天元數學國際交流中心

Tianyuan Mathematics Research Center

International Conference on Stochastic Analysis and Its Applications



Nov. 2-8, 2025

Kunming, CHINA

Organizing Committee

Tusheng Zhang, University of Science and Technology of China

Xicheng Zhang, Beijing Institute of Technology

Jian Wang, Fujian Normal University

Contact Information

If you need any help, please feel free to contact:

Shijie Shang, University of Science and Technology of China,
sjshang@ustc.edu.cn, 13035069383

Workshop Schedule

November 2, Sunday: Registration and Arrival

November 8, Saturday: Departure

DATE / TIME	Nov. 3 Monday	Nov.4 Tuesday	Nov.5 Wednesday	Nov.6 Thursday	Nov.7 Friday
08:50-09:00	**Opening Ceremony**				
Chair	**Tusheng Zhang**	**Xiangdong Li**	**Xicheng Zhang**	**Jian Wang**	**Litan Yan**
09:00-09:40	Fengyu Wang	Zhenqing Chen	Yanxia Ren	Xiangdong Li	Kai Du
09:40-10:20	Fuqing Gao	Kainan Xiang	Fuke Wu	Zhenxin Liu	Weijun Xu
10:20-10:50	Tea Break	Tea Break	Tea Break	Tea Break	Tea Break
Chair	**Fengyu Wang**	**Zhenqing Chen**	**Fuqing Gao**	**Zhenxin Liu**	**Rongchan Zhu**
10:50-11:30	Jianliang Zhai	Juan Li	Jianglun Wu	Tianyang Nie	Litan Yan
11:30-14:30	**Lunch**	**Lunch**	**Lunch**	**Lunch**	**Lunch**
Chair	**Fuke Wu**	**Kainan Xiang**	**Free Discussion**	**Kai Du**	**Jianglun Wu**
14:30-15:10	Longjie Xie	Wei Liu		Rongchan Zhu	Wenjie Ye
15:10-15:50	Jian Song	Jianhai Bao		Saisai Yang	Wei Xu
15:50-16:10	Tea Break	Tea Break		Tea Break	Tea Break
Chair	**Juan Li**	**Wei Liu**		**Yanxia Ren**	**Free Discussion**
16:10-16:50	Qi Zhang	Jing Wu		Shijie Shang	
16:50-17:30	Chenlin Gu	Lujing Huang		Zaoli Chen	
17:30-19:00	**Dinner**	**Dinner**	**Dinner**	**Dinner**	**Dinner**

Titles & Abstracts

Long-time error bounds of Euler type schemes for non-dissipative SDEs

Jianhai Bao

Tianjin University

Abstract: Under Lyapunov and monotone conditions, via the reflection coupling, we establish a long-time error bound between the laws of exact solutions to SDEs with additive noise and the associated Euler type schemes. Whereas, the reflection coupling approach is no longer workable when the driven noise of SDEs under consideration is multiplicative. For such setting, we leverage the generalized coupling approach to tackle the associated long-time error bound. In particular, the theory derived can be applicable to functional SDEs and SDEs with piecewise continuous drifts. In addition, we deliver two results on the error bounds associated with the exact IMPs and the numerical counterparts under the relative entropy and the total variation distance, in which the power type Harnack inequality and the log-Harnack inequality play a vital role, respectively.

A Tale of Two Tails: Extremes under Long-Range Dependence

Zaoli Chen

University of Science and Technology of China

Abstract: In a long-range dependent setting, extreme values of a stationary processes exhibit both macroscopic and microscopic clustering features. Such an extremal clustering is subject to the dependence structure as well as the marginal distribution, which are moderated by two tails respectively. In this talk, I will introduce the mechanism of a class of stationary infinitely divisible sequences. I will show how the interaction between the two tails affects the extremal behaviors.

Heat kernel estimates for jump diffusions with possibly degenerate jumping kernels

Zhenqing Chen

University of Washington

Abstract: In this talk, I will present some new result on the heat kernel lower bound estimates for jump diffusions with possibly degenerate jumping kernels.

A collision particle model for the Landau equation

Kai Du

Fudan University

Abstract: We propose and implement a structure-preserving stochastic particle method for the Landau equation. The method is based on a particle system for the Landau equation, where pairwise grazing collisions are modeled as diffusion processes. By exploiting the unique structure of the particle system and a spherical Brownian motion sampling, the method avoids additional temporal discretization of the particle system, ensuring that the discrete-time particle distributions exactly match their continuous-time counterparts. The method achieves O(N) complexity per time step and preserves fundamental physical properties, including the conservation of mass, momentum and energy. It demonstrates strong long-time accuracy and stability in numerical experiments.

Fluctuations and moderate deviations for a binary collision model

Fuqing Gao

Wuhan University

Abstract: We study fluctuations and moderate deviations for a discrete energy Kac-like walk associated with a Boltzmann-type equation. We show that the fluctuations of the empirical measure around the Boltzmann-type equation converge in law to an infinite dimensional Ornstein-Uhlenbeck process, and establish the moderate deviation principle for the empirical measure.

