Japanese-German Open Conference on Stochastic Analysis 2019

Program and Abstracts

September 2 (Mon.) – September 6 (Fri.), 2019

A201 and AB01, A-Building, Fukuoka University

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- JSPS Grant-in-Aid for Scientific Research (S) Grant Number 16H06338 「無限粒子系の確率解析学」(Principal Investigator: Hurofumi Osada (Graduate School of Mathematics, Kyushu University))
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Timetable (2.Sep–4.Sep)

	2.Sep	3.Sep	3.Sep	4.Sep
	A201	A201	AB01	A201
8:30–10:30	Registration			
8:50–9:00	Opening			
9:00–9:30	Funaki	Collins		Aida
9:30–10:00	Overbeck	Katori		Z.Q.Chen
	20 min break			
10:20–10:50	Kusuoka	Shiraishi		X. D. Li
10:50–11:20	Orenshtein	Tanemura		Inahama
11:20–11:50	Kumagai	Osada		Thalmaier
	100 min lunch break			
13:30–14:00	Guneysu	D. Zhang	Nguyen	
14:00–14:30	Takeda	Hoshino	Slowik	
14:30–15:00	S. Li	Liu	Matsuura	
	20 min break			
15:20–15:50	Naganuma	Suzaki	Hamaguchi	
15:50–16:20	Kawamoto	Murayama	Dondl	
16:20–16:50	Esaki	Herry	Nakajima	
	20 min break			
17:10–17:40	R. Fukushima	Croydon		
17:40–18:10	Roeckner	Tsunoda		

Timetable (5.Sep–6.Sep)

	5.Sep	5.Sep	6.Sep
	A201	AB01	A201
8:30–10:30	Registration		
9:00–9:30	Mukherjee		Neukamm
9:30–10:00	T. S. Zhang		Schaffner
	20 min break		
10:20–10:50	Uemura		Zimmermann
10:50–11:20	Trutnau		Shiozawa
11:20–11:50	Hoh		Grothaus
	100 min lunch break		
13:30–14:00	Alonso Ruiz	Trinh	Xie
14:00–14:30	Braun	Kutoviy	X. Zhang
14:30–15:00	Habermann	Wittmann	Oshima
	20 min break		
15:20–15:50	Schlichting	Suzuki	M. Fukushima
15:50–16:20	Tsuchida	dello Schiavo	Kajino
16:20–16:50	Namba	Mertin	Sturm
	20 min break	16:50-17:00	Closing
17:10–17:40	Erbar		
17:40–18:10	Maas		

Abstracts

On a certain class of path-dependent stochastic differential equations

Shigeki Aida
(University of Tokyo)

Perturbed SDEs and perturbed reflected SDEs contain a real parameter. W. Yue and T. Zhang proved Malliavin differentiability of the solution and proved the absolute continuity of the law of the solution under suitable assumptions on the coefficients for certain range of the parameter. We extend their results slightly. Also we discuss multidimensional versions of the equations.

Heat kernel approach to BV functions on metric measure spaces

Patricia Alonso Ruiz
(Texas A & M University)

Functions of bounded variation (BV) appear naturally in the study of variational problems and are intrinsically related to isoperimetric sets and sets of finite perimeter. Extending the notion of BV functions to more than one variable became possible due to the seminal work by de Giorgi in the 50s. The essence of his approach was a new characterization of BV functions in terms of the standard heat semigroup on $\mathbb{R}^d$, which together with later investigations due to Ledoux brought the connection to isoperimetric problems. De Giorgi and Ledoux' ideas provide the basis of the study of BV functions on metric measure spaces presented in this talk. With the heat semigroup as the main tool, we develop an associated scale of Besov spaces and investigate the critical parameter that corresponds to the BV class. The main assumption on the underlying space will be a non-negative curvature type condition that we call weak Bakry-Émery. This condition is formulated as a regularization property of the heat semigroup and is satisfied in many examples of interest, in particular fractals such as Sierpinski gaskets and carpets.

Pathwise coupling on spaces with variable Ricci bounds

Mathias Braun
(University of Bonn)

In this talk, we demonstrate how couplings of Brownian motions on metric measure spaces characterize the “Ricci curvature of it being bounded from below by a function”, a synthetic notion which has been introduced by Sturm. This result extends previous works of Arnaudon, Coulibaly and Thalmaier (Riemannian manifolds, constant Ricci bounds), Veysseire (Riemannian manifolds, variable Ricci bounds) and Sturm (general metric measure spaces, constant Ricci bounds). More precisely, we derive a pathwise contraction estimate along coupled Brownian motions and prove the equivalence of it with various other characterizations of variable lower Ricci bounds for singular spaces. This is a joint work with Karen Habermann and Karl-Theodor Sturm.

Homogenization of stable-like processes in random media

Zhen-Qing Chen
(University of Washington)

In this talk, I will discuss homogenization of discontinuous Markov processes with Levy type generators in random media. Two cases will be studied: symmetric stable-like processes in ergodic medium and non-symmetric discontinuous Markov processes in random medium with periodic structure. Based on joint work with Xin Chen, Takashi Kumagai and Jian Wang.

Strong convergence for random permutations and random tensors

Benoit Collins
(Kyoto University)

We report on joint works with Charles Bordenave, where we prove that non-commuting polynomials in i.i.d random permutations or random tensors have an operator norm that converges in the large dimension limit. Time allowing, we discuss the techniques of proof (involving a new non-commuting non-backtracking theory) and some applications (e.g. to the solution of Alon ' s generalized second largest eigenvalue problem).

Random walks on the two- and three-dimensional uniform spanning trees

David Croydon
(RIMS, Kyoto University)

I will describe recent work regarding the random walks on the two- and three-dimensional uniform spanning trees. The results from the two-dimensional case are from joint work with Martin Barlow (UBC) and Takashi Kumagai (Kyoto), and include demonstrating fluctuations in the on-diagonal part of the quenched heat kernel, as well as off-diagonal estimates for the averaged heat kernel. As for the three-dimensional situation, this is being investigated in an ongoing work with Omer Angel (UBC), Sarai Hernandez-Torres (UBC) and Daisuke Shiraishi (Kyoto). In the latter work, we demonstrate the tightness of the random walk's annealed law under rescaling, and convergence along a particular subsequence. We also derive the random walk's walk dimension (with respect to both the intrinsic and Euclidean metric) and its spectral dimension, as well as heat kernel estimates for any diffusion that arises as a scaling limit.

The Dirichlet–Ferguson diffusion

Lorenzo Dello Schiavo
(University of Bonn)

A diffusion process is constructed on the L^2-Wasserstein space $P_2(M)$ over a closed Riemannian manifold M. The process, which may be regarded as a candidate for the Brownian motion on $P_2(M)$, is associated with the Dirichlet form induced by the L^2-Wasserstein gradient and by the Dirichlet–Ferguson random measure with intensity the Riemannian volume measure on M. We discuss the closability of the form via an integration-by-parts formula, which allows explicit computations for the generator and a specification of the process via a measure-valued SPDE. We comment how the construction is related to previous work of von Renesse–Sturm on the Wasserstein Diffusion and of Konarovskyi–von Renesse on the Modified Massive Arratia Flow.

