2D IFM using finite-size scaling methods.

DY 41.47 Thu 17:00 P3

Direct simulation of critical Casimir forces — •Hendrik Hobrecht and Fred Hucht — Fakultät für Physik, Universität Duisburg-Essen, 47048 Duisburg

Using a Monte Carlo simulation, critical Casimir forces in a two-dimensional Ising spin system are examined. The system is divided into two subsystems by a movable wall parallel to fixed top and bottom boundary conditions. Due to the antisymmetric boundary conditions of the subsystems, counteracting repulsive forces bring the wall in a position of equilibrium. The critical Casimir force and the universal Casimir amplitude are determined from the distribution function of the wall position and compared to exactly known results.

DY 41.48 Thu 17:00 P3

Critical Casimir force in the presence of random local adsorption preference — •Francesco Parisen Toldin — Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Germany

We study the critical Casimir force for a film geometry in the Ising universality class. We employ a homogeneous adsorption preference on one of the confining surfaces, while the opposing surface displays quenched random disorder, leading to a random local adsorption preference. Disorder is characterized by a parameter p which measures, on average, the portion of the surface which prefers one component, so that p=0,1 correspond to homogeneous adsorption preference. By means of Monte Carlo simulations of an improved Hamiltonian and finite-size scaling analysis, we determine the critical Casimir force and the associated universal scaling function. We show that by tuning the disorder parameter p the system exhibits a crossover between an attractive and a repulsive force. At p=0.5 disorder allows to effectively realize Dirichlet boundary conditions, which are generically not accessible in classical fluids. Our results are relevant for the experimental realizations of the critical Casimir force in binary liquid mixtures.

Ref: F. Parisen Toldin, arXiv:1308.5220