DY 70: Poster: Flows, Patterns, Delay, Reaction Diffusion

Time: Thursday 15:30–18:00 Location: Poster A

DY 70.1 Thu 15:30 Poster A

Does a wind turbine care about turbulent intermittency? — •Johannes Kruse[1], Bodil Carlsen[2], and Martin Greiner[2] — [1]Georg-August Universität Göttingen — [2]Department of Engineering, Aarhus University, Denmark

Wind turbines operate in the turbulent atmospheric boundary layer and are exposed to highly intermittent wind fluctuations. We aim to clarify whether a wind turbine cares about these strongly non-Gaussian, multi-fractal fluctuations. Wind time series from an offshore site reveal an enlarged correlation time which is significantly larger than the typical turbine response time. A simple relaxation model for the wind-to-power conversion is investigated to quantify how the intermittency in the wind affects the statistical properties of the turbine power output and how this depends on the response time as well as the dynamical noise of the wind turbine. It is found that in particular for offshore wind turbines the intermittency in the wind can have a significant effect on the fluctuations of the wind power generation time series.

DY 70.2 Thu 15:30 Poster A

Optimization of non-contact seals — •Sabine Bogner — Universität Ulm, Institut für Experimentelle Physik

The non-contact seal of interest provides a separation between an upper and a lower chamber that are connected by a shaft. In the lower chamber there is a hydraulic driving and therefore a lot of liquid is present in the chamber. The upper chamber is filled with air that must be kept clean from liquid. Thus, the seal in between the two chambers must on the one hand prevent the liquid in the bottom chamber from flowing to the upper chamber. On the other hand, it must be contact-free in order to prevent friction between the shaft and its surroundings so that it can rotate freely.

In its current state the sealing effect should be reached by a labyrinth like geometry of a partition wall that divides the two chambers in combination with a fan arranged below the partition wall.

To improve the seal the pressure ratios inside the system are measured for different rates of rotation with an experimental setup. Apart from that the path of the penetrating liquid is analyzed both in the system itself and with CFD simulations. Different geometries of the partition wall labyrinth and the leak fan are tested with respect to their influence on the stream of air and liquid.

DY 70.3 Thu 15:30 Poster A

Liquid meniscus and film states driven by a surface acoustic wave — •Kevin David Joachim Mitas[1], Ofer Manor[3], and Uwe Thiele[1,2] — [1]Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm Klemm Straße 9, D-48149 Münster, Germany — [2]Center of Nonlinear Science (CeNoS), Westfälische Wilhelms-Universität Münster, Corrensstr. 2, D-48149 Münster, Germany — [3]Department of Chemical Engineering. Technion - Israel Institute of Technology, Haifa 32000, Israel

We study the shape of a liquid meniscus and the transfer of a liquid film from a bath of Newtonian liquid onto a (moving) plate under the influence of a Rayleigh surface acoustic wave (SAW). This Landau-Levich-type problem is studied with a thin-film equation that combines SAW driving (employed in [1] for wetting liquid) with the standard dragged-film problem for partially wetting liquid [2] to account for SAW driving in the case of partially wetting liquids. We use numerical path-continuation methods [3] to obtain the pertinent bifurcation diagrams that allow us to discuss the occuring qualitative transitions. [1] M. Moronov and O. Manor. J., *Fluid Mech.*, 810:307–322, 2017; [2] M. Galvagno., D. Tseluiko, H. Lopez and U. Thiele, *Phys. Rev. Lett.*, 112:137803, 2014; [3] H. A. Dijkstra et al., *Comun. Comput. Phys.*, 15:1–45, 2014.