Pinning, depinning, and homogenization of interfaces in random media

Patrick Dondl
(Albert-Ludwigs-University of Freiburg)

We consider the evolution of an interface, modeled by a parabolic equation, in a random environment. The randomness is given by a distribution of obstacles of random strength. To provide a barrier for the moving interface, we construct a positive, steady state supersolution. This construction depends on the existence, after rescaling, of a Lipschitz hypersurface separating the domain into a top and a bottom part, consisting of boxes that contain at least one obstacle of sufficient strength. We prove this percolation result. Furthermore, we examine the question of existence of a solution propagating with positive velocity in a random field with non-bounded random obstacle strength. This work shows the emergence of a rate independent hysteresis in systems subject to a viscous microscopic evolution law through the interaction with a random environment.

A variational characterization of the Sine_β **point process**

Matthias Erbar
(University of Bonn)

The one-dimensional log gas in finite volume is a system of particles interacting via a repulsive logarithmic potential and confined by some external field. When the number of particles goes to infinity, their macroscopic empirical distribution approaches a deterministic limit shape. When zooming in one sees microscopic fluctuations around this limit which are described in the limit by a stationary point process, the Sine_β process constructed by Valko and Virag. Leblé and Serfaty have established a large deviation principle for the microscopic configurations governed by a rate function which is the sum of a specific entropy and a renormalized interaction energy. Thus the typical microscopic behavior of the gas is described by the minimizers of this free

energy functional, one of which is the Sine_β process. We show that this is indeed the unique minimizer. Our argument is based on optimal transport of random point configurations and exploits strict displacement convexity in the free energy functional.
This is joint work with Martin Huesmann and Thomas Leblé

Consistency and ISDE representation of long range interacting particle systems with jumps

Syota Esaki
(Fukuoka University)

In this talk, we would like to consider infinite particle systems with jumps. Unlabeled systems (dynamical systems on the configuration space) are constructed by Esaki[Tohoku J, 2019] using Dirichlet form technique. Then, we would like to give infinite dimensional stochastic differential equation (ISDE) representations for each particle on the dynamics. However, the coordinate function can NOT be in the domain of the Dirichlet form associated with the unlabeled dynamics. Hence, we need to "label" for the unlabeled dynamics. After labelling, we can obtain ISDE representations for each particle. Under suitable conditions, our theorem can be applied to the systems of alpha-stable particles with logarithmic interactions associated with Dyson, Ginibre, Airy and Bessel random point fields, which are examined in the random matrix theory. This is a joint work with Hideki Tanemura (Keio University).

Gaussian fields and potential theory for Dirichlet forms

Masatoshi Fukushima
(Osaka University)

There have been two stochastic objects associated with a regular Dirichlet form: one is the symmetric Hunt process whose transition function generates the semigroup for the form, another is the centered Gaussian field indexed by the extended Dirichlet space with covariance being the Dirichlet inner product. We like to study the structure of the latter by developing and using the probabilistic potential theory involving the Hunt process. The Gaussian field is shown to enjoy a pseudo-Markov property formulated in terms of spectrum and balayage of functions. The splitting sigma-algebra is described in terms of the support of jumping measures. The Liouville random measures for the Gaussian field can be formulated generally using a newly introduced notion of equilibrium measures as in Oshima's talk. We study their dependence on the reference sets and on the approximating shrinking families of sets.

Tail estimates for random walk in random scenery

Ryoki Fukushima
(RIMS, Kyoto University)

The random walk in random scenery is a process defined by adding the values of a random field (called random scenery) along a random walk trajectory. This process first appeared in the independent works by Borodin and Kesten-Spitzer in 1979, who aimed at constructing a new class of self-similar processes by taking scaling limits. Beside this initial motivation, it naturally appears in models of diffusion in random media, for example in the parabolic Anderson model and the Bouchaud trap model. In this talk, I will present results on the tail estimates for the random walk in random scenery. They have applications to heat kernel estimates for a random conductance model that has a layered structure. Based on joint works with Jean-Dominique Deuschel.

Mean curvature interface limit from Glauber-Zero range interacting particles

Tadahisa Funaki
(Waseda University)

We derive the motion by mean curvature in the diffusive space-time scaling limit directly from the microscopic interacting particle system called the Glauber-Zero range process. The Glauber part which governs the creation and annihilation of particles is also speeded up, but slower compared with the diffusive time scale. The Zero range part produces a nonlinear diffusion operator. We apply the relative entropy method and the Boltzmann-Gibbs principle in the probabilistic part. Then we combine this with the asymptotic expansion up to the second order and the comparison method for the discrete nonlinear Allen-Cahn equation in the PDE part. This is joint work with Danielle Hilhorst and Sunder Sethuraman.

On the stochastic heat equation with sticky reflected boundary condition

Martin Grothaus
(TU Kaiserslautern)

Via Dirichlet form techniques we constructed a Markov process corresponding to the gradient Dirichlet form with respect to the law of the modulus of the Brownian bridge. The process is conjectured to be the scaling limit of the dynamical wetting model, also known as Ginzburg-Landau dynamics with pinning and reflection competing on the boundary. In order to identify the constructed process as a solution of the stochastic heat equation with boundary condition, we prove an integration by parts formula for modulus of the Brownian bridge. First we construct the generalized logarithmic derivative in the space of Hida distributions. In a second step we identify the obtained distribution with a regular countable additive set function in a Gelfand triple. This allows us to show that the constructed process is a solution to an infinite-dimensional Skorohod problem.

Global Hölder estimates for Schrödinger semigroups on RCD spaces from probability theory (with applications to molecules)

Batu Güneysu
(University of Bonn)

In his seminal paper on mathematical quantum mechanics from 1957, Kato has shown that the eigenfunctions of a Schrödinger operator in Euclidean space are β-Hölder continuous, provided the potential satisfies a certain L^p-assumption, where p depends on β. When applied to the Hamilton operator of a molecule, this result shows that the molecular eigenfunctions are β-Hlder continuous for all $\beta < 1$. In this talk, I am going to explain how one can use probabilistic (coupling) methods to prove a Hölder-smoothing result for Schrödinger semigroups on RCD spaces which naturally generalizes Kato's result to this abstract framework. Finally, I will discuss magnetic Schrödinger semigroups and open problems.

A semicircle law and decorrelation phenomena for iterated Kolmogorov loops

Karen Habermann
(University of Bonn)

We consider a standard one-dimensional Brownian motion on [0,1] conditioned to have vanishing iterated time integrals up to order N. We show that the resulting processes converge weakly to the zero process as N tends to infinity. We further study the fluctuation processes and show that they converge in finite dimensional distributions to a collection of independent zero-mean Gaussian random variables whose variances follow a scaled semicircle.

