Asymptotic Behavior of systems of PDE arising in physics and biology: theoretical and numerical points of view (ABPDE III)

Report of Contributions

https://indico.math.cnrs.fr/e/2915

Contribution ID: **1** Type: **not specified**

Segregation phenomena in population dynamics

Tuesday, 28 August 2018 14:00 (45 minutes)

In this talk we consider two large groups of interacting agents, whose dynamics are influenced by the overall perceived density. Such dynamics can be used to describe two pedestrian groups, walking in opposite directions. Or to model the relocation behavior of two distinct populations, which have a preference to stay within their own group.

We discuss the mathematical modeling in different applications as well as the corresponding PDE models. Furthermore we analyze the long term behavior of solutions and show that already minimal interactions can lead to segregation. Finally we confirm our analytical results and illustrate the rich dynamics with numerical experiments.

Presenter: Dr WOLFRAM, Marie-Thérèse (University of Warwick)

Contribution ID: **2** Type: **not specified**

A finite-volume scheme for a degenerate cross-diffusion model motivated from ion transport

Tuesday, 28 August 2018 14:45 (35 minutes)

An implicit Euler finite-volume scheme for a degenerate cross-diffusion system describing the ion transport through biological membranes is proposed. We consider the model developed in [1] for describing size exclusion effects in narrow channels. The strongly coupled equations for the ion concentrations include drift terms involving the electric potential, which is coupled to the concentrations through a Poisson equation. The cross-diffusion system possesses a formal gradient-flow structure revealing nonstandard degeneracies, which lead to considerable mathematical difficulties.
The proposed finite-volume scheme is based on two-point flux approximations with "double" upwind mobilities. The existence of solutions to the fully discrete scheme is proved. When the particles are not distinguishable and the dynamics are driven by cross-diffusion only, it is shown that the scheme preserves the structure of the equations like nonnegativity, upper bounds, and entropy dissipation. The degeneracy is overcome by proving a new discrete Aubin-Lions lemma of "degenerate" type. Numerical simulations of a calcium-selective ion channel in two space dimensions show that the scheme is efficient even in the general case of ion transport.

This is a joint work with C. Cancès (Inria Lille), C. Chainais-Hillairet (Univ. Lille) and A. Jüngel (TU Wien).

References

[1] M. Burger, B. Schlake, and M.-T. Wolfram, Nonlinear Poisson-Nernst-Planck equations for ion flux through confined geometries, Nonlinearity 25 (2012) pp. 961-990.

[2] C. Cancès, C. Chainais-Hillairet, A. Gerstenmayer and A. Jüngel, Convergence of a Finite-Volume Scheme for a Degenerate Cross-Diffusion Model for Ion Transport, submitted, arXiv:1801.09408.

[3] A. Gerstenmayer and A. Jüngel, Analysis of a degenerate parabolic cross-diffusion system for ion transport, submitted, arXiv:1706.07261.

Presenter: GERSTENMAYER, Anita (Vienna University of Technology)

Contribution ID: **3** Type: **not specified**

On a Cross-Diffusion model for Multiple Species with Nonlocal Interaction and Size Exclusion

Tuesday, 28 August 2018 15:20 (35 minutes)

In this talk we study a PDE model for two diffusing species interacting by local size exclusion and global attraction. This leads to a nonlinear degenerate cross-diffusion system, for which we provide a global existence result as well as a uniqueness proof in the case of equal diffusivities. The analysis is motivated by the formulation of this system as a formal gradient flow for an appropriate energy functional consisting of entropic terms as well as quadratic nonlocal terms. Key ingredients are entropy dissipation methods as well as the recently developed boundedness-by-entropy principle. Moreover, we investigate phase separation effects inherent in the cross-diffusion model by an analytical and numerical study of minimizers of the energy functional and their asymptotics to a previously studied case as the diffusivity tends to zero.