DY 70.4 Thu 15:30 Poster A

Rotating turbulent Rayleigh-Bérnard convection at very large Rayleigh numbers — •Marcel Wedi[1,2], Dennis van Gils[3], Stephan Weiss[2], Guenter Ahlers[4], and Eberhard Bodenschatz[2] — [1]Georg-August-Universität Göttingen, Germany — [2]Max Planck Institute for Dynamics and Self-Organisation, Germany — [3]Twente University, Enschede, The Netherlands — [4]University of California, Santa Barbara, USA

Thermal convection in astro- and geophysical systems is both, highly turbulent and strongly influenced by Coriolis forces caused by the rotation of their celestial body. We aim to study the influence of rotation on the heat transport and the temperature field at very large thermal driving, in the High Pressure Convection Facility (HPCF) in Göttingen. The facility consists of a cylindrical cell with a diameter of 1.10 m and a height of 2.20 m that can be filled with pressurized sulfur hexafluoride (SF_6) of up to 19 bar. The height of the cell and the large density of SF_6 enable us to reach Ra up to 2×10^{15}. The cell is mounted on a rotating table and connected to the non-rotating world via water feed-throughs and slip rings. We can reach Ekman numbers down to 10^{-8} while still keeping the influence of centrifugal forces small. In our poster we show and discuss recent major upgrades of the facility as well as measurements of the heat flux and the temperature field.

DY 70.5 Thu 15:30 Poster A

Dynamics of wetting explored with inkjet printing — •Jonas Landgraf, Simeon Völkel, and Kai Huang — Experimentalphysik V, Universität Bayreuth, 95440 Bayreuth, Germany

Experiments on sessile drops require precise volume control. However, to control drop volume without altering the solid-liquid or liquid-gas interfaces is challenging. Here, we propose to use a conventional, low cost inkjet printhead to solve this challenge. Taking advantage of the high repeatability [1] and fine resolution of drop volume (23 picoliter), we investigate the dynamics of a sessile drop sitting on an inclined substrate. In addition, we explore the wetting front propagation in a granular monolayer.

[1] Völkel and Huang, EPJ Web of Conferences, 140, 09035 (2017)

DY 70.6 Thu 15:30 Poster A

Leidenfrost universality: an experimental study — •Olinka J. Ramírez Soto[1], Michiel A.J. van Limbeek[2], and Detlef Lohse[2] — [1]Max Planck Institute for Dynamics and Self-Organization (MPIDS), Am Faßberg 17, D-37077 Göttingen, Germany — [2]Universiteit Twente, Drienerlolaan 5, 7522NB Enschede, The Netherlands

When a drop is deposited on a hot surface there is a minimum temperature, the Leidenfrost temperature (T_L), at which the drop levitates in its own vapor. The first detailed description of the phenomenon was given 300 years ago by the physicist J. G. Leidenfrost. Since then, a model describing the conditions at which this phenomenon happens has still to be addressed. Previous studies exhibited a linear relation between T_L and T_{sat} (saturation temperature) for a group of hydrocarbons. A similar behavior between the two temperatures for a single liquid at different ambient pressure conditions was also observed. In the present study, the relation between both temperatures was explored.

The Leidenfrost temperature of different organic liquids and water at low and high pressures was obtained by observing the behavior of drops at different surface temperatures. As a first result, a linear relationship was found between T_L and T_{sat} at low pressures for each liquid. For all liquids, these relation differs by a prefactor. From a dimensional analysis with phase transition variables, we defined the parameter $\frac{L}{C_{Pv}}$ to nondimensionalize both temperatures. The collapse of the experimental data with this parameter, including high pressure measurements, reveals the universality of the Leidenfrost temperature.

DY 70.7 Thu 15:30 Poster A

Magnetic wave calming — •Alexandra Fischer, Armin Kögel, and Reinhard Richter — Experimentalphysik 5, Universität Bayreuth, Germany

One of the most prominent hydrodynamic instabilities in nature is the Kelvin-Helmholtz instability [1]: Wind blowing over water causes surface waves, if a critical velocity is surpassed. Here we demonstrate for the first time, that the magnetic susceptibility of a ferrofluid can be exploited in order to calm the waves by applying a magnetic field parallel to the surface. We measure the spatial growth rate, the critical velocity depending on the frequency of the interfacial wave, and the dispersion relation while varying the magnetic field strength. Finally we compare our values to the non viscous theory as put forward by Rosensweig [2].

[1] Hermann v. Helmholtz, Über discontinuierliche Flüssigkeitsbewe-

gungen. *Berl. Ber.* p. 215. (1868).

[2] Ronald E. Rosensweig, *Ferrohydrodynamics* Cambridge University Press, Cambridge (1985).