Time-inconsistent stochastic control and a flow of forward-backward SDEs

Yushi Hamaguchi
(Kyoto University)

Motivated from time-inconsistent stochastic control problems, we introduce a new type of coupled forward-backward stochastic systems, namely, flows of forward-backward stochastic differential equations. They are systems consisting of a single forward SDE and a continuum of BSDEs, which are defined on different time intervals and connected via an equilibrium condition. We formulate a notion of equilibrium solutions in a general framework and prove small-time well-posedness of the equations. We also consider discretized flows and show that their equilibrium solutions approximate the original one, together with an estimate of the convergence rate.

On logarithmic Sobolev inequalities for the heat kernel on the Heisenberg group

Ronan Herry
(University of Bonn)

Gross proved the logarithmic Sobolev inequality for the Gaussian measure via a tensorization property and the central limit theorem. This methodology can be adapted to the Heisenberg group to produce a logarithmic Sobolev inequality for the heat kernel. I will explain the methodology and the importance of understanding logarithmic Sobolev inequalities on the Heisenberg group, that is the simplest non-trivial instance of a sub-Riemannian manifold.
Joint work with Michel Bonnefont and Djalil Chafaï.

Some results on pseudo differential operators generating Markov processes

Walter Hoh
(Bielefeld Univerity)

Generators of jump type processes typically have a representation as Lévy-type operators or as pseudo differential operators. Starting with the latter representation, various analytical methods had been developed to to construct associated Markov processes. In contrast to the case of local generators these methods usually require a certain degree of regularity of the symbol with respect to the space variable. In the talk we consider assumptions on the behaviour of the symbol with respect to the co-variable, which particularly allow the construction of a process for continuous symbols in this case.

Paracontrolled calculus and regularity structures

Masato Hoshino
(Kyushu University)

In the field of singular SPDEs, there are two strong general theories: the theory of regularity structures by Hairer and the paracontrolled calculus by Gubinelli, Imkeller and Perkowski. They are believed to be equivalent theories, but there are still some gaps between them. In this talk, we show the complete equivalence between these two theories. In particular, our result implies that the space of all models (it is a nonlinear space in general) is decomposed into the direct product of Banach spaces.
This is a joint work with Ismaël Bailleul (Université Rennes 1).

Stochastic flows and rough differential equations on foliated spaces (joint work with Kiyotaka SUZAKI)

Yuzuru Inahama
(Kyushu University)

In this talk we construct stochastic flows associated with SDEs on compact foliated spaces via rough path theory.
In 2015 Suzaki constructed "leafwise diffusion processes" on compact foliated spaces via SDE theory. However, it is not known whether the stochastic flows associated to them exist or not. The main difficulty is in showing the existence of continuous modifications. The reason is that Kolmogorov-Centsov criterion is not available in this case since a foliated space is just a locally compact metric space.
From the viewpoint of rough path theory, however, there is in fact not much difficulty here and this problem is naturally and easily solved.
Since stochastic flows play a very important role in stochastic analysis on manifolds, we hope our result would open the door for stochastic analysis on foliated spaces.
This is an ongoing joint work with Kiyotaka SUZAKI (Kumamoto Univ.)

Sub-Gaussian heat kernel bounds imply singularity of energy measures

Naotaka Kajino
(Kobe University)

This talk will present the result of a recent joint work with Mathav Murugan (University of British Columbia) that, for a strongly local regular symmetric Dirichlet space equipped with a geodesic metric, two-sided sub-Gaussian heat kernel bounds imply the singularity of energy measures with respect to the reference measure.
For self-similar (scale-invariant) Dirichlet forms on self-similar sets, the singularity of energy measures is known to hold in many cases by Kusuoka (1989, 1993), Ben-Bassat, Strichartz and Teplyaev (1999), Hino (2005), Hino and Nakahara (2006), but these results heavily relied on the self-similarity of the space.
It was conjectured, and had remained open for the last two decade to prove, that the singularity of energy measures should follow, without assuming the self-similarity, just from two-sided sub-Gaussian heat kernel bounds of the same form as that for diffusions on typical self-similar fractals. The main result of this talk answers this conjecture affirmatively.

Partial isometries, duality, and determinantal point processes

Makoto Katori
(Chuo University)

A determinantal point process (DPP) is an ensemble of random nonnegative-integer-valued Radon measures Ξ on a space S with measure λ, whose correlation functions are all given by determinants specified by an integral kernel K called the correlation kernel. We consider a pair of Hilbert spaces,

$H_\ell, \ell = 1,2$, which are assumed to be realized as L^2-spaces, $L^2(S_\ell, \lambda_\ell)$, $\ell = 1,2$, and introduce a bounded linear operator $\mathcal{W} : H_1 \to H_2$ and its adjoint $\mathcal{W}^* : H_2 \to H_1$. We prove that if both of $\mathcal{W}$ and $\mathcal{W}^*$ are partial isometries and both of $\mathcal{W}^*\mathcal{W}$ and $\mathcal{W}\mathcal{W}^*$ are of locally trace class, then we have unique pair of DPPs, $(\Xi_\ell, K_\ell, \lambda_\ell)$, $\ell = 1,2$, which satisfy useful duality relations. We assume that $\mathcal{W}$ admits an integral kernel W on $L^2(S_1, \lambda_1)$, and give practical setting of W which makes $\mathcal{W}$ and $\mathcal{W}^*$ satisfy the above conditions. By showing several examples, we demonstrate that the class of DPPs obtained by our method is large enough to study universal structures of DPPs. The present talk is based on a joint work with Tomoyuki Shirai (https://arxiv.org/abs/1903.04945).

Uniqueness of Dirichlet forms related to non-tail trivial random point fields

Yosuke Kawamoto
(Fukuoka Dental College)

For random point fields with infinitely many particles, we consider Dirichlet forms to construct equilibrium dynamics. There are two typical Dirichlet forms, that is, the upper Dirichlet form and the lower Dirichlet form, whose difference is these domains; the domain of the lower Dirichlet form contains that of the upper one. Then the natural problem of uniqueness of Dirichlet forms arises; when the domains are the same and the two Dirichlet forms correspond?
A sufficient condition of the uniqueness of Dirichlet forms is known. The essential three conditions of this are, non-explosion of tagged particles of the equilibrium dynamics, infinite-dimensional stochastic differential equation representation of the dynamics, and the tail triviality of a random point field. In these, the most difficult condition to check is the tail triviality. For example, the first two conditions have been shown for Airy random point field for the inverse temperature β =1,2,4, but the tail triviality has been proven only for β =2. In this talk, I will give a sufficient condition of the uniqueness of Dirichlet forms WITHOUT using the tail triviality.