Relaxation to equilibrium of non-gradient exclusion processes

Chenlin Gu

Tsinghua University

Abstract: For the conservative particle systems in infinite volume, the relaxation to equilibrium is expected to be a Gaussian-type decay. The sharp decay rate was known for two models -SSEP by Bertini and Zegarlinski, and zero-range processes by Janvresse, Landim, Quastel and Yau - and they are btained via different methods. This talk aims to unify the two existing approaches with homogenization, and presents the result in speed-change exclusion rocesses. The talk is based on a joint work with Linzhi Yang.

The effective resistance and random walk in one-dimensional critical long-range percolation

Lujing Huang

Fujian Normal University

Abstract: We study the critical long-range percolation on $\mathbb{Z}$, where an edge connects i and j independently with probability $1-\exp\{-\beta\int_i^{i+1}\int_j^{j+1}|u-v|^{-2}d ud v\}$ for $|i-j|>1$ for some fixed $\beta>0$ and with probability 1 for $|i-j|=1$.

Viewing this as a random electric network where each edge has a unit conductance, we show that the effective resistances from 0 to $[-n,n]^c$ and from the interval $[-n,n]$ to $[-2n,2n]^c$ (conditioned on no edge joining $[-n,n]$ and $[-2n,2n]^c$) both grow like $n^{\delta(\beta)}$ for some $\delta(\beta)\in (0,1)$. Finally, we will introduce our new progress in this topic. This is based on joint works with Jian Ding and Zherui Fan.

Diffusion approximation for the joint distribution of the fully coupled multi-scale stochastic system

Longjie Xie

Jiangsu Normal University

Abstract: We establish a uniform in time diffusion approximation for the joint distribution of the fully coupled multi-scale stochastic system with irregular coefficients. As a direct application, we obtain the explicit characterization of the limit of invariant measure of the original multi-scale system. As a second application, we derive an formula for the entropy production in the small mass limit of the degenerate Langevin dynamic,and the entropy anomaly is rigorously proved.

A Global Stochastic Maximum Principle for Mean-Field Forward-Backward Stochastic Control Systems with Quadratic Generators

Juan Li

Shandong University

Abstract: Our talk is devoted to the study of Peng’s stochastic maximum principle (SMP) for a stochastic control problem composed of a controlled forward stochastic differential equation (SDE) as dynamics and a controlled backward SDE which defines the cost functional. Our

studies combine the difficulties which come, on one hand, from the fact that the coefficients of both the SDE and the backward SDE are of mean-field type (i.e., they do not only depend on the control process and the solution processes but also on their law), and on the other hand, from the fact that the coefficient of the BSDE is of quadratic growth in Z. Our SMP is novel, it extends in a by far non trivial way existing results on SMP. The talk is based on a joint work with Rainer Buckdahn (UBO, France), Yanwei Li (SDU, China), Yi Wang (SDU, China).

Malliavin calculus and kinetic Fokker-Planck equation

Xiangdong Li

Academy of Mathematics and Systems Science,CAS

Abstract: In 1974, P. Malliavin introduced the Stochastic Calculus of Variations and gave a probabilistic proof of the Hormander hypoellipticity theorem. Since then, the Malliavin calculus has been a central topic in stochastic analysis. The purpose of this talk is to use the Malliavin calculus to study the geometric Langevin processes in connection with the kinetic Fokker-Planck equation on the cotangent bundle over compact Riemannian manifolds. We present an integration by parts formula and the gradient formula for the kinetic Fokker-Planck semigroup on the cotangent bundle of a compact Riemannian manifokd. Our results extend previous ones due to Bismut and P. L. Lions et al.

Smoluchowski–Kramers approximation for stochastic differential equations

Wei Liu

Wuhan University

Abstract: In this talk, we will show the Smoluchowski–Kramers approximation for McKean-Vlasov equations driven by fractional

Brownian motion and Brownian motion respectively. The convergence rates for the total variation and L^p distance are obtained. In addition, we also study the large deviation, moderate deviation and central limit theorem. Furthermore, we will present our recent results about the Smoluchowski–Kramers approximation for invariant measures of SDEs/SPDEs by using stein's method.

Trajectorial version of the W_h-gradient flow for nonlinear Fokker-Planck equations

Zhenxin Liu

Dalian University of Technology

Abstract: In this talk, we will introduce a trajectorial approach to the gradient flow of nonlinear Fokker-Planck equations. We first give the definitions of the generalized entropy and the modified Wasserstein metric W_h, which is adapted to the nonlinear setting. Then we establish the trajectorial version of the relative entropy dissipation identity by McKean-Vlasov SDEs. Averaging the energy dissipation of trajectories yields the free energy dissipation of nonlinear Fokker-Planck equations. Furthermore, leveraging properties of the tangent space of $(\mathcal{P}_2({\mathbb R}^d), W_h)$, we derive the W_h-gradient flow. As an illustrative example, we analyze the Fermi-Dirac-Fokker-Planck equation. We conclude with two questions motivated by numerical observations. This talk is based on the collaboration with Xuewei Wang.