Presenter: BERENDSEN, Judith (Westfälische-Wilhelmsuniversität Münster)

Contribution ID: **5** Type: **not specified**

An asymptotic-preserving and well-balanced scheme for the shallow-water equations with Manning friction

Tuesday, 28 August 2018 17:00 (35 minutes)

Presenter: BULTEAU, Solène (Université de Nantes)

Contribution ID: **6** Type: **not specified**

A second-order numerical method for aggregation equations

Wednesday, 29 August 2018 09:30 (45 minutes)

Inspired by so-called TVD limiter-based second-order schemes for hyperbolic conservation laws, we develop a second-order accurate numerical method for multi-dimensional aggregation equations. The method allows for simulations to be continued after the first blow-up time of the solution. In the case of symmetric, lambda-convex potentials with a possible Lipschitz singularity at the origin we prove that the method converges in the Monge–Kantorovich distance towards the unique gradient flow solution. This is joint work with José A. Carrillo and Susanne Solem.

Presenter: Dr FJORDHOLM, Ulrik Skre (University of Oslo)

Contribution ID: **7** Type: **not specified**

Flux vector approximation schemes for systems of conservation laws

Wednesday, 29 August 2018 10:15 (35 minutes)

Conservation laws in continuum physics are often coupled, for example the continuity equations for a reacting gas mixture or a plasma are coupled through multi-species diffusion and a complicated reaction mechanism. For space discretisation of these equations we employ the finite volume method. The purpose of this talk is to present novel flux vector approximation schemes that incorporate this coupling in the discretisation. More specifically, we consider as model problems linear advection-diffusion systems with a nonlinear source and linear diffusion-reaction systems, also with a nonlinear source.
The new flux approximation schemes are inspired by the complete flux scheme for scalar equations, see [1]. An extension to systems of equations is presented in [2]. The basic idea is to compute the numerical flux vector at a cell interface from a local inhomogeneous ODE-system, thus including the nonlinear source. As a consequence, the numerical flux vector is the superposition of a homogeneous flux, corresponding to the homogeneous ODE-system, and an inhomogeneous flux, taking into account the effect of the nonlinear source. The homogeneous ODE-system is either an advection-diffusion system or a diffusion-reaction system. In the first case, the homogeneous flux contains only real-valued exponentials, on the other hand, in the second case, also complex-valued components are possible, generating oscillatory solutions. The inclusion of the inhomogeneous flux makes that all schemes display second order convergence, uniformly in all parameters (Peclet and Damköhler numbers).
The performance of the novel schemes is demonstrated for several test cases, moreover, we investigate several limiting cases.

This is a joint work with J. van Dijk and R.A.M. van Gestel (Department of Applied Physics, Eindhoven University of Technology).

References

[1] J.H.M. ten Thije Boonkkamp and M.J.H. Anthonissen, The finite volume-complete flux scheme for advection-diffusion-reaction equations, J. Sci. Comput. 46 (2011) pp. 47-70.

[2] J.H.M. ten Thije Boonkkamp, J. van Dijk, L. Liu and K.S.C. Peerenboom, Extension of the complete flux scheme to systems of comservation laws, J. Sci. Comput. 53 (2012), pp. 552-568.

Presenter: Dr TEN THIJE BOONKKAMP, Jan (Eindhoven University of Technology)

Contribution ID: **8** Type: **not specified**

About the equilibria of a cross-diffusion system in population dynamics

Wednesday, 29 August 2018 11:10 (35 minutes)

Presenter: Dr BREDEN, Maxime (Technical University of Munich)

Contribution ID: **9** Type: **not specified**

An asymptotic-preserving scheme for a kinetic equation describing propagation phenomena

Wednesday, 29 August 2018 11:45 (35 minutes)

The run-and-tumble motion of bacteria such as E. coli can be represented by a nonlinear kinetic equation. It will be considered under an hyperbolic scaling, and rewritten using the Hopf-Cole transform of the distribution function. It has been shown that the asymptotic model is either a Hamilton-Jacobi equation in which the Hamiltonian is implicitely defined, or a non-local Hamilton-Jacobi-like equation.

Since the kinetic equation becomes a stiff problem when reaching the asymptotic, its numerical computation must be performed with care to avoid instabilities when reaching it. Asymptotic Preserving (AP) schemes have been introduced to avoid these difficulties, since they enjoy the property of being stable along the transition towards the asymptotic regime.

I will present an AP scheme for this nonlinear kinetic equation, which is based on a formal asymptotic analysis of the problem. The discretization of the limit Hamilon-Jacobi equation will also be discussed.

