Stochastic Equations and Stochastic Dynamics—Title and Abstract —

Please add your entry **in Alphabetic order by name of speakers**

Andrea Agazzi (University of Bern) Random Splitting of Fluid Models: Ergodicity, Convergence and Lyapunov exponents

Time of talk: Monday, 10:50

We consider a family of processes obtained by decomposing the deterministic dynamics associated with some fluid models (e.g. Lorenz 96, 2d Galerkin-Navier-Stokes) into fundamental building blocks - i.e., minimal vector fields preserving some fundamental aspects of the original dynamics - and by sequentially following each vector field for a random amount of time. We characterize some ergodic properties of these stochastic dynamical systems and discuss their convergence to the original deterministic flow in the small noise regime. Finally, we show that the top Lyapunov exponent of these models is positive.sto

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Alexandra Blessing (University of Konstanz)

Title: Finite-time Lyapunov exponents for SPDEs with fractional noise

Time of talk: Monday, 18:20

Abstract: We estimate the finite-time Lyapunov exponents for a stochastic partial differential equation driven by a fractional Brownian motion (fbm) with Hurst index $H\in(0,1)$ close to a bifurcation of pitchfork type. We characterize regions depending on the distance from bifurcation, the Hurst parameter of the fbm and the noise strength where finite-time Lyapunov exponents are positive and thus indicate a change of stability. The results on finite-time Lyapunov exponents are novel also for SDEs perturbed by fractional noise.

This is joint work with D. Blömker (University of Augsburg).

Bjoern Bringmann (Princeton University)

Title: Global well-posedness of the stochastic Abelian-Higgs model in two dimensions

Time of talk: Thursday, 10:50 am (according to tentative schedule)

Abstract: There has been much recent progress on the local solution theory for geometric singular SPDEs. However, the global theory is still largely open. In this talk, we discuss the global well-posedness of the stochastic Abelian-Higgs model in two dimensions, which is a geometric singular SPDE arising from gauge theory. The proof is based on a new covariant approach, which consists of two parts: First, we introduce covariant stochastic objects, which are controlled using covariant heat kernel estimates. Second, we control nonlinear remainders using a covariant monotonicity formula, which is inspired by earlier work of Hamilton.

This is joint work with S. Cao (MIT).

Amarjit Budhiraja (University of North Carolina)

Title: Equilibrium Fluctuations for Some Particle Systems with Singular Interactions

Time of Talk: 9:00 am on Friday

Abstract: We study equilibrium fluctuations for certain infinite particle systems with singular interactions. This particle system with a homogeneous stationary distribution of particles was considered in Dembo-Tsai(2017). The focus in the current work is on an inhomogeneous stationary profile with an exponentially growing density. We show that the appropriately centered and scaled occupation measure of the particle positions, with suitable translations, viewed as a space-time random field, converges to a limit that can be characterized in terms of a certain stochastic partial differential equation (SPDE). The initial condition for this equation is given by a Brownian motion, the equation is driven by an additive space-time noise that is white in time and colored in space, and the linear operator governing the evolution is the infinitesimal generator of a geometric Brownian motion. We use this SPDE to also characterize the fluctuations of the ranked particle positions with a suitable centering and scaling. Joint work with Sayan Banerjee and Peter Rudzis.

Oleg Butkovsky (Weierstrass Institute and Humboldt University, Berlin)

Title: Weak uniqueness within the rough path framework

Time of Talk: 10:50 am Monday

Abstract: Joint work with Leonid Mytnik and Konstantinos Dareiotis. Consider a stochastic differential equation

d X_t= \sigma(X_t) d B_t^H,

where B^H is a fractional Brownian motion with the Hurst index H. If $H=1/2$, this equation can be treated within the framework of Ito's theory. It is known that for $\sigma\in C^1$ it has a unique strong solution, and for bounded continuous and uniformly elliptic σ it has a unique weak solution. However, if $H<1/2$, then there is no analogue of weak well-posedness; only strong well-posedness for smooth enough σ is known. We close this gap and show that weak uniqueness holds for irregular σ in the rough case as well. We use a combination of Le's stochastic sewing with Hairer-Mattingly-Kulik-Scheutzow's generalized coupling arguments.

Francesco Caravenna (University of Milano-Bicocca)

Title: Noise sensitivity for 2d Stochastic Heat Equation and directed polymers

Time of Talk: 9:00 am Tuesday

Abstract: We consider the (ill-defined) 2d Stochastic Heat Equation with multiplicative space-time white noise. Upon discretisation of space-time, the solution coincides with the partition function of 2d directed polymers in random environment: under a critical (logarithmic) rescaling of the noise strength, it converges to a universal limit known as the Stochastic Heat Flow. We prove that discretised solution (or partition function) is noise sensitive, i.e. any small perturbation of the underlying noise produces a solution which becomes asymptotically independent of the original one. This is obtained by generalising classical criteria for noise sensitivity beyond the boolean setting, which have an independent interest.