Stability of heat kernel estimates and parabolic Harnack inequalities for symmetric Dirichlet forms

Takashi Kumagai
(RIMS, Kyoto University)

We consider symmetric Dirichlet forms that consist of strongly local (diffusion) part and non-local (jump) part on a metric measure space. Under general volume doubling condition and some mild assumptions on scaling functions, we establish stability of two-sided heat kernel estimates in terms of Poincaré inequalities, jumping kernels and generalized capacity inequalities. We also discuss characterizations of the associated parabolic Harnack inequalities. Our results apply to symmetric diffusions with jumps even when the underlying spaces have walk dimensions larger than 2. This is a joint work with Z.Q. Chen (Seattle) and J. Wang (Fuzhou).

Approach to the quantum field with exponential interactions by singular SPDEs

Seiichiro Kusuoka
(Kyoto University)

We consider the stochastic quantization of the quantum field model with exponential interactions on the two-dimensional torus, which is called Hoegh-Krohn model. The model has been studied by Dirichlet forms. In this talk, we study the model by singular stochastic differential equations, which is recently developed. By the method, we construct the time-global solution and the invariant probability measure of the stochastic quantization, and see the relation to the process obtained by Dirichlet forms. This is a joint work with Masato Hoshino and Hiroshi Kawabi.

Non-linear perturbation of evolution systems in scales of Banach spaces

Oles Kutoviy
(Bielefeld Univerity)

A variant of the abstract Cauchy-Kovalevskaya theorem is considered. We prove existence and uniqueness of classical solutions to the nonlinear, non-autonomous initial value problem

$$\frac{\mathrm{d}u(t)}{\mathrm{d}t} = A(t)u(t) + B(u(t), t), \quad u(0) = x$$

in a scale of Banach spaces. Here $A(t)$ is the generator of an evolution system acting in a scale of Banach spaces and $B(u, t)$ obeys an Ovcyannikov-type bound.

Continuous dependence of the solution with respect to $A(t)$, $B(u, t)$ and x is proved.

The results are applied to the Kimura-Maruyama equation for the mutation-selection balance model. This yields a new insight in the construction and uniqueness question for nonlinear Fokker-Planck equations related with interacting particle systems in the continuum.

Convergence of Langevin deformation flows

Songzi Li
(Renmin University of China)

In this talk, I will discuss the convergence of Langevin deformation flows that were introduced in our study of W-entropy. Langevin deformation flows are a family of equations connecting gradient flows and the geodesic flows, which is closely linked to compressible Euler equation with damping. We prove that the classical solutions to Langevin deformation flows converge respectively to those to gradient flows and the geodesic flows.

On Shannon entropy power on Riemannian manifolds and Ricci flow

Xiang-Dong Li
(AMSS, Chinese Academy of Sciences)

In his 1948 fundamental paper entitled A mathematical theory of communications, Claude Shannon introduced the notion of entropy power and found the entropy power inequality. In this talk, I will first give a survey on the entropy power inequality and related topics, then I will present some recent work on the concavity and isoperimetric inequality of Shannon entropy power on Riemannian manifolds and on Ricci flow. I will also present a beautiful formula which links the Shannon entropy power, the Fisher information and the W-entropy introduced by G. Perelman for Ricci flow.

Stochastic 3D Leray-α Model with Fractional Dissipation

Wei Liu
(Jiangsu Normal University)

In this talk, we present the well-posedness and asymptotic properties of stochastic 3D Leray-α model with general fractional dissipation. This model is the stochastic 3D Navier-Stokes equations regularized through a smoothing kernel of order θ_1 in the nonlinear term and a θ_2-fractional Laplacian. The main results cover some existing works in the deterministic cases, and also generalize some known results of stochastic models such as stochastic hyperviscous Navier-Stokes equations and classical stochastic 3D Leray-α model.

Homogenisation of discrete optimal transport

Jan Maas
(IST Austria)

We consider dynamical transport metrics for probability measures on discretisations of a bounded convex domain in $\mathbb{R}^d$. These metrics are natural discrete counterparts to the 2-Kantorovich metric, defined using a Benamou-Brenier type formula. However, we show that the discrete transport metrics may fail to converge to the 2-Kantorovich metric, even on certain one-dimensional meshes. We present a homogenisation result that identifies the limiting metric. Under additional isotropy assumptions on the mesh, which are essentially necessary, we show that convergence of the discrete transport metric to the 2-Kantorovich metric holds.
This is based on joint work with Peter Gladbach, Eva Kopfer, and Lorenzo Portinale.

The strong Feller property of reflected Brownian motions on rough planar domains

Kouhei Matsuura
(Kyoto University)

We study the strong Feller property of the semigroups generated by reflected Brownian motions on Jordan domains which are images of the unit disk under Hölder continuous conformal maps. If the Jordan domains are quasidisks, the heat kernels of the semigroups are Hölder continuous, and the lower bounds of the Hölder exponents are given quantitatively. Our proofs are mainly based on a probabilistic argument.

Hypocoercivity of Langevin-type dynamics on abstract manifolds

Maximilian Mertin
(TU Kaiserslautern)

We investigate convergence of Langevin-type dynamics on manifolds to equlibrium state using the abstract Hilbert space hypocoercivity method due to Dolbeault, Mouhot and Schmeiser. This yields a qualitative result on homogeneity of nonwoven fabric in industrial melt-blow production. We generalise results by Grothaus and Stilgenbauer on fibre lay-down models in Euclidean position space with (algebraic) side condition, namely that the decay to the equilibrium is of exponential rate and the rate can be calculated explicitly, to the case of an abstract Riemannian manifold as position space. With this end in view, we outline how to formulate the problem appropriately and briefly explain that the hypocoercivity method does apply under weak conditions on potential and geometry indeed. Thereby, we gain insight into the invariant form of the corresponding Langevin generator as well as new perspectives for applications with geometric degrees of freedom.

The KPZ equation in $d \geq 3$ and the Gaussian multiplicative chaos in the Wiener space

Chiranjib Mukherjee
(University of Münster)

In the classical finite dimensional setting, a Gaussian multiplicative chaos (GMC) is obtained by tilting an ambient measure by the exponential of a centred Gaussian field indexed by a domain in the Euclidean space. In the two-dimensional setting and when the underlying field is "log-correlated", GMC measures share close connection to the 2D Liouville quantum gravity, which has seen a lot of revived interest in the recent years.
A natural question is to construct a GMC in the infinite dimensional setting, where techniques based on log-correlated fields in finite dimensions are no longer available. In the present context, we consider a GMC on the classical Wiener space, driven by a (mollified) Gaussian space-time white noise. In $d \geq 3$, in a previous work with A. Shamov and O. Zeitouni, we showed that the total mass of this GMC, which is directly connected to the (smoothened)

Kardar-Parisi-Zhang equation in $d \geq 3$, converges for small noise intensity to a well-defined strictly positive random variable, while for larger intensity (i.e. for small temperature) it collapses to zero. We will report on joint work with Yannic Bröker (Münster) where we study the endpoint distribution of a Brownian path under the GMC measure and show that, for low temperature, the endpoint GMC distribution localizes in few spatial islands and produces asymptotically purely atomic states.