Presenter: Dr HIVERT, Hélène (Ecole Centrale de Lyon)

Contribution ID: **10** Type: **not specified**

Benchmark of asymptotic preserving schemes for the hyperbolic to diffusive degeneracy

Wednesday, 29 August 2018 12:20 (35 minutes)

Presenter: Dr BLACHÈRE, Florian (Université de technologie de Troyes)

Contribution ID: **11** Type: **not specified**

Swarming models with local alignment effects: phase transitions & hydrodynamics

Wednesday, 29 August 2018 14:30 (45 minutes)

We will discuss a collective behavior model in which individuals try to imitate each other's velocity and have a preferred asymptotic speed. It is a variant of the well-known Cucker-Smale model in which the alignment term is localized. We showed that a phase change phenomenon takes place as diffusion decreases, bringing the system from a disordered" to anordered" state. This effect is related to recently noticed phenomena for the diffusive Vicsek model. We analysed the expansion of the large friction limit around the limiting Vicsek model on the sphere leading to the so-called Self-Organized Hydrodynamics (SOH). This talk is based on papers in collaboration with Bostan, and with Barbaro, Cañizo and Degond.

Presenter: Prof. CARRILLO DE LA PLATA, Jose Antonio (Imperial College London)

Contribution ID: **12** Type: **not specified**

On the Motion of Several Disks in an Unbounded Viscous Incompressible Fluid

Wednesday, 29 August 2018 15:15 (35 minutes)

In this talk, we will present a recent result on fluid solid interaction problem. We consider the system formed by the incompressible Navier Stokes equations coupled with Newton's laws to describe the motion of a finite number of homogeneous rigid disks within a viscous homogeneous incompressible fluid in the whole space R2 . The motion of the rigid bodies inside the fluid makes the fluid domain time dependent and unknown a priori. First, we generalize the existence and uniqueness of strong solutions result of the considered system in the case of a single rigid body moving in a bounded cavity in [3], and then by careful analysis of how elliptic estimates for the Stokes operator depend on the geometry of the fluid domain, we extend these solutions up to collision. Finally, we prove contact between rigid bodies cannot occur for almost arbitrary configurations by studying the distance between solids by a multiplier approach [1]. This talk is based on the results of the preprint [2].

References

[1] Gérard-Varet, D., Hillairet, M., Regularity issues in the problem of fluid structure interaction, Arch. For ration. Mech. Anal., page 375-407 (2010).

[2] Sabbagh, L., On the motion of several disks in an unbounded viscous incompressible fluid, in progress.

[3] Takahashi, T., Analysis of strong solutions for the equation modelling the motion of a rigid-fluid system in a bounded domain, Adv. Differential Equations, page 1499-1532 (2003).

Presenter: SABBAGH, Lamis (Université de Montpellier)

Contribution ID: **13** Type: **not specified**

Poster session

Contribution ID: **14** Type: **not specified**

Fluid boundary layer models: beyond the Prandtl equation ?

Thursday, 30 August 2018 09:30 (45 minutes)

The Prandtl equation was derived in 1904 by Ludwig Prandtl in order to describe the behavior of fluids with small viscosity around a solid obstacle. Over the past decades, several results of ill-posedness in Sobolev spaces have been proved for this equation. As a consequence, it is natural to look for more sophisticated boundary layer models, that describe the coupling with the outer Euler flow at a higher order. Unfortunately, these models do not always display better mathematical properties, as I will explain in this talk.

This is a joint work with Helge Dietert, David Gérard-Varet and Frédéric Marbach.