(Based on joint work with Anna Donadini)

Xin Chen (SJTU)

Title: Recent progress about long range random walk on random conductance model

Time of talk: 10:50 Wednesday

Abstract: We will introduce several results about long range random walk on random conductance model, including the quenched invariance principle, quenched local limit theorem, quantitative stochastic homogenization for random conductance models with stable-like jumps.The talk is based on a series of joint work with Marek Biskup, Zhen-qing Chen, Takashi Kumagai and Jian Wang.

Robert C. Dalang (Ecole Polytechnique Fédérale de Lausanne, Switzerland)

Time of talk: Tuesday 18:20

Title: Path regularity of non-autonomous uniformly parabolic SPDEs

Abstract: We consider a stochastic PDE driven by a parabolic second order partial differential operator with non-constant coefficients and with a nonlinear random external forcing given by a Gaussian noise that is white in time and spatially homogeneous. We prove the existence and uniqueness of a random field solution to this SPDE. Our main result concerns the space-time sample path Hölder-continuity properties of the solution. The Hölder exponents that we obtain are essentially optimal.

Jean-Dominique Deuschel (Technische Universitaet Berlin)

Title: Random Line Model

Time of Talk: 10:50 Friday

Abstract: We consider a variable speed random walk in a random environment on the two dimensional integer lattice with horizontal and vertical random jump rates.The jump rates are independent with fat tails.If the jump rates are integrable, the diffusively rescaled walk converge to a Brownian motion. On the other hand for non integrable fat jump rates, the process converges to a Brownian motion time changed by a self similar process introduced by Kesten-Spitzer in 1979 in the

context of random walk in a random scenery. Moreover, in case of different fat tails for the horizontal and vertical rates, the first coordinate of the corresponding constant speed random walk converges to an independent Brownian motion while the second coordinate converges to a Fontes-Isopi-Newman diffusion as is known for the one dimensional trapping model of Ben Arous-Cerny.

This is a joint work with H. Elad-Altman and T. Matsuda.

Alex Dunlap (Duke University)

Title: A critical stochastic heat equation with long-range noise

Time of Talk: 9:40 Friday

Abstract: I will describe a critical nonlinear stochastic heat equation in dimension $d \geq 3$ with noise that is white in time with spatial covariance that looks like the Riesz kernel at large scales. If the noise is attenuated by a logarithmic factor, then the limiting pointwise statistics of this equation can be described in terms of a forward-backward SDE (FBSDE). The FBSDE is similar to but not the same as a similar FBSDE obtained for analogous limits of the 2D nonlinear stochastic heat equation with spatially uncorrelated noise. This work also complements 2004 work by Mueller and Tribe in the linear case, where there is no logarithmic attenuation and a measure-valued process is obtained. Joint work in progress with Martin Hairer and Xue-Mei Li.

Andreas Eberle (University of Bonn)

Title: Non-reversible lifts of reversible diffusion processes and relaxation times

Time of talk: Thursday, 17:40

Abstract: We propose a new concept of lifts of reversible diffusion processes and show that various well-known non-reversible Markov processes arising in applications are lifts in this sense of simple reversible diffusions. Furthermore, we introduce a concept of non-asymptotic relaxation times and show that these can at most be reduced by a square root through lifting, generalising a related result in discrete time.

For reversible diffusions on domains in Euclidean space, or, more generally, on a Riemannian manifold with boundary, non-reversible lifts are in particular given by the Hamiltonian flow on the tangent bundle, interspersed with random velocity refreshments, or perturbed by Ornstein-Uhlenbeck noise, and reflected at the boundary. In order to prove that for certain choices of parameters, these lifts achieve the optimal square-root reduction up to a constant factor, precise upper bounds on relaxation times are required. We demonstrate how the recently developed approach to quantitative hypocoercivity based on space-time Poincaré inequalities can be rephrased and simplified in the language of lifts and how it can be applied to find optimal lifts.

This is joint work with Francis Lörler (Bonn).

Maximilian Engel (University of Amsterdam, FU Berlin)

Title: Detecting random bifurcations via rigorous enclosures of large deviations rate functions

Time of talk: Thursday, 18:20 pm (according to tentative schedule)

Abstract: We provide a description of transitions from uniform to non-uniform snychronization in diffusions based on large deviation estimates for finite time Lyapunov exponents. These can be characterized in terms of moment Lyapunov exponents which are principal eigenvalues of the generator of the tilted (Feynman-Kac) semigroup. Using a computer assisted proof, we demonstrate how to determine these eigenvalues and investigate the rate function which is the Legendre-Fenichel transform of the moment Lyapunov function. We apply our results to two case studies: the pitchfork bifurcation and a two-dimensional toy model, also considering the transition to a positive asymptotic Lyapunov exponent.