Loewner chains and evolution families on parallel slit half-planes

Takuya Murayama
(Kyoto University)

For the last two decades, the Loewner equation, which describes the time-evolution of conformal mappings on simply connected domains, has attracted much attention in relation to Schramm-Loewner evolution (SLE). Now, there are many SLE-like stochastic objects, such as multiple-paths SLE and quantum Loewner evolution, defined via this equation. Recently, some researchers began to work on its generalization towards multiply connected domains, which is called the Komatu-Loewner equation. However, even in the case where the corresponding hull is multiple paths, the known results are not enough to develop a theory analogous to multiple-paths SLE. In this talk, we establish the chordal Komatu-Loewner equation for a very wide range of conformal mappings, which does not necessarily come from bounded hulls with local growth. Our framework is almost as general as the one in simply connected domains. A key in obtaining the equation is to establish the integral representation of uniformizing mappings on parallel slit half-planes, which generalizes Lemma 1 of Goryainov and Ba (1992), using the complex Poisson kernel of Brownian motion with darning (BMD).

Asymptotic expansion of the density for hypoelliptic rough differential equation

Nobuaki Naganuma
(Osaka University)

In this talk, we study a rough differential equation driven by fractional Brownian motion. We assume the Hurst parameter associate to the fractional Brownian motion is greater than 1/4 and smaller than or equal to 1/2. It is known that the solution has a smooth density for each fixed time under Hörmander's condition on the coefficient vector fields. As a main result of this talk, we introduce a short time full asymptotic expansion of the density under quite natural assumptions. A main tool to obtain the result is Watanabe's distributional Malliavin calculus. This result can be regarded as a "fractional version" of Ben Arous' famous work on the off-diagonal asymptotics. This talk is based on a joint work with Yuzuru Inahama (Kyushu University).

Gaussian fluctuations in directed polymers.

Shuta Nakajima
(Nagoya University)

In this talk, we consider the discrete directed polymer model with i.i.d. environment and we study the fluctuations of the partition function. It was proven by Comets and Liu that for sufficiently high temperature, the fluctuations converge in distribution towards the product of the limiting partition function and an independent Gaussian random variable. We extend the result to the whole L^2-region, which is predicted to be the maximal high-temperature region where the Gaussian fluctuations should occur under the considered scaling. This is joint work with Clément Cosco.

Laws of the iterated logarithm on covering graphs of polynomial volume growth

Ryuya Namba
(Ritsumeikan University)

In this talk, laws of the iterated logarithm (LILs) on covering graphs of polynomial volume growth are discussed form a geometric perspective. We first establish moderate deviation principles (MDPs) for random walks on the covering graphs, which deal with any intermediate spatial scalings between those of laws of large numbers and those of central limit theorems. The corresponding rate functions are given by quadratic forms determined by the Albanese metric associated with the given random walks. Finally, we apply MDPs to prove LILs on the covering graphs by characterizing the set of all a.s. limit points of the normalized random walks.

Optimal homogenization rates in stochastic homogenization of monotone, uniformly elliptic equations

Stefan Neukamm
(TU Dresden)

We derive homogenization rates for elliptic PDEs with monotone nonlinearity in the uniformly elliptic case. Under the assumption of a fast decay of correlations on scales larger than the microscale ε, we establish estimates of optimal order for the L^2-homogenization error. Previous results in nonlinear stochastic homogenization have been limited to a small algebraic rate of convergence. We also establish error estimates for the approximation of the homogenized operator by the method of representative volumes of the order $(L/\varepsilon)^{-\frac{d}{2}}$ for a representative volume of size L. The talk is based on a joint work with Julian Fischer.

Overcoming the curse of dimensionality in the numerical approximation of semilinear parabolic partial differential equations

Tuan Anh Nguyen
(University of Duisburg-Essen)

For a long time it is well-known that high-dimensional linear parabolic partial differential equations (PDEs) can be approximated by Monte Carlo methods with a computational effort which grows polynomially both in the dimension and in the reciprocal of the prescribed accuracy. In other words, linear PDEs do not suffer from the curse of dimensionality. For general semilinear PDEs with Lipschitz coefficients, however, it remained an open question whether these suffer from the curse of dimensionality. We introduce a new numerical approximation algorithm, which overcomes the curse of dimensionality in the numerical approximation of general semilinear heat equations with gradient-independent nonlinearities, and thereby partially solves this open problem. The proposed scheme is an extension of the recently introduced multilevel Picard approximations. We show in the case of general semilinear heat equations with gradient-independent and globally Lipschitz continuous nonlinearities that the computational effort of the proposed approximation algorithm grows at most polynomially in both the PDE dimension and the reciprocal of the required approximation accuracy. We thereby prove, for the first time, that such PDEs are strong polynomially tractable in the stochastic setting. Joint work with Martin Hutzenthaler Arnulf Jentzen Thomas Kruse, and Philippe von Wurstemberger, arXiv:1807.01212

Random walks in random environment as rough paths.

Tal Orenshtein
(HU and TU Berlin)

Random walk in random environment (RWRE) is a model to describe propagation of heat or diffusion of matter through a highly irregular medium. The latter is expressed locally in the model in terms of a random environment according to which the process evolves randomly in time. In a few fundamental classes the phenomenon of homogenization of the media takes place. One way this can be expressed is in the fact that on large scales, the RWRE looks like a Brownian motion with a covariance matrix given in terms the law of the environment.

Rough path theory enables the construction of solutions of SDEs so that the solution map is continuous with respect to the noise. One important application guarantees that if the approximation converges to the noise in the rough path topology, the SDEs driven by the noise approximations converge, in an appropriate sense, to a well-defined SDE different than the original one, so that the correction term is explicit in terms of the noise approximating sequence.

In this talk we'll present our current program, where we lift RWREs to the rough path space and show convergence to an enhanced Brownian motion in the rough path topology. Interestingly, the limiting second level of the lifted

RWRE may have a linear correction, called area anomaly, which we identify. Except for the application to approximations of SDEs (and potentially of SPDEs) and the development of new tools to tackle these models, this gives novel and a rather complete information on the RWRE limiting path.
Based on joint works with Jean-Dominique Deushcel and Nicolas Perkowski, with Olga Lopusanschi and with Martin Slowik.

Diffusion in Coulomb environment and a phase transition

Hirofumi Osada
(Kyushu University)

I talk homogenization of diffusion in two-dimensional Euclidian space in a periodic Coulomb environment. That is, I consider a periodic point process in the plane. The diffusion has the repulsive interaction with the two-dimensional Coulomb potential with inverse temperature β to each particle in the periodic point process. We first prove that the diffusion is diffusive with non-degenerated effective diffusion constant γ. We then remove one particle from the environment and consider the diffusive scaling limit of the diffusion. Then its new effective constant depends on inverse temperature β. It has a phase transition whose critical point is given explicitly in terms of the first effective diffusion constant γ of the periodic homogenization problem. Using this result, we present explicit bounds for the critical point of the self-diffusion matrices of the strict two-dimensional Coulomb interacting Brownian motions for inverse temperature β. Moreover, we discuss the case d-dimensional case with $d \geq 3$.