Presenter: Prof. DALIBARD, Anne-Laure (Université Pierre et Marie Curie)

Contribution ID: **15** Type: **not specified**

A kinetic approach to the bi-temperature Euler model

Thursday, 30 August 2018 10:15 (35 minutes)

The aim of this work is the study of out-of-equilibirum plasma physics. It is a multiscale problem involving both very small lengths (Debye length) and high frequency oscillations (electronic plasma frequency). Transport of charged particles (electrons and ions) in context of Inertial Confinement Fusion (ICF) can be modelled by the bi-temperature Euler equations, which are a non-conservative hyperbolic system. It contains so-called non-conservatives terms, which cannot be put in divergential form. Such terms are not well-defined, and, in situations involving shocks, computing exact or approximated solutions is a challenging issue.
The bi-temperature Euler model can be recovered by using a ChapmanEnskog expansion on an underlying kinetic approach of this system, the Vlasov-BGK-Ampère system, which is conservative. We are interested in the numerical resolution of this kinetic model, in a macroscopic setting. Hence, a scaling is performed on this model in order to exhibit the behaviour of the system in large scale configurations. The
major issue of such a system is that the Maxwell equations are describing small scale electromagnetics. At the macroscopic level, these equations degenerate into algebraic relations, preventing their use for computation purposes. Hence, we derive an Asymptotic-Preserving numerical method, which is able to solve the system even when these small scales (Debye length, electronic plasma frequency) are not resolved, i.e Δt, Δx ε, with $\varepsilon \longrightarrow 0$ [2].
Numerical test cases are studied. Several well-known Riemann problems are solved with our method and then compared with methods for the macroscopic bi-temperature Euler model, derived in [1].

References

[1] D. Aregba-Driollet, J. Breil, S. Brull, B. Dubroca and E. Estibals, Modelling and numerical approximation for the nonconservative bi-temperature Euler model, Math. Model. Numer. Anal. (2017), DOI 10.1051/m2an/2017007

[2] S. Jin, Efficient asymptotic-preserving (AP) schemes for some multiscale kinetic equations, SIAM J. Sci. Comput. 21-2 (1999), pp. 441-454.

Presenter: PRIGENT, Corentin (Université de Bordeaux)

Contribution ID: **16** Type: **not specified**

Dynamics of electrochemical interfaces

Thursday, 30 August 2018 11:10 (35 minutes)

Interface processes play an important role in many electrochemical applications like batteries, fuel-cells or water purification. In boundary regions typically sharp layers form where electrostatic potential develops steep gradients and the ionic species accumulate to an extend that saturation effects become relevant. In contrast, the classical Nernst-Planck model for electrolyte transport is build on the assumption of dilute solutions and thus it is unable to accurately describe electrochemical interfaces.
Various modifications of the standard Nernst-Planck systems have been proposed. Recently, we derived an extended continuum model from consistent coupling of electro- and thermodynamics in bulk domains intersected by singular surfaces. We apply the model to the interface between a liquid electrolyte and a metal electrode. The interface consists of the surface and the adjacent boundary layers. The surface is assumed to be blocking to all species such that no Faradayic surface reactions occur but adsorption-desorption between volume and surface is permitted. By means of matched asymptotic analysis, the dynamic behavior of such electro-chemical interfaces is investigated in the thin double layer limit, i.e. for small Debye length. We find three different time scales characterizing the time scales of the bulk diffusion, the double layer charging and the bulk polarization.
For small amplitudes of the applied potential, a linearization of the asymptotic thin double layer model leads to an equivalent circuit model. Electrochemical impedance spectroscopy then allows the identification of parameters in the original full PDE model.

This is a joint work with W. Dreyer and C. Guhlke (WIAS Berlin).

Presenter: Dr MÜLLER, Rüdiger (Weierstrass-Institute)

Contribution ID: **17** Type: **not specified**

Numerical simulations of slurry pipeline for water-slurry-water

Thursday, 30 August 2018 11:45 (35 minutes)

Numerous slurry transportation pipeline systems have been built in the past 10 years. At the same time, T. Chakkour & F. Benkhaldoun study in [2, 3] the hydraulic transport of particles in tubes. We investigated in [1] the hydraulic transport of slurry system in horizontal tubes (The Khouribga mines). This mineral pipeline has often been referred to as one of the most challenging projects in terms of operating complexity and system configuration in Morocco. This physical model features a mass and momentum balance for three-fluid model in 1D. It allows to predict the pressure drop and flow patterns. The originality of this work is to present in simplified form a homogeneous single-phase model. The most important advantage of this model is the considerably smaller number of variables to be solved compared to the multiphase model. In this presentation, we give the asymptotic behavior of friction-disharge term fQ2 that is involved in the last term of motions equation, taking into account the Reynolds number. This allows to understand how the elevation varies, when the flow is very laminar.