This is joint work with A. Blessing (Konstanz), A. Blumenthal (Georgia Tech) and M. Breden (Ecole Polytechnique).

Benjamin Fehrman (Louisiana State University)

Title: Stochastic dynamics of conservative stochastic PDE

Time of talk: Monday, 11:30

Abstract: In this talk, we will motivate the study of stochastic PDE with conservative noise through their application to the non-equilibrium statistical mechanics theories

of fluctuating hydrodynamics and macroscopic fluctuation theory. We will discuss some of the difficulties that arise in the analysis of such equations, and explain an approach to their well-posedness based on the equation's kinetic form. The well-posedness theory will then be used to study the stochastic dynamics, including through the construction a random dynamical system and invariant measure, and the dynamical fluctuations and large deviations.

Peter K. Friz (TU and WIAS Berlin)

Title: Rough stochastic differential equations and applications

Time of talk: Wednesday, 18:20 (according to tentative schedule)

Abstract: Rough stochastic differential equations (RSDEs) are a common generalization of Ito SDEs and Lyons RDEs. With concrete motivation from (I) non-linear filtering theory, (II) pathwise stochastic control and (III) a non-Markovian stochastic volatility models, I will then indicate all the progress made possible with RSDEs. The talk is based on

Friz, P. K., Lê, K., Hocquet, A. (2021-2024). Rough stochastic differential equations. https://arxiv.org/abs/2106.10340

Friz, P. K., Lê, K., Zhang, H. (2024). Controlled rough SDEs, pathwise stochastic control and dynamic programming principles. https://arxiv.org/abs/2412.05698.

Bugini, F., Friz, P. K., Zhang, H., Lê, K. (2025). Rough path stability of the filtering problem, revisited. Work in preparation.

Bank, P., Bayer, C., Friz, P. K., Pelizzari, L. (2025). Rough PDEs for local stochastic volatility models. https://onlinelibrary.wiley.com/doi/10.1111/mafi.12458

Christophe Garban (Université Lyon 1)

Title: Non-linear sigma models and curvature

time of talk: Thursday 11:30-12:10

Abstract: Daniel Friedan has identified in the 80's that the behaviour of non-linear sigma models at low temperatures is governed by the Ricci flow. After introducing non-linear sigma models, I will discuss a work in progress with Nathan de Montgolfier which establishes one of the predictions that can be derived from Friedan's Ricci flow.

Yu Gu (University of Maryland)

Title: Integration by parts in KPZ

time of talk: Tuesday 10:50-11:30

Abstract: Using Stein's method and a Gaussian integration by parts, we provide a direct proof of the known fact that drifted Brownian motions are invariant measures (modulo height) for the KPZ equation.

Cyril Labbé (Université Paris Cité)

Title : Construction and spectrum of the Anderson Hamiltonian with white noise

Time of talk: 17:40 Tuesday

Abstract: I will present a construction of the Anderson Hamiltonian with white noise on R^2 and R^3, which relies on a very nice result of Klein and Landau. Then I will show that the spectrum of this operator equals R almost surely. Joint work with Yueh-Sheng Hsu (TU Wien).

Chiranjib Mukherjee (University of Münster)

Title of Talk: Polaron and its Effective Mass

Time of Talk: Tuesday, 9:40 AM on Tuesday

Abstract: We show that the effective mass of the Fröhlich Polaron diverges as a quartic power of the coupling parameter, proving a conjecture of Landau and Pekar from 1948 and of Spohn from 1986. Joint work with R. Bazaes, M. Sellke and S. R. S. Varadhan.

Leonid Mytnik (Technion)

Time of talk : Thursday 9:40

Title: Exceptional times for the instantaneous propagation of superprocesses

Abstract. We consider the Dawson-Watanabe superprocess X on $\R^d$, whose spatial motion is a symmetric stable process with index $\alpha <2$. It has been shown by Perkins that, at any fixed time, conditioned on the survival of X, its closed support is almost surely the entire space R^d. This is known as the "instantaneous propagation" property. We show that for $\alpha \in (0,2/3)$, there exist exceptional times at which the support of X is compact and nonempty. Moreover, we show that the set of exceptional times is dense and has a full Hausdorff dimension. This is a joint work with Jieliang Hong.