Gaussian fields, equilibrium potentials and Liouville random measures for Dirichlet forms

Yoichi Oshima
(Kumamoto University)

We consider a regular recurrent strongly local Dirichlet form $(\mathcal{E}, \mathcal{F})$ on $L^2(\mathbb{C}; d\mathbf{x})$ corresponds to a uniformly elliptic partial differential operator of divergence form. The associated symmetric diffusion process $\mathbb{M} = (X_t, \mathbb{P}_{\mathbf{x}})$ on $\mathbb{C}$ has a positive jointly continuous transition density $p_t(\mathbf{x}, \mathbf{y})$ satisfying the Gaussian estimate. We choose the annulus $F = \overline{B(S+1)} \setminus B(S)$ as the admissible set and consider the family $\{R\mu \in \mathcal{F}_e : \mu \in \mathcal{M}_0\}$ of recurrent potentials relative to F. We try to construct a Liouville random measure on $B(S)$ for a given Radon measure σ on it.
For a disk $B(\mathbf{x}, r) \subset B(S)$, let $\mu^{\mathbf{x},r} \in \mathcal{M}_0$ and $f(\mathbf{x}, r)$ be its equilibrium measure and the Robin constant relative to F, respectively. They admit simple probabilisitic expressions in terms of the diffusion $\mathbb{M}$. Let $\{X_u : u \in \mathcal{F}_e\}$ be the centered Gaussian field with $\mathbb{E}[X_u X_v] = \mathcal{E}(u, v)$ and define $Y^{\mathbf{x},\varepsilon} = X_{R\mu^{\mathbf{x},\varepsilon}}$. For a fixed $\gamma > 0$, put

$$\mu_\varepsilon(A, \omega) = \int_A \exp\left(\gamma Y^{\mathbf{x},\varepsilon} - \frac{\gamma^2}{2} f(\mathbf{x}, \varepsilon)\right) \sigma(d\mathbf{x}), \quad A \in \mathcal{B}(B(S)),$$

Under a certain condition on the growth rate of the Robin constant $f(\mathbf{x}, \varepsilon)$ as $\varepsilon \downarrow 0$, the weak convergence in probability of the random measures $\mu_\varepsilon(\cdot, \omega)$

as $\varepsilon \downarrow 0$ will be derived. The possible range of the value γ will then be given by using the constant κ related to a constant related with the Harnack inequality. The case that $(\mathcal{E}, \mathcal{F}) = (\mathcal{E}, H_0^1(D))$ for a domain $D \subset \mathbb{C}$ will be also considered.

Functional Ito-Calculus for measure value diffusion

Ludger Overbeck
(University of Giessen)

Functional Ito-calculus extends the well-known classical Ito-formula to functions which depend not only on the value of a stochastic process at time t, but on the entire path upto time t. It was introduced by Dupire in 2009 in the context of mathematical finance. Superprocesses are well studied branching processes with an infinite-dimensional state space, namely the space of finite measures M(E) over a space E. It is the diffusion limit of a critical branching particle system, e.g. for a super Brownian motion E are the real numbers and the so-called one particle process is the Brownian motion. The classical Ito-formula for such a process was developed in 2003 and we will extend this to the functional setting. We will also comment on historical process, in which the one-particle motion is the path process. On the theoretical side an application will be the predictable representation of martingales with respect to the filtration of a superprocess and a historical process. There are also recent applications of these types of branching processes in the non-linear option pricing theory and our extension can be used to solve non-linear pricing equations for path-dependent options.

A natural extension of Markov processes and applications to singular SDEs

joint work with:
Lucian Beznea (Romanian Academy, Bucharest, Romania)
Iulian Cîmpean (Romanian Academy, Bucharest, Romania)

Michael Röckner
(Bielefeld University and Academy for Mathematics and Systems Science, CAS, Beijing)

We develop a general method for extending Markov processes to a larger state space such that the added points form a polar set. The so obtained extension is an improvement on the standard trivial extension in which case the process is made stuck in the added points, and it renders a new technique of constructing extended solutions to S(P)DEs from all starting points, in such a way that they are solutions at least after any strictly positive time. Concretely, we adopt this strategy to study SDEs with singular coefficients on an infinite dimensional state space (e.g. SPDEs of evolutionary type), for which one often encounters the situation where not every point in the space is allowed as an initial condition. The same can happen when constructing solutions of martingale problems or Markov processes from (generalized) Dirichlet forms, to which our new technique also applies.

Regularity for non-uniformly elliptic equations and applications to the random conductance model

Mathias Schäffner
(Leipzig University)

I will discuss regularity properties for solutions of linear second order non-uniformly elliptic equations in divergence form. Assuming certain integrability conditions on the coefficient field, we obtain local boundedness and validity of Harnack inequality. The assumed integrability assumptions are essentially sharp and improve upon some classical results in the literature. From the local boundedness result, we deduce sublinearity of the corrector and a quenched invariance principle for the random walk among random degenerate conductances.

Meanfield jump processes on graphs and the upwind transportation metric

André Schlichting
(University of Bonn)

We propose a nonlocal gradient structure approximating the aggregation equation motivated by classical upwind scheme widely used for the numerical approximation of first order equations. We show, that the nonlocal upwind metric is very well suited for the variational formulation of first-order equations on graphs and graphons. Although, the induced distance is only a quasi-metric (non-symmetric), we explain, how in a proper local limit the L2-Wasserstein gradient flow formulation for the aggregation equation is recovered.
joint work with Antonio Esposito, Francesco Patacchini, Dejan Slepcev.

Limiting distributions for the maximal displacement of branching Brownian motions

Yuichi Shiozawa
(Osaka University)

This talk is based on a joint work with Yasuhito Nishimori (National Institute of Technology, Anan College, Japan). In this talk, we determine the long time behavior and the exact order of the tail probability for the maximal displacement of a branching Brownian motion in Euclidean space in terms of the principal eigenvalue of the associated Schrödinger type operator. We also prove the existence of the Yaglom type limit for the distribution of the population outside the forefront. To establish our results, we show a sharp and locally uniform growth order of the Feynman-Kac semigroup.

Scaling limit of uniform spanning tree in three dimensions

Daisuke Shiraishi
(Kyoto University)

We will show that the properly rescaled three-dimensional uniform spanning tree converges weakly with respect to a Gromov-Hausdorff-Prohorov-type topology in a space whose elements are measured, rooted real trees continuously embedded into Euclidean space. We will describe various properties of the intrinsic metrics, measures and embeddings of the limit in this space. This is based on a joint work with Omer Angel (UBC), David Croydon (Kyoto University) and Sarai Hernandez Torres (UBC).