References

[1] T. Chakkour, F. Benkhaldoun and M. Boubekeur, Slurry Pipeline for fluid transients in pressurized conduits, submitted

[2] T. Chakkour, Simulations numériques des tubes avec contraction brusque sur openfoam, Thermodynamique des interfaces et mécanique des fluides 17 (2017).

Presenter: Dr CHAKKOUR, Tarik (LAGA - Paris 13)

Contribution ID: **18** Type: **not specified**

Asymptotic behaviour of some biological models stemming from structured population dynamics

Thursday, 30 August 2018 12:20 (35 minutes)

We consider two different partial differential equation models structured by elapsed time for dynamics of neuron population and give some improved results for long time asymptotics. The first model we study is a nonlinear version of the renewal equation, while the second model is a conservative drift-fragmentation equation which adds adaptation and fatigue effects to the neural network model. These problems were introduced in [1] and [2].
We prove that both the problems are well-posed in a measure setting. Both have steady states which may or may not be unique depending on further assumptions. In order to show the exponential convergence to steady states we use a technique from the theory of Markov processes called Doeblins method. This method was used in [3] for demonstrating exponential convergence of solutions of the renewal equation to its equilibrium. It is based on the idea of finding a positive quantitative bound for solutions to the linear problem. This leads us to prove the spectral gap property in the linear setting. Then by exploiting this property we prove that both models converge exponentially to a steady state.
We consider an extension of the Doeblin's Theorem which is called Harris' Theorem, in order to obtain asymptotic convergence result for growth-fragmentation equation which is a more general model for cell growth and division and other phenomena involving fragmentation. This part is still on progress.

This is a joint work with José A. Cañizo.

References

1] K. Pakdaman, B. Perthame and D. Salort, Dynamics of a structured neuron population, Nonlinearity 23-1 (2010), pp. 55-75.

[2] K. Pakdaman, B. Perthame and D. Salort, Adaptation and fatigue model for neuron networks and large time asymptotics in a nonlinear fragmentation equation, J. Math. Neurosci. 4-1 (2014), pp. 1-26.

[3] P. Gabriel, Measure solutions to the conservative renewal equation, submitted, arXiv:1704.00582

[4] J. A. Cañizo and H. Yoldaş, Asymptotic behaviour of neuron population models structured by elapsed-time, submitted, arXiv:1803.07062

Presenter: YOLDAŞ, Havva (BCAM - Universidad de Granada)

Contribution ID: **19** Type: **not specified**

On all-regime and well-balanced Lagrange-Projection schemes for compressible fluid systems

Thursday, 30 August 2018 14:30 (45 minutes)

It is the purpose of this talk to provide an overview on recent advances on the development of Lagrange Projection like numerical schemes for compressible fluids systems with source terms. The key idea of the Lagrange-Projection strategy is to decouple the acoustic and transport phenomenon. When combined with a Suliciu like relaxation technique, the Lagrange-Projection strategy leads to efficient implicit-explicit discretisations on fixed unstructured grids, with CFL conditions driven by the (slow) material waves and not by the (fast) acoustic waves. The resulting scheme also satisfies a fully discrete entropy inequality. As we will see, the strategy is very well-suited to design efficient all-regime and well balanced numerical schemes. For the purpose of illustration, we will first consider the nearly incompressible limit of low Mach number flows and the diffusive limit of the gas dynamics equations with source terms, for which asymptotic-preserving schemes are proposed. We will also show that the strategy allows to design fully well-balanced schemes for the shallow water equations. By fully well-balanced, we mean here that the scheme is able to preserve stationary states with non-zero velocity.

Presenter: Prof. CHALONS, Christophe (Université Versailles Saint-Quentin-en-Yvelines)

Contribution ID: **20** Type: **not specified**

Equilibration in Wasserstein distance of partially damped Euler equations

Thursday, 30 August 2018 15:15 (35 minutes)

We discuss ideas and tools to construct Lyapunov functionals on the space of probability measures to investigate convergence to global equilibrium of partially damped Euler equations under the influence of external and interaction potential forces with respect to the 2-Wasserstein distance.

