Berufungsvorträge
„Mathematische Stochastik“

Die Berufungsvorträge schließen folgende Punkte mit ein:

- Didaktischer Vortrag (15 Minuten) zum Thema „Conditional Expectation“
- Fragen/Pause
- Wissenschaftlicher Vortrag (ca. 45 Minuten) zu einem freien Thema, siehe Abstracts
- Fragen/Pause
- Kommissionelles Hearing unter Ausschluss der Öffentlichkeit

Veranstaltungsräume/Hörsäle:
HS 17 Friedrich Hartmann, Hauptgebäude der TU Wien, Stiege 7, 3. Stock, Karlsplatz 13, 1040 Wien
FH 2 und FH 3: Freihaus der TU Wien, gelber Bereich, 2. Stock, Wiedner Hauptstraße 8, 1040 Wien

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Di., 18. Dezember 2018, 10:30 – 12:30
HS 17 Friedrich Hartmann, Hauptgebäude der TU Wien

Alexandre Stauffer
University of Bath, https://sites.google.com/site/alexandrestauffer/

Random Aggregation Processes:
Long-Time Behavior, Phase Transition and Dendritic Formation
There are several works in the physics literature to understand aggregation processes coming from nature, such as the formation of crystals and snowflakes, electrodeposition and dielectric breakdown. Several mathematical models have been proposed, but most of them are notoriously challenging to analyze rigorously. One reason behind this is that such processes produce a delicate and beautiful geometry, with fractal-like, dendritic ramifications that are yet very poorly understood. Another reason is that they are based on strongly interacting systems of particles, whose evolution is drastically affected by how particles behaved in the past, producing a non-equilibrium dynamics.

In this talk I will review our current understanding on this subject, with special emphasis on the model of multi-particle diffusion limited aggregation, whose analysis has been widely open for almost 40 years. I will highlight the main challenges in this area, and explain a novel process that we recently introduced to analyze this model and its phase transition.

Mo., 7. Jänner 2019, 08:30 – 10:30
FH 3, Freihaus der TU Wien

Omer Angel
University of British Columbia, https://www.math.ubc.ca/~angel/

Hyperbolic (and Parabolic) Planar Maps
I will discuss several natural models of hyperbolic random planar maps, and the settings in which they arise as stationary measures and as local limits of random maps. There are numerous differences between Euclidean and hyperbolic spaces. These include curvature and other metric properties, amenability and geometric properties, and a number of analytic and probabilistic properties. To a limited extent, these extend also to discrete maps, and I will survey the current known results.

Mo., 7. Jänner 2019, 10:30 – 12:30
FH 3, Freihaus der TU Wien

Mykhaylo Shkolnikov

Princeton University, https://mykhaylo.princeton.edu/

The Supercooled Stefan Problem

The Stefan problem arising from the physics of supercooled liquids poses major mathematical challenges due to the presence of blow-ups, including even the definition of solutions. I will explain how the problem can be reformulated in probabilistic terms and how related particle system models lead to an appropriate notion of a solution. The solutions can be then studied by probabilistic techniques and a sharp description of the blow-ups can be established. Based on joint works with Sergey Nadtochiy and an ongoing joint work with Francois Delarue and Sergey Nadtochiy.

Mo., 7. Jänner 2019, 14:00 – 16:00
FH 3, Freihaus der TU Wien

Erika Hausenblas

Montanuniversität Leoben, http://institute.unileoben.ac.at/amat/erika/

Stochastic Systems Arising in Biology

Chemotaxis is defined as the oriented movement of cells (or an organism) in response to a chemical gradient. Many sorts of motile cells undergo chemotaxis. For example, bacteria and many amoeboid cells can move in the direction of a food source. In our bodies, immune cells like macrophages and neutrophils can move toward invading cells. Other cells, connected with the immune response and wound healing, are attracted to areas of inflammation by chemical signals.

Theoretical and mathematical modelling of chemotaxis dates back to the works of Patlak in the 1950s and Keller and Segel in the 1970s. The deterministic model, i.e., the macroscopic system of equations, is derived from the microscopic behaviour studying the limit behaviour. From the microscopic perspective, one interprets the movements of the cells as a result of microscopic irregular movement. Taking the limit and passing from the microscopic to the macroscopic equation, one is neglecting the fluctuations around the mean value.

For a more realistic model, it is necessary to consider features of the natural environment which are non-reproducible and, hence, modelled by random spatiotemporal forcing.

In the talk, the system of chemotaxis with a stochastic noise is presented. Then I will highlight the main results gained for the system, and point out some perspectives for the future.

Mo., 7. Jänner 2019, 16:00 – 18:00
FH 3, Freihaus der TU Wien

Johannes Muhle-Karbe

Carnegie Mellon University, http://www.math.cmu.edu/~jmuhleka/

Nonlinear FBSDEs and the Equilibrium Dynamics of Illiquid Assets

How does a transaction tax affect the volatility of a financial market? How are agents' beliefs incorporated into the prices of assets that are difficult to trade? Such questions about the interplay of liquidity and asset prices need to be addressed with “equilibrium models”, where prices are not inputs of the model but determined endogenously by matching supply and demand. However, equilibrium models generally lead to notoriously intractable fixed-point problems, that have confined most previous work to simple toy models. In this talk, we discuss how to overcome these difficulties using new well-posedness results and asymptotic expansions for nonlinear forward-backward stochastic differential equations (FBSDEs).