DY 70.8 Thu 15:30 Poster A

Slip-mediated dewetting of polymer microdroplets — •Joshua McGraw[1,2], Tak Shing Chan[1], Thomas Salez[3], Simon Maurer[1], Michael Benzaquen[3], Elie Raphaël[3], Ralf Seemann[1], Martin Brinkmann[1], and Karin Jacobs[1,4] — [1]Experimental Physics, Saarland University, 66041 Saarbrücken, Germany — [2]Département de Physique, Ecole Normale Supérieure/ Paris Sciences et Lettres (PSL) Research University, CNRS, 75005 Paris, France — [3]Laboratoire de Physico-Chimie Théorique, UMR Gulliver 7083, Ecole Supérieure de Physique et de Chimie Industrielles ParisTech/PSL Research University, 75005 Paris, France — [4]fLeibniz-Institute for New Materials, 66123 Saarbrücken, Germany

Classical hydrodynamic models predict that infinite work is required to move a three-phase contact line. Assuming a slip boundary condition, in which the liquid slides against the solid, such an unphysical prediction is avoided. Here, we present the results of experiments in which a contact line moves and where slip is a dominating and controllable factor. Spherical cap-shaped polystyrene microdroplets, with nonequilibrium contact angle, are placed on solid self-assembled monolayer coatings from which they dewet. The relaxation is monitored using in situ atomic force microscopy. We find that slip has a strong influence on the droplet evolutions, both on the transient nonspherical shapes and contact line dynamics. The observations are in agreement with scaling analysis and boundary element numerical integration of the governing Stokes equations, including a Navier slip boundary condition.

DY 70.9 Thu 15:30 Poster A

Using the Saffman effect to opitmally control colloidal trajectories in inertial microfluidics — •Felix Rühle[1], Christian Schaaf[1], Fredi Tröltzsch[2], and Holger Stark[1] — [1]Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, 10623 Berlin — [2]Institut für Mathematik, TU Berlin, Straße des 17. Juni 136, 10623 Berlin

Inertial microfluidics is used for particle sorting and separation in biomedical applications [1]. Here, fluid inertia at intermediate Reynolds numbers drives cross-streamline migration of colloidal particles under Poiseuille flow and eventually lets them reach lateral steady state positions. These stable positions are determined by stable fixed points in the lateral lift-force profiles and can be controlled via the Saffman effect by applying axial forces [2-4].

We determine the lateral lift-force profiles for different external axial forces using lattice Boltzmann simulations [4]. We then interpret this axial force as a control term [4] and use optimal control theory to numerically determine optimal, time-dependent forces in order to steer particles with variable sizes to target positions in a microchannel. We provide the proof of principle that this is indeed possible.

[1] D. Di Carlo, *Lab Chip* **9**, 3038 (2009).
[2] P.G. Saffman, *J. Fluid Mech.* **22**, 385 (1965).
[3] W.Y. Kim and J.Y. Yoo, *Lab Chip* **9**, 1043 (2009).
[4] C. Prohm and H. Stark, *Lab Chip* **14**, 2115 (2014).

DY 70.10 Thu 15:30 Poster A

Magnetophoretic Lab-on-a-Chip system for biomolecular interaction analysis — •Hai Hoang[1], Özge Efendi[2], Meike Reginka[1], Daniela Bertinetti[2], Dennis Holzinger[1], Friedrich W. Herberg[2], and Arno Ehresmann[1] — [1]Institute of Physics, Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel — [2]Institute of Biology, Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel

Lab-on-a-Chip (LOC) systems are promising devices for point-of-care technologies in biomedicine. Using a microfluidic system in combination with a remotely controllable transportation system of functionalized superparamagnetic beads can increase the detection limit of biomarkers (e.g. proteins) in body fluids. In a first step, the green fluorescent protein (GFP) was used as a model protein. For the LOC approach superparamagnetic beads functionalized with a GFP-specific binder are used for directed transport of GFP and GFP accumulation whereby channel design, mixing of fluids by bead movement and flow speed of the GFP-solution perpendicular to the bead movement are taken into consideration. The investigation of the system is done via optical and fluorescence microscopy as well as tracking and image analysis techniques.