Presenter: Dr TSE, Oliver (Eindhoven University of Technology)

Contribution ID: **21** Type: **not specified**

Asymptotical methods for optimal control problems. Examples for the groundwater management

Thursday, 30 August 2018 16:10 (45 minutes)

This talk aims at illustrating some methods for the asymptotical analysis of optimal contribution-ol problems. We use examples in the context of groundwater pollution. The spatio-temporal objective takes into account the economic trade off between the pollutant use –for instance fertilizer– and the cleaning costs. It is constrained by a hydrogeological PDEs model for the spread of the pollution in the aquifer. We rigorously derive, by asymptotic analysis, the effective optimal control problem for contaminant species that are slightly concentrated in the aquifer. On the other hand, the mathematical analysis of the optimal control problems is performed and we prove in particular that the latter effective problem is well-posed. Furthermore, a stability property of the optimal control process is provided: any optimal solution of the properly scaled problem tends to the optimal solution of the effective problem as the characteristic pollutant concentration decreases. Finally we give some results in game theory.

Presenter: Prof. CHOQUET, Catherine (Université de La Rochelle)

Contribution ID: **22** Type: **not specified**

On convergences of the square root approximation scheme to the Fokker- Planck operator

Thursday, 30 August 2018 16:55 (35 minutes)

We study the qualitative convergence behavior of a novel FV-discretization scheme of the Fokker-Planck equation, the squareroot approximation scheme (SQRA), that recently was proposed by [Lie, Fackeldey and Weber 2013] in the context of conformation dynamics. We show that SQRA has a natural gradient structure related to the Wasserstein gradient flow structure of the Fokker-Planck equation and that solutions to the SQRA converge to solutions of the Fokker-Planck equation. This is done using a discrete notion of G-convergence for the underlying discrete elliptic operator. The gradient structure of the FV-scheme guaranties positivity of solutions and preserves asymptotic behavior of the Fokker-Planck equation for large times. Furthermore, the SQRA does not need to account for the volumes of cells and interfaces and is taylored for high dimensional spaces. However, based on FV-discretizations of the Laplacian it can also be used in lower dimensions taking into account the volumes of the cells. As an example, in the special case of stationary Voronoi tessellations we use stochastic two-scale convergence to prove that this setting satisfies the G-convergence property.

Presenter: Dr HEIDA, Martin (WIAS Berlin)

Contribution ID: **23** Type: **not specified**

Spectral theory of a transport equation with elastic and inelastic collision operators

Thursday, 30 August 2018 17:30 (35 minutes)

Presenter: Dr AL IZERI, Abdul Majeed (Laboratoire de Mathématiques Blaise Pascal)

Contribution ID: **24** Type: **not specified**

Particle Micro-Macro schemes for collisional kinetic equations in the diffusive scaling

Friday, 31 August 2018 09:30 (45 minutes)

In this talk, I will present a new asymptotic preserving scheme for kinetic equations of Boltzmann-BGK type in the diffusive scaling. The scheme is a suitable combination of micro-macro decomposition, the micro part being discretized by a particle method, and Monte Carlo techniques. Thanks to the Monte Carlo particle approximation, the computational cost of the method automatically reduces when the system approaches the diffusive limit. However, this approximation requires a splitting between the transport part and the collisional one, so that both stiff terms can not offset each other a priori, which prevents from uniform stability. That is why we propose a suitable reformulation of the micro-macro system, without stiff terms. The scheme will be presented in detail and illustrated by several numerical results (including in the 3D in space - 3D in velocity framework).
This work is a collaboration with Nicolas Crouseilles, Giacomo Dimarco and Mohammed Lemou.

Presenter: Dr CRESTETTO, Anaïs (Laboratoire de Mathématiques Jean Leray)

Contribution ID: **25** Type: **not specified**

Implicit kinetic relaxation schemes. Application of plasma physics models

Friday, 31 August 2018 10:15 (35 minutes)

In this work we consider PDE models used in plasmas physic like MHD or Vlasov equations.
The key point to solve the kinetic Vlasov equation is the Semi Lagrangian Solver, which is a high-order, CFL less and Matrix-free solver for the transport equation.
The other models present in plasma physic like MHD, anisotropic equation or Poisson solver can be written like approximated BGK models.
For each type of model we will present the different BGK models used to approximate the different physical equations. After that we will propose a high-order asymptotic-preserving scheme in time based on spitting approach. Using this, we obtain a full semi-Lagrangian solver (or other implicit solver for the advection equation) for all the type of models in plasmas physics.
We will illustrate this by some numerical results.