Di., 8. Jänner 2019, 10:00 – 12:00
FH 2, Freihaus der TU Wien

Nicolas Perkowski

Humboldt-Universität zu Berlin, http://www.math.hu-berlin.de/~perkowsk

Singular Stochastic Partial Differential Equations
In certain areas of mathematical physics such as infinite-dimensional Langevin dynamics or dynamics near criticality one encounters so called “singular stochastic PDEs”, a class of equations that are ill posed due to resonances which may arise from the interplay of irregular noise and nonlinearities. Recent years saw a number of mathematical developments allowing us to solve and study such equations for the first time. In my talk I will motivate the appearance of some singular SPDEs, present the main ideas of our new solution theories, and discuss some recent developments in the field.

Di., 8. Jänner 2019, 13:30 – 15:30
FH 2, Freihaus der TU Wien

Fabio Toninelli

Université Claude Bernard Lyon 1, http://math.univ-lyon1.fr/~toninelli/

Dynamics of Random Interfaces and Dimer Models
I will start from the following apparently simple question, motivated by Markov dynamics of spin models in statistical physics. Given an integer L, color the points x of Z^d black for $|x| < L$ and white otherwise. Then, let the colors evolve randomly as follows: the color at each x is updated with rate one and it takes the color of the majority of its neighbors, or is chosen via a symmetric coin toss in case of tie.

How does the set of black sites evolve macroscopically, as L and the time tend to infinity?

I will show that this question is actually quite challenging and it is related to several interesting mathematical objects: (i) to anisotropic curve shortening flows in the $d = 2$ case, (ii) to random tilings of the plane and planar dimer models in the $d = 3$ case; and (iii) to the computation of the running time of probabilistic Markov Chain Monte Carlo sampling algorithms on complex combinatorial structures.

Di., 8. Jänner 2019, 16:00 – 18:00
FH 2, Freihaus der TU Wien

Arnulf Jentzen

ETH Zürich, http://www.ajentzen.de/

Stochastic Approximation Algorithms for High-Dimensional PDEs
Partial differential equations (PDEs) are among the most universal tools used in modelling problems in nature and man-made complex systems. For example, stochastic PDEs are a fundamental ingredient in models for nonlinear filtering problems in chemical engineering and weather forecasting, deterministic Schroedinger PDEs describe the wave function in a quantum physical system, deterministic Hamiltonian-Jacobi-Bellman PDEs are employed in operations research to describe optimal control problems where companys aim to minimise their costs, and deterministic Black-Scholes-type PDEs are highly employed in portfolio optimization models as well as in state-of-the-art pricing and hedging models for financial derivatives. The PDEs appearing in such models are often high-dimensional as the number of dimensions, roughly speaking, corresponds to the number of all involved interacting substances, particles, resources, agents, or assets in the model. For instance, in the case of the above mentioned financial engineering models the dimensionality of the PDE often corresponds to the number of financial assets in the involved hedging portfolio. Such PDEs can typically not be solved explicitly and it is one of the most challenging tasks in applied mathematics to develop approximation algorithms which are able to approximatively compute solutions of high-dimensional PDEs. Nearly all approximation algorithms for

PDEs in the literature suffer from the so-called "curse of dimensionality" in the sense that the number of required computational operations of the approximation algorithm to achieve a given approximation accuracy grows exponentially in the dimension of the considered PDE. With such algorithms it is impossible to approximatively compute solutions of high-dimensional PDEs even when the fastest currently available computers are used. In the case of linear parabolic PDEs and approximations at a fixed space-time point, the curse of dimensionality can be overcome by means of stochastic approximation algorithms and the Feynman-Kac formula. In this talk we introduce a new stochastic approximation algorithm for high-dimensional nonlinear PDEs. We prove that this algorithm does indeed overcome the curse of dimensionality in the case of a general class of semilinear parabolic PDEs and we thereby prove, for the first time, that a general semilinear parabolic PDE with a nonlinearity depending on the PDE solution can be solved approximatively without the curse of dimensionality.

Mi., 9. Jänner 2019, 08:30 – 10:30
FH 3, Freihaus der TU Wien

Noam Berger

Technische Universität München, https://www.professoren.tum.de/en/berger-noam/

A Probabilistic Approach to Quantitative Homogenization
In this talk I'll present an approach for quantitative homogenization which is based on direct random walk calculations. This approach yields results in balanced (or non-divergence form) cases, often without ellipticity assumptions. Based on joint work with D. Criens and J.-D. Deuschel.

Mi., 9. Jänner 2019, 10:30 – 12:30
FH 3, Freihaus der TU Wien

Matthias Erbar

Universität Bonn, https://wt.iam.uni-bonn.de/erbar/

Optimal Transport, Stochastic Particle Systems, Gradient Flows, and Curvature
Ideas from optimal transport have become a powerful tool in the analysis of diffusion processes and the associated evolution equations, starting from Otto's gradient flow interpretation. In this talk, I will present two sets of results that expand the scope of these ideas on one hand to stochastic dynamics on discrete spaces and on the other hand to kinetic evolution equations.

In the first part, I will present a discrete notion of curvature that applies to Markov chains based on convexity of the entropy. I will show that bounds on the curvature entail a number of functional inequalities governing the trend to equilibrium of the stochastic dynamics. A crucial feature is that the dynamics evolves as a gradient flow with respect to a suitable discrete transport distance.

In the second part, I will present a new point of view on the spatially homogeneous Boltzmann equation viewing it in a similar way as the gradient flow of the entropy with respect to a new notion of distance between probability measures that takes the collision process between particles into account. We will close the circle to the first part of the talk by giving a new and simple proof for the convergence of Kac's random walk to the Boltzmann equation using the rigidity of gradient flows.