Green kernel asymptotics for two-dimensional random walks among random conductances

Martin Slowik
(TU Berlin)

The random conductance model is a well-established model for a random walk in random environment. In recent years the behaviour of the associated heat kernel and Green function has been intensively studied, and in dimension $d \geq 3$ the asymptotics of the Green kernel are meanwhile quite well-understood. In this talk, I present precise asymptotics of the potential kernel and the Green function of the random walk killed upon exiting balls in dimension $d = 2$. This result holds, for instance, in the case of uniformly elliptic conductances, random walks on supercritical percolation clusters or ergodic degenerate conductances satisfying certain moment conditions.
This talk is based on a joint work with Sebastian Andres (U Cambridge) and Jean-Dominique Deuschel.

Gradient estimates for the Neumann heat flow on non-convex domains of metric measure spaces

Theo Sturm
(University of Bonn)

We briefly recall the Eulerian and the Lagrangian approach to synthetic lower Ricci bounds on metric measure spaces due to Bakry-Emery and Lott-Sturm-Villani, resp., and present recent extensions to spaces with variable lower Ricci bounds. Our main results will be a gradient estimate for the heat flow with Neumann boundary conditions on domains of metric measure spaces obtained through “convexification” of the domains by means of subtle time changes. This improves upon previous results both in the case of non-convex domains and in the case of convex domains.

A limit theorem for persistence diagrams of random filtered complexes built over marked point processes

Kiyotaka Suzaki
(Kumamoto University)

A persistence diagram is an expression of a persistent homology, which is an important tool to understand topological features (connected components, rings, cavities, etc.) of data. A standard way to convert input data into a filtered complex with parameter $t \geq 0$ is to use the Čech complexes, i.e., the family of nerves of the t-balls centered at each data point.
In this talk, a filtered complex is constructed from a finite marked data point set in Euclidean space. Examples of our construction include a family of nerves of sets with various sizes, growths, and shapes. In addition, we consider the case when input data are marked point processes (randomly distributed marked point sets). We then discuss a law of large numbers of these persistence diagrams as the size of the convex window observing random data tends to infinity. If times allows, we also discuss a law of large numbers for persistent Betti numbers, which is a key result to prove the limit theorem mentioned above. This talk is based on a joint work with Tomoyuki Shirai (Kyushu University).

Configuration Spaces Over Metric Measure Spaces

Kohei Suzuki
(Scuola Normale Superiore)

We shall talk about analytic, geometric and stochastic properties of configuration spaces over metric measure spaces with the Poisson measure. We construct a Dirichlet form on configuration spaces over metric measure spaces based on Ma-Röckner '00. In the case of the Poisson measure, we show Rademacher's theorem, the Sobolev-to-Lipschitz property, Curvature-Dimension conditions, and the stability of Dirichlet forms. We further study the corresponding diffusion processes identified with infinite particle systems of diffusion processes in the base space. This is a joint work with Lorenzo Dello Schiavo from Bonn University.

Existence and Uniqueness of Quasi-Stationary Distributions for Symmetric Markov Processes with Tightness Property

Masayoshi Takeda
(Kansai University)

Let X be an irreducible symmetric Markov process with strong Feller property. We assume, in addition, that X is explosive and has a tightness property, i.e., for any $\epsilon > 0$, there exists a compact set K such that $\sup_{x \in E} R_1 1_{K^c}(x) \leq \epsilon$. Here 1_{K^c} is the indicator function of the complement of K and R_1 is the 1-resolvent of X. We then prove existence and uniqueness of quasi-stationary distributions of X.

Uniqueness of solutions of ISDEs related infinite particle systems with jumps

Hideki Tanemura
(Keio university)

We consider infinite particle systems with jump associated with Dirichlet forms. Unlabeled systems are constructed by Esaki[Tohoku J, 2019] by Dirichlet form technique. Labeling each particle, we can obtain labeled systems, which are related to infinite dimensional stochastic deferential equations (ISDEs) under suitable conditions. We discuss the uniqueness of solutions of the ISDEs. This talk is based on a joint work with Syota Esaki.

Brownian motion and curvature in sub-Riemannian geometry

Anton Thalmaier
(University of Luxembourg)

The goal of sub-Riemannian geometry is to study geometric concepts induced intrinsically by the sub-Riemannian structure. We describe recent work centered around the concept of curvature in sub-Riemannian geometry. Our work relies on the study of subelliptic diffusion processes on sub-Riemannian manifolds and is based on stochastic analysis of the path space over a sub-Riemannian manifold.

On beta Laguerre ensembles at varying temperature

Khanh Duy Trinh
(Waseda University)

Beta Laguerre ensembles are generalizations of Wishart and Laguerre matrices where the parameter beta is regarded as an inverse temperature. They are now realized as eigenvalues of certain random tridiagonal matrices. It is well known that for fixed beta, the empirical distribution of the eigenvalues converges weakly to a Marchenko–Pastur distribution, almost surely. The aim of this talk is to completely describe the global limiting behavior of the eigenvalues in case the parameter beta is allowed to vary with the matrix size.

Well-posedness for a class of degenerate Itô-SDEs with fully discontinuous coefficients

Gerald Trutnau
(Seoul National University)

We show uniqueness in law for a general class of stochastic differential equations in $\mathbb{R}^d$, $d \geq 2$, with possibly degenerate and/or fully discontinuous locally bounded coefficients among all weak solutions that spend zero time at the points of degeneracy of the dispersion matrix. The points of degeneracy have

d-dimensional Lebesgue-Borel measure zero. Weak existence is obtained for more general not necessarily locally bounded drift coefficient. This is joint work with Haesung Lee (Seoul National University).

Green-tight measures of Kato class and compact embedding theorem for symmetric Markov processes

Kaneharu Tsuchida
(National Defense Academy)

Let E be a locally compact separable metric space and m a Radon measure on E with full support. Let $\mathbf{X}$ be a m-symmetric Markov process and $(\mathcal{E}, \mathcal{F})$ its Dirichlet form on $L^2(E;m)$. Takeda proves in [2] that the semigroup of $\mathbf{X}$ is compact on $L^2(E;m)$ if $\mathbf{X}$ satisfies that irreducibility (I), resolvent strong Feller property (RSF), and Green-tightness (T). As an application, the compactness of embedding from $(\mathcal{F}, \mathcal{E})$ to $L^2(E;m)$ can be proved. This compact embedding theorem plays important role in proving the large deviation principle for additive functionals generated by $\mathbf{X}$. In this talk, we extend this result to the Markov process which satisfies absolute continuity (AC) and (T). To do this, we prove the equivalence between two kinds of classes of Green-tight measures. One was introduced by Zhao and the other was by Chen. Finally, we present some examples that are (AC) but not (RSF).

References

[1] K. Kuwae and K. Tsuchida: Green-tight measures of Kato class and compact embedding theorem for symmetric Markov processes, preprint, 2019.