Presenter: Dr FRANCK, Emmanuel (INRIA)

Contribution ID: **26** Type: **not specified**

Critical singularities in the higher dimensional minimal Keller-Segel model

Tuesday, 28 August 2018 16:15 (45 minutes)

Existence of global in time radially symmetric solutions is studied for “large” initial data. Criteria for blowup of solutions in terms of Morrey norms are derived.

Presenter: Prof. BILER, Piotr (Uniwersytet Wrocławski)

Contribution ID: **29** Type: **not specified**

A degenerate Cahn-Hilliard model as constrained Wasserstein gradient flow

Wednesday, 29 August 2018 16:10 (2h 20m)

Presenter: Dr CANCÈS, Clément (Inria Lille)

Session Classification: Poster session

Contribution ID: **30** Type: **not specified**

Convergence analysis of a numerical scheme for a general class of Mean field Equation

Wednesday, 29 August 2018 16:10 (2h 20m)

A widely used prototype phase model to describe the synchronous behavior of weakly coupled limit-cycle oscillators is the Kuramoto model whose dynamics for sufficiently large ensemble of oscillators can be effectively approximated by the corresponding mean-field equation 'the Kuramoto Sakaguchi Equation'. In the recent past, it has been extensively studied to analyze the phase transition of between different kind of ordered states.In the talk, we are going to derive and analyze a numerical method for a general class of mean-field equations, including the Kuramoto Sakaguchi equation. Along the way, we will prove the strong convergence of the scheme to the unique weak solution whenever the initial datum has bounded variation. We also show convergence in the sense of measures, thereby relaxing the assumption of bounded variation. The theoretical results will be verified with several numerical experiments.

This is a joint work with U. S. Fjordholm.

Presenter: Mr CHATTERJEE, Neelabja (University of Oslo)

Session Classification: Poster session

Contribution ID: **31** Type: **not specified**

Time asymptotic behavior for singular neutron transport equation with bounce-back boundary conditions in L1 spaces

Wednesday, 29 August 2018 16:10 (2h 20m)

Presenter: Dr KOSAD, Youssouf (Université de Djibouti)

Session Classification: Poster session

Contribution ID: **32** Type: **not specified**

A Multilevel Monte Carlo Method For Kinetic Transport Equations Using Asymptotic-Preserving Particle Schemes

Wednesday, 29 August 2018 16:10 (2h 20m)

Presenter: LOEVBAK, Emil (KU Leuven)

Session Classification: Poster session

Contribution ID: **33** Type: **not specified**

Sedimentation of particles in Stokes flow

Wednesday, 29 August 2018 16:10 (2h 20m)

We consider the sedimentation of N identical spherical particles in a uniform gravitational field. Particle rotation is included in the model while inertia is neglected.
In the dilute case, the result in [5] shows that the particles do not get closer in finite time. The rigorous convergence of the dynamics to the solution of a Vlasov-Stokes equation is proven in [4] in a certain averaged sense. The result holds true in the case of particles that are not so dilute as in [5] and for which the interactions between particles are still important.
In this paper, using the method of reflections, we extend the investigation of [4] by discussing the optimal particle distance which is conserved in finite time. The set of particle configurations considered herein is the one introduced in [3] for the analysis of the homogenization of the Stokes equation. We also prove that the particles interact with a singular interaction force given by the Oseen tensor and justify the mean field approximation of Vlasov-Stokes equations in the spirit of [1] and [2].

Key-words: Suspension flows, Interacting particle systems, Stokes equations, Vlasov-like equations

References

[1] M. Hauray, Wasserstein distances for vortices approximation of Euler-type equations, Math. Models Methods Appl. Sci. 19 (2009) pp. 1357-1384.

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[4] R.-M. Höfer, Sedimentation of Inertialess Particles in Stokes Flows, Commun. Math. Phys. 360-1 (2018), pp. 55-101.