DY 70.11 Thu 15:30 Poster A

Adaptability of oxygen supply by vessel dilation — •Felix J. Meigel[1], Peter Cha[2], Michael P. Brenner[2], and Karen Alim[1,2] — [1]Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — [2]Harvard University, Cambridge, MA, U.S.A.

Organs in mammals are pervaded by a vascular network, supplying the tissue with oxygen. In the brain, capillaries built a highly interconnected mesh each equipped with small muscles allowing for the constriction and dilation of capillaries. How much control of oxygen supply resides in the active adaptation of capillary diameter? Here, we build a theoretical model for oxygen transport and absorption in a capillary and determine how capillary geometry and network topology affect the control by active adaptation. On the level of an individual capillary, we derive analytically how vessel parameters affect the local change in oxygen supply due to dilation. Within the model we identify a regime of more than linear increase in supply, which we locate in the vasculature of recorded data of a rat brain excerpt. Extending our model to an entire network we statistically quantify the impact of network architecture on changes in supply profiles.

DY 70.12 Thu 15:30 Poster A

Multiple-relaxation-time lattice Boltzmann implementation for shear thinning fluids — •Sebastian Johannes Müller and Stephan Gekle — Juniorprofessur Theoretische Physik, Universität Bayreuth

An important aspect of biofabrication processes is the shear thinning behaviour of polymer solutions used as bioinks. It becomes particularly important considering the forces acting on the flowing cells and the cell deformations during the printing procedure. As the lattice Boltzmann method is a common approach to computational fluid dynamics, we use a multiple-relaxation-time model to implement different models for non-Newtonian fluids in the simulation package ESPResSo. The simplest model, allowing comparison of the simulation results with analytical flow results, is the power-law model for the fluid viscosity. We extend our simulations with enhanced models for non-Newtonian fluids, like the Carreau-Yasuda and the Cross model, which include Newtonian behaviour in the limits of zero and infinite shear-rate.

DY 70.13 Thu 15:30 Poster A

Propulsion and hydrodynamic particle transport of a magnetically driven colloidal ribbon — •Helena Massana-Cid[1], Fernando Martinez-Pedrero[2], Eloy Navarro-Argemí[1,3], Ignacio Pagonabarraga[1,3], and Pietro Tierno[1,3,4] — [1]Departament de Física de la Matèria Condensada, Universitat de Barcelona, E-08028, Barcelona, Spain — [2]Departamento de Química Física I, Universidad Complutense de Madrid, Ciudad Universitaria, E-28040, Madrid, Spain — [3]Universitat de Barcelona Institute of Complex Systems (UBICS), Universitat de Barcelona, E-08028, Barcelona, Spain — [4]Institut de Nanociència i Nanotecnologia, IN2UB, Universitat de Barcelona, E-08028, Barcelona, Spain

We describe a method to trap, transport and release microscopic particles in a viscous fluid using the hydrodynamic flow field generated by a magnetically driven colloidal ribbon. The ribbon is composed by ferromagnetic microellipsoids that assemble perpendicular to each other due to their permanent magnetic moment. We use an external precessing magnetic field to torque the anisotropic particles forming this structure, and the particle rotational motion is rectified into a net translation due to the hydrodynamic coupling with the surface. Non-magnetic particles can be captured or expelled by the hydrodynamic flow field generated by the propelling ribbon. The proposed technique may be used in channel-free microfluidic applications, where precise trapping and transport of functionalized particles via non invasive magnetic fields is required.

DY 70.14 Thu 15:30 Poster A

Does a vesicle migrate to the center or to the periphery in a bounded shear flow? — •Abdessamad Nait Ouhra[1,2], Alexander Farutin[1], Hamid Ez-Zahraouy[2], Abdelilah Benyoussef[3], and Chaouqi Misbah[1] — [1]Grenoble Alpes University, CNRS, LIPhy, Grenoble, France — [2]Mohammed V University, Rabat, Morocco — [3]Hassan II Academy of Science and Technology, Rabat, Morocco