[2] M. Takeda: Compactness of symmetric Markov semi-groups and boundedness of eigenfunctions, *Trans. Amer. Math. Soc.* **372** (2019), no. 6, 3905–3920.

Incompressible limit for weakly asymmetric simple exclusion processes

Kenkichi Tsunoda
(Osaka University)

We consider in this talk the so-called incompressible limit for the weakly asymmetric simple exclusion processes. A fundamental question in mathematical physics is the derivation of the master equation of fluids such as the Burgers equation or the Navier-Stokes equation. By the celebrated Varadhan's nongradient method, Esposito, Marra and Yau (1996) and Quastel and Yau (1998) derived the Burgers equation and the Navier-Stokes equation as a consequence of the incompressible limits in dimensions strictly larger than 2. On the other hand, the derivation of these equations in low dimensions is achieved only from a stochastic lattice gas dynamics which admits mesoscopically big jumps. In this talk, we discuss the incompressible limit for the weakly asymmetric simple exclusion processes via recent notable entropy bounds developed by Jara and Menezes. This talk is based on joint work with Milton Jara (IMPA) and Claudio Landim (IMPA).

Homogenization of Symmetric Dirichlet Forms

Toshihiro Uemura
(Kansai University)

Homogenization of Elliptic operators with periodic coefficent is formulated as follows:

$$\begin{cases} -\mathrm{div}\Big(A\Big(\frac{\cdot}{\delta}\Big)\nabla u_\delta\Big)(x) = f(x), & x \in G, \\ \qquad\qquad\qquad\quad u_\delta(x) = 0, & x \in \partial G, \end{cases}$$

where $\delta > 0$ is a small parameter used to represent the heterogeneities of the body G, a bounded open set of $\mathbb{R}^d$. The main problem of the homogenization procedure consists in finding possible limit(s) u_0 to the sequence $\big(u_\delta\big)_{\delta>0}$ and in identifying the problem(s) that u_0 solves. In this talk, we consider the problem for a class of symmetric transient jump-diffusion processes by using Dirichlet form theory. This talk is based on a joint work with Matsuyo Tomisaki.

Stability of the Markov property for weak limits of a class of diffusions via gradient bounds

Simon Wittmann
(TU Kaiserslautern)

The equation $\vec{T_t} \circ \partial = \partial \circ T_t$ relates the semigroup of a symmetric, regular Dirichlet form via the intrinsic gradient to another semigroup, which is associated with the divergence operator and acts on vector fields. Supported by the complementary concept of a semigroup domination, the relation results in gradient estimates which incorporate - and go beyond - the classical gradient estimate of Bakry-Émery. This well-known idea finds application in some dynamical Ginzburg-Landau stochastic interface models and proves the preservation of the Markov property under a space-time diffusive scaling.

Dimension-free Harnack inequalities for stochastic Cahn-Hilliard equation with logarithmic nonlinearity

Bin Xie
(Shinshu University)

We establish dimension-free Harnack inequalities for the stochastic Cahn-Hilliard equations with singular nonlinearity driven by two kinds of noises. We mainly consider the stochastic Cahn-Hilliard equations with the singularities of the logarithmic free energy at ± 1 and the conservation of solutions in their spatial variable. Both the degenerate colored noise and non-degenerate white noise are discussed. For the highly degenerate space-time colored noise, the asymptotic log-Harnack inequality is established under the so-called essentially elliptic conditions, which implies the asymptotic strong Feller property. For non-degenerate space-time white noise, the Harnack inequality with power is established. Applications of dimension-free Harnack inequalities will also been considered. This talk is based on a joint work with L. Goudenège.

The stochastic nonlinear Schrödinger equations: defocusing mass and energy critical cases

Deng Zhang
(Shanghai Jiao Tong University)

In this talk we will present our recent results on stochastic nonlinear Schrödinger equations with linear multiplicative noise, particularly, in the defocusing mass-critical and energy-critical cases. More precisely, for general initial data, we obtain the global existence and uniqueness of solutions in both mass-critical and energy-critical case. When the quadratic variation of noise is globally bounded, we also prove the rescaled scattering behavior of stochastic solutions in the spaces L2, H1 as well as the pseudo-conformal space. Furthermore, we will also present the Stroock-Varadhan type theorem for the topological support of solutions to stochastic nonlinear Schrödinger equations in the Strichartz and local smoothing spaces.

Quadratic Transportation Cost Inequalities For Stochastic Reaction Diffusion Equations

Tusheng Zhang
(University of Manchester)

We established a quadratic transportation cost inequality for solutions of stochastic reaction diffusion equations driven by multiplicative space-time white noise based on a new inequality we proved for the moments (under the uniform norm) of the stochastic convolution with respect to space-time white noise, which is of independent interest. The solutions of such stochastic partial differential equations are typically not semimartingales on the state space.

Stochastic Lagrangian path for Leray solutions of 3D Navier-Stokes equations

Xicheng Zhang
(Wuhan University)

In this paper we show the existence of stochastic Lagrangian particle trajectory for Leray's solution of 3D Navier-Stokes equations. More precisely, for any Leray's solution $\mathbf{u}$ of 3D-NSE and each $(s,x) \in \mathbb{R}_+ \times \mathbb{R}^3$, we show the existence of weak solutions to the following SDE, which has a density $\rho_{s,x}(t,y)$ belonging to $\mathbb{H}^{1,p}_q$ provided $p,q \in [1,2)$ with $\frac{3}{p} + \frac{2}{q} > 4$:

$$\mathrm{d}X_{s,t} = \mathbf{u}(s, X_{s,t})\mathrm{d}t + \sqrt{2\nu}\mathrm{d}W_t, \quad X_{s,s} = x, \quad t \geq s,$$

where W is a three dimensional standard Brownian motion, $\nu > 0$ is the viscosity constant. Moreover, we also show that for Lebesgue almost all (s, x), the solution $X^n_{s,\cdot}(x)$ of the above SDE associated with the mollifying velocity field $\mathbf{u}_n$ weakly converges to $X_{s,\cdot}(x)$ so that X is a Markov process in almost sure sense. (This is a joint work with Guohuan Zhao).

Renormalized solutions for a stochastic p-Laplace equation with L^1-intial data

Aleksandra Zimmermann
(University of Rostock/University of Duisburg-Essen)

We consider a p-Laplace evolution problem with stochastic forcing on a bounded domain $D \subset \mathbb{R}^d$ with homogeneous Dirichlet boundary conditions for $1 < p < \infty$. The additive noise term is given by a stochastic integral in the sense of Itô. The technical difficulties arise from the merely integrable random initial data u_0 under consideration. Due to the poor regularity of the initial data, estimates in $W^{1,p}_0(D)$ are available with respect to truncations of the solution only and therefore well-posedness results have to be formulated in the sense of generalized solutions. We extend the notion of renormalized solution for this type of SPDEs, show well-posedness in this setting and study the Markov properties of solutions.