Tatiana Nagnibeda (University of Geneva)

Title: On spectra of Laplacians on infinite graphs

Time of talk: 9:00 am on Wed

Abstract: We study spectral properties of Laplacians on graphs naturally associated with infinite finitely generated groups and their actions, with a particular interest in self-similar groups. The main motivations are to understand how the spectra and spectral measures depend on the algebraic structure and on the geometry of the group and to explore spectral rigidity, in the sense of the question "Can one hear the shape of a drum?"

Different approaches will be discussed in the talk: approximation by finite graphs, renormalization, reduction to the spectral theory of Schroedinger operators with aperiodic order.

Nicolas Perkowski (FU Berlin)

Title:

Dean-Kawasaki type SPDE models for particle systems

Time of talk: 9:00 Monday

Abstract: I will present weak error bounds for modeling the empirical measure of a large but finite system of mean-field interacting particles with an effective SPDE. I will also discuss different models for fluctuations, and which type of noise we can expect to see in the SPDE models. The weak error bounds are based on transport equations and calculus on Wasserstein space. This is joint work with Ana Djurdjevac and Xiaohao Ji.

Stanislav Smirnov (Geneva)

Title: Coulomb gas and lattice models

Time: 11:30 Friday

Abstract: Even before the introduction of Conformal Field Theory by Belavin, Polyakov and Zamolodchikov, it appeared indirectly in the work of den Nijs and Nienhuis using Coulomb gas techniques. The latter postulate (unrigorously) that height functions of lattice models of statistical mechanical (like percolton, Ising, 6-vertex models etc) converge to the Gaussian Free Field allowing to derive many exponents and dimensions of 2D lattice models.

This convergence would be a 2D analogue of the graph of a 1D Random Walk converging to the graph of the Brownian Motion, but remains in many ways mysterious, in particular it was never formulated in the presence of a boundary, but rather on a torus or a cylinder.

We will discuss the original arguments as well as some recent progress,

including possible formulations on general domains or Riemann surfaces and their relations to CFT, SLE and conformal invariance of critical lattice models.

Interestingly, new objects in complex geometry and potential theory seem to arise.

Josef Teichmann (ETHZ)

Title : Takens Theorem in Continuous Time and Large Language Models

Time of talk: Wednesday

Abstract: The success of large language models can also be analysed from the perspective of path dependent characteristics of stochastic processes. We provide some insight to extensions of Takens' classical theorem and prove a continuous time version in a stochastic case of it.

Max von Renesse (Univ. Leipzig)

Title: Functional Inequalities for Brownian Motion on Riemannian Manifolds with Sticky-Reflecting Boundary Diffusion

Time of talk: 11:30 Wednesday

Abstract: We prove geometric upper bounds for the Poincaré and Logarithmic Sobolev constants for Brownian motion on manifolds with sticky reflecting boundary

diffusion i.e. extended Wentzell-type boundary condition under general curvature assumptions on the manifold and its boundary.

We also discuss connections to particle systems with singular zero range interaction and Dean-Kawasaki type models for glassy materials.

The method is based on an interpolation involving energy interactions between the boundary and the interior of the manifold. As side results we obtain explicit geometric bounds on the first nontrivial Steklov eigenvalue.

Based on joint works with Vitalii Konarovskyi & Victor Marx and Marie Borman and Feng-Yu Wang

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Rongchan Zhu (BIT)

Title: Makeenko-Migdal equations for 2D Yang--Mills: from lattice to continuum

Time of talk: 11:30 Tuesday

Abstract: In this talk, I will talk about the convergence of the discrete Makeenko--Migdal equations for Yang--Mills model on the discrete lattice to their continuum counterparts on the plane, in an appropriate sense.

The key step in the proof is identifying the limits of the contributions from deformations as the area derivatives of the Wilson loop expectations.

Xiangchan Zhu (CAS)

Title: Φ^4_3 Theory from many-body quantum Gibbs states

Time of talk: 17:40 Monday

Abstract: We derive the Φ^4_3 measure on the torus as a rigorous limit of the quantum Gibbs state of an interacting Bose gas, where the limiting classical measure describes the critical behavior of the Bose gas just above the Bose--Einstein phase transition. Since the quantum problem is typically formulated using a nonlocal interaction potential, a key challenge is to approximate the local Φ^4_3 theory by a Hartree measure with a nonlocal interaction. This requires uniform estimates on the Hartree measure, which are achieved using techniques from recent development on stochastic quantization and paracontrolled calculus from \cite{GIP15}. The connection to the quantum problem is then established by applying the variational approach in \cite{LewNamRou-21}, where using a recent correlation inequality from \cite{DeuNamNap-25} we refine the analysis and derive a quantitative convergence of the quantum correlation functions to those of the Hartree classical field.