The lateral migration of a suspended vesicle (a model of red blood cells

(RBCs)) in a bounded shear flow is investigated numerically at vanishing Reynolds number (the Stokes limit) using a boundary integral method. We explore the relevant dimensionless parameters to study the dynamics and rheology of a vesicle as a function of the viscosity contrast $\lambda = \eta_{in}/\eta_{out}$, where η_{in}, η_{out} denote the inner and the outer viscosities. A vesicle is found to migrate to the centerline or to the wall depending on λ. We found that below a critical viscosity contrast λ_c, the vesicle is centered, and above λ_c, the vesicle can be either centered or off-center depending on initial condition. The equilibrium lateral position of the vesicle exhibits a saddle-node bifurcation as a function of the bifurcation parameter λ, which leads to a surprising acute decrease of the effective viscosity of the suspension at a critical value of viscosity contrast (λ_c). This study can be exploited in the problem of cell sorting out and can help understanding the intricate nature of the rheology of confined suspensions.

DY 70.15 Thu 15:30 Poster A

Nonlinear analysis of coupled dissipative system with a conservation law — •Tobias Frohoff-Hülsmann[1] and Uwe Thiele[1,2] — [1]Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster — [2]Center of Nonlinear Science (CeNoS), Westfälische Wilhelms-Universität Münster, Corrensstr. 2, 48149 Münster

We investigate the coupled dynamics of a conserved and a non-conserved order parameter field using the generic example of a Cahn-Hilliard equation that is coupled to a Swift-Hohenberg equation. Both equations correspond to gradient dynamics and, here, we employ a coupling that preserves the variational structure. The coupled system is effectively of 8th order and allows for individual and coupled short-scale and long-scale instabilities. We analytically examine the linear and weakly nonlinear behaviour and study the fully nonlinear bifurcation behaviour employing numerical path continuation. The nonlinear results are compared to the results gained with amplitude equations of first and higher orders obtained in the weakly nonlinear limit.

DY 70.16 Thu 15:30 Poster A

Modeling Structure Formation of Twin Polymerization via a reactive Bond Fluctuation Model — •Janett Prehl, Constantin Huster, and Halit Taskin — Institut für Physik, Technische Universität Chemnitz, Chemnitz, Germany

Understanding the structure formation of new chemical processes is a big challenge for the development of new materials as for instance in the case of Twin Polymerisation (TP). The TP is a chemical method to synthesize interesting nano-porous hybrid materials with organic and inorganic domains in the range of 0.5 up to 3nm for further industrial applications.

In order to obtain the key mechanisms of structure formation processes of TP the reactive bond fluctuation model (rBFM) [1] is developed. In comparison to the classic BFM the rBFM can deal with multiple bond vectors instead of only 1 between the beads. The beads represent the monomers and the bond vector can form and cleave. Within reactive Monte Carlo steps of the rBFM the complex reaction mechanism of TP is defined. By doing so, resulting structural properties as for example the amount of bonds per particle (BpP) or the radial distribution function (RDF) are compared with experimental data.

This comparison will help us to find correlations between the structure formation process and morphological properties of emerging materials.

[1] K.H.Hoffmann, J.Prehl, *Reac Kinet Mech Cat* DOI: 10.1007/s11144-017-1303-y

DY 70.17 Thu 15:30 Poster A

Orientation of stripe patterns in small rectangular domains — •Mirko Ruppert, Fabian Bergmann, Lisa Rapp, and Walter Zimmermann — Theoretische Physik I, Universität Bayreuth, Deutschland

Motivated by recent observations of pattern formation in small systems, we investigate the orientation of nonlinear stripe patterns in small, rectangular domains for different boundary conditions along the domain borders. In addition the orientation of stripe patterns is investigated, when the control parameter is only supercritical in a small domain. We characterize, how the orientation of stripe patterns depends on the aspect ratio G between the length and the width of a domain. We find stable coexistence between stripe pattern of different wavelength and orientations. Orientational transitions take place at different values of G for different boundary condtions as well as in the case of control-parameter variations. This is investigaged by analytical considerations and numerical solutions of the generic Swift-Hohenberg-model.