[5] P.-E. Jabin and F. Otto, Identification of the dilute regime in particle sedimentation, Commun. Math. Phys. 250 (2004), pp. 415-432.

Presenter: Mrs MECHERBET, Amina (MAG, Montpellier University)

Session Classification: Poster session

Contribution ID: **34** Type: **not specified**

Existence of traveling waves for the nonlocal Gross-Pitaevskii-equation in dimension one

Wednesday, 29 August 2018 16:10 (2h 20m)

Presenter: Mr MENNUNI, Pierre (Laboratoire Paul Painlevé, Université de Lille)

Session Classification: Poster session

Contribution ID: **35** Type: **not specified**

Nonlocal elliptic equations: existence and multiplicity results

Wednesday, 29 August 2018 16:10 (2h 20m)

Presenter: Mrs MUKHERJEE, Debangana (Montanuniversität, Leoben)

Session Classification: Poster session

Contribution ID: **36** Type: **not specified**

Maxwell's equations with sign changing permittivity tensor

Wednesday, 29 August 2018 16:10 (2h 20m)

To model hybrid resonances in fusion plasma, Maxwell's equations feature a sign changing permittivity tensor. The problem can be expressed as a degenerate elliptic PDE. There is no uniqueness of the solution, and the solutions admit a singularity inside the domain.
A small regularizing viscosity parameter can be introduced, but the problem is still numerically challenging because of the competition of this small parameter with the discretization step.
The work presented will consist of the characterization of the limit solution in a mixed variational setting and will be numerically illustrated.

Presenter: Mrs NICOLOPOULOS, Anouk (LJLL, Université Pierre et Marie Curie)

Session Classification: Poster session

Contribution ID: **38** Type: **not specified**

Long time asymptotics for solutions of the Short Pulse Equation

Wednesday, 29 August 2018 16:10 (2h 20m)

Presenter: Prof. ZIELINSKI, Lech (LMPA, Université du Littoral Côte d'Opale)

Session Classification: Poster session

Contribution ID: **39** Type: **not specified**

An entropy preserving DG-scheme for the Fisher-KPP equation

Friday, 31 August 2018 11:10 (35 minutes)

The Fisher-KPP equation is a diffusion equation with logistic reaction modeling the time evolution of the density of one species confined in the bounded domain.
According to this interpretation, we expect that the density remains non-negative during the evolution. Despite in the continuous setting it is not difficult to prove this, at the discrete level the same results are not trivial at all.
During this talk, we discuss a numerical method preserving the entropy structure of the Fisher-KPP equation. With this structure, we can show that the density stays always non-negative and decays algebraically to the stable steady state of the Fisher-KKP equation.

This talk is based on a a joint work with Francesca Bonizzoni (University of Vienna), Ansgar Jüngel (Vienna University of technology) and Ilaria Perugia (University of Vienna).

Presenter: Dr BRAUKHOFF, Marcel (Institute for Analysis and Scientific Computing, Vienna University of Technology)

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Dimension reduction of improved Nernst-Planck models for charged nanopores

Wednesday, 29 August 2018 16:10 (2h 20m)

The classical Nernst-Planck model suffers from its inability to accurately resolve boundary layers where locally large ion concentrations and pronounced voltage differences occur. In nanofluidic applications like nanopores with charged pore walls,
one spatial dimension is in the order of the Debye length which corresponds to the boundary layer width.
Improved models, in particular models that take the finite size of the ions into account, can give a more realistic description of the ion flow in the boundary layers.
Since typically the aspect ratio of the pore geometry is large the numerical discretization of the nanopore problem needs very fine meshes to resolve the layers, leading to extremely large algebraic systems to be solved.
By asymptotic analysis we derive a dimension reduced system 1D PDE system for averaged quantities plus a small algebraic system in each discretization point.
We compare our reduced 1D model to the full 2D model over a large range of bulk ion concentrations and boundary charges.
We demonstrate that improved material models lead to considerable deviations from solutions of the Nernst-Planck model.

Joint work with: J. Fuhrmann (WIAS), C. Guhlke (WIAS), B. Matejczyk (U Warwick)

Presenter: Dr MÜLLER, Rüdiger (Weierstrass-Institute)

Session Classification: Poster session