DY 70.18 Thu 15:30 Poster A

Traveling waves in a chemorepulsive active particle system — •Samuel Grimm, Fabian Bergmann, Lisa Rapp, and Walter Zimmermann — Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth, Germany

A chemorepulsive active particle system may give rise to a bifurcation to spatially periodic traveling waves (TWs), whereby the density of active particles is conserved. Traveling waves in conserved systems show modified nonlinear dynamics compared to TWs in unconserved systems. The envelopes of these TWs also obey different generic model equations. We compare simulations of the continuum equations for the active particle systems to simulations of reduced generic equations. This comparison allows for the identification of generic properties of TWs in a chemorepulsive active particle system.

DY 70.19 Thu 15:30 Poster A

Oscillatory phase separation in active particle systems — •Andre Förtsch, Lisa Rapp, Fabian Bergmann, and Walter Zimmermann — University of Bayreuth, Bayreuth, Germany

We introduce a model with two types of interacting active particle A and B. We assume A-A attraction, A-B attraction and B-B repulsion. The continuum approximation corresponds to two chemotactically interacting species. This continuum model shows an oscillatory instability. Since the two particle types are conserved, this oscillatory instability leads to oscillatory phase separation. Particle simulations leads to the same scenario. Above the oscillatory onset of phase separation we find traveling clusters in simulations.

DY 70.20 Thu 15:30 Poster A

Stability and Coexistence of Vegetation Patterns in a Reduced Model — •Florian Dietl[1], Fabian Bergmann[1], Lisa Rapp[1], Ehud Meron[2], and Walter Zimmermann[1] — [1]Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth — [2]Blaustein Institutes for Desert Research, Ben Gurion University

We analyze a reduced normal form of a vegetation model for water-limited ecosystems [1]. The model has both finite amplitude homogeneous and spatially periodic solutions, as well as superpositions of the different solutions. We investigate the elementary bifurcations between these states in terms of four coupled, spatially independent nonlinear equations, which are obtained from the original model by a Galerkin-truncation. Among other phenomena, we find for the four coupled equations a transition between a homogeneous vegetation state and a hexagonally modulated state. This and other transitions are characterized and analyzed. We also show that the solutions and bifurcations obtained from the four coupled equations agree over a wide range of parameters with the solutions of the full vegetation model.

[1] E. Gilad et al., J. Theor. Biol. 244, 680 (2007)

DY 70.21 Thu 15:30 Poster A

Time-delayed feedback control of oscillatory states in sheared micellar systems — •Benjamin von Lospichl and Sabine H. L. Klapp — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstraße 36, 10623 Berlin

We investigate a rheological model for the shear stress [1], which is suitable to describe the dynamics of elongated micelles under shear. Within the model a link between a structural variable, namely the micellar length, and the mechanical variables (stress and shear rate) is made. Through this connection it is possible to find a great variety of dynamical states ranging from steady shear banding to spatio-temporal oscillatory and chaotic states. To explore the phase space of the model we employ concepts of linear stability analysis and solve the dynamical system numerically in space and time using a Crank-Nicolson algorithm. A key feature of this model is the appearance of a Hopf bifurcation separating a spatio-temporal oscillatory region from a homogeneous region. Motivated by experiments [2], we explore possibilities to manipulate the oscillatory states by applying time-delayed feedback control (TDFC) such that they become stationary. The TDFC is introduced via a Pyragas scheme [3].

[1] S.M. Fielding and P.D. Olmsted, *Phys. Rev. Lett.* **92**, 084502 (2004).

[2] O. Lüthje *et al.*, *Phys. Rev. Lett.* **86**, 1745 (2001).

[3] K. Pyragas, *Phys. Lett. A* **170**, 421 (1992).

DY 70.22 Thu 15:30 Poster A

Delayed feedback control of self-mobile cavity solitons in a wide-aperture laser with a saturable absorber — •Tobias Schemmelmann[1], Felix Tabbert[1], Alexander Pimenov[2], Andrei Vladimirov[2], and Svetlana Gurevich[1,3] — [1]Institute for Theoretical Physics, University of Münster, Wilhelm-Klemm-Str. 9, D-48149, Münster, Germany — [2]Weierstrass Institute for Applied Analysis and Stochastics, Mohrenstrasse 39, D-10117 Berlin, Germany — [3]Center for Nonlinear Science (CeNoS), University of Münster, Corrensstr. 2, 48149 Münster, Germany

We investigate the spatiotemporal dynamics of cavity solitons in a broad area vertical-cavity surface-emitting laser (VCSEL) under the influence of time-delayed optical feedback using a combination of analytical, numerical and path continuation methods. In particular, two types of moving cavity solitons are found, corresponding to slow and fast motion of the localised structure. We show that time-delayed feedback influences the dynamics of both stationary and moving cavity solitons, leading to a complex dynamical behaviour. The delay-induced instabilities range from simple drifting to wiggling dynamics and a combination of both. In addition, our analysis reveals that it is possible to use time-delayed feedback to stabilise intrinsically drifting cavity solitons.

DY 70.23 Thu 15:30 Poster A

Spatiotemporal instabilities of light bullets in passively-mode-locked lasers — •Frederik Edens[1], Julien Javaloyes[2], and Svetlana Gurevich[1] — [1]Institute for Theoretical Physics, University of Münster, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany — [2]Departament de Física, Universitat de les Illes Balears, C/ Valldemossa km 7.5, 07122 Mallorca, Spain

Recently, the existence of robust three-dimensional light bullets was predicted theoretically in the output of a laser coupled to a distant saturable absorber. We use a generic model of mode-locking that consists in a time-delayed dynamical system, and describe the passively mode-locked laser using the generic Haus partial differential equation. We analyze the stability and the range of existence of these dissipative localized structures in the uniform-field limit and provide guidelines and realistic parameter sets for their experimental observation. We conclude our analysis by the study of the influence of group velocity dispersion on the stability properties of light bullets and show that it may have a profound impact on their dynamics.

DY 70.24 Thu 15:30 Poster A

Modeling of the Chemotatic Response of Amoeboid Cells with a Phase Field Model — •Eduardo Moreno[1], Francesc Font[1], Carsten Beta[2], and Sergio Alonso[1] — [1]Department of Physics, Universitat Politecnica de Catalunya, Barcelona, Spain — [2]Institute of Physics and Astronomy, Universität Potsdam, Potsdam, Germany

Cells are able to polarize and move following gradients of chemical concentrations. The receptors of the cells induce an internal signal which produce the formation of localized regions of the cell with high concentrations of certain biochemicals which drive the locomotion of cells. We apply a phase field for the description of the interior (where the polarization processes evolve) and the exterior of the cells (where the chemicals diffuse) to model the two types of dynamics and the interaction of both environments at the membrane of the cell. We compare the resulting dynamics of the computer models with experiments of the motion of Dictyostelium discoideum following chemical gradients of the chemo-attractant cAMP (cyclic adenosine monophosphate).

DY 70.25 Thu 15:30 Poster A

Diffusion-influenced bimolecular reactions: Beyond the classical Langmuir-Hinshelwood theory — •Yi-Chen Lin[1,2], Won Kyu Kim[1], Rafael Roa[1], and Joachim Dzubiella[1,2] — [1]Institut für Weiche Materie und Funktionale Materialien, Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany — [2]Institut für Physik, Humboldt-Universität zu Berlin, Berlin, Germany

The study of the Langmuir-Hinshelwood (LH) reaction mechanism is essential to understand bimolecular catalytic reactions [1]. Nevertheless, the classical theory of the LH reaction is restricted in the limit of the surface-controlled case, while the diffusion-controlled limit can be analyzed within the Smoluchowski theory of diffusion [2]. In other words, the coupling of 2D (on the surface) and 3D (in the bulk) diffusion of reactants is neglected. We present a Brownian dynamics simulation model for the diffusion-influenced LH reaction. The effects of the interaction strength ϵ between the sink and the reactants, of the 2D diffusion and of the crowding of the products on the total rates are investigated under the framework of this simulation model. One of the interesting findings is that the monotonicity of the total rate with the increase of ϵ disappears when the crowding of the products is present. The simulations results exemplify a theory, which we also present in this work on a mean-field level.

[1] Laidler, K. J., Meiser, J. H., and Sanctuary, B. C. *Physical Chemistry*, 4th ed; Houghton Mifflin: Boston, 2002.

[2] Smoluchowski, M. v. *Physik. Z.* **1916**, 17, 557-585.