Connection between MP and DPP for Stochastic Optimal Control Problem

Tianyang Nie

Shandong University

Abstract: In this talk, we first recall some results about the connection between maximum principle and dynamic programming principle for stochastic optimal control problem. Then we study the connection between MP and DPP for optimal control problems driven by McKean-Vlasov type stochastic differential equations. We can establish the relationship between the derivatives of the value function and the first order and second order adjoint equations.

Moments of additive martingales of branching L\'evy processes and some applications

Yanxia Ren

Peking University

Abstract: . Let $W_t(\theta)$ be the Biggins martingale of a supercritical branching L\'evy process with non-local branching mechanism, and denote by $W_\infty(\theta)$ its limit. In this talk, we first study properties of $W_\infty(\theta)$. We provide sufficient and necessary conditions for $W_\infty(\theta)$ to have finite pth moment and sufficient conditions for $\mathbb{E}(W_\infty(\theta)^pL(W_\infty(\theta))<\infty$, where L is slowly varying at infinity. We also study the tail behavior of $W_\infty(\theta)$. We then use our results on $W_\infty(\theta)$ to establish central limit theorems and stable central limit theorems for $W_t(\theta)-W_\infty(\theta)$.

The talk is based on joint work with Renming Song and Rui Zhang.

Stochastic reaction-diffusion equations with super-linear drift

Shijie Shang

University of Science and Technology of China

Abstract: In this talk, we consider the stochastic reaction-diffusion equations with logarithmic super-linear drift, driven by Brownian motion or space-time white noise. We will present recent progress on the global existence and uniqueness of solutions to these equations in both bounded and unbounded domains.

On Polymer Models in Correlated Random Environments

Jian Song

Shandong University

Abstract: In this talk, we discuss the directed polymer in a time-correlated random environment and the pinning model in a correlated environment. We show that, under suitable scalings, their partition functions converge weakly to non-trivial random variables whose chaos expansions can be explicitly characterized.

Stochastic intrinsic gradient flows on the Wasserstein space

Fengyu Wang

Tianjin University

Abstract: We construct stochastic gradient flows on the Wasserstein space for a class of energy functionals, which includes the entropy functional and the Lyapunov function of generalized porous media equations. First, we define a class of Gaussian-based measures and weighted O-U Processes on the Wasserstein space, then use Dirichlet form techniques to construct quasi-regular Dirichlet forms associated with Gibbs measures induced by the energy functionals and Gaussian measures, and finally prove that the associated diffusion processes provide weak solutions to the stochastic intrinsic gradient flows. This is a joint work with Panpan Ren, Michael Rockner and Simon Wittmann.

Limit theorems of SDEs and SFDEs with reflections

Jing Wu

Sun Yat-sen University

Abstract: We are concerned with some problems of SDEs and SFDEs with reflections in non-smooth domains, including the wellposedness results, limit theorems and the support characterization.

Fast-Slow Coupled Forward-Backward Stochastic Differential Equations

Fuke Wu

Huazhong University of Science and Technology

Abstract: This work focuses on fast-slow coupled forward-backward stochastic differential equations (FBSDEs). We first establish the well-posedness of such systems and provide some necessary estimates. Subsequently, we derive a strong averaging principle for both forward and backward terms using Khasminskii's time discretization technique. Finally, we demonstrate applications of these averaging results to singularly perturbed linear-quadratic problems.

Global well-posedness and ergodicity of 3D stochastic Burgers equation with a multiplicative noise force

Jianglun Wu

Beijing Normal-Hong Kong Baptist University

Abstract: This talk is concerned with a 3D stochastic Burgers equation perturbed by a linear multiplicative noise. Utilising Doss-Sussman transformation, we link the 3D stochastic Burgers equation to a 3D random Burgers equation. Utilising certain techniques from nonlinear

partial differential equations and stochastic analysis, we are able to establish the global well-posedness of 3D Burgers equation with constant diffusion coefficient. Moreover, by developing a solution which is orthogonal to the gradient of diffusion coefficient, we extend the global well-posedness result to a more general case to allow the diffusion coefficient to be a function of space and time variables. Our results and methodology pave a way to extend regularity results of 1D Burgers equations to 3D Burgers equations. Based on joint works with Zhao Dong (Chinese Academy of Sciences), Boling Guo (Beijing Institute of Applied Physics and Computational Mathematics) and Guoli Zhou (Chongqing University).

Non Local-approximation of Unimodular Random Networks

Kainan Xiang

Xiangtan University

Abstract: In this talk, we will state one of the most important central open problems in the graph/network limit theory, called Aldous-Lyons Conjecture by L. Lovász (2009), which says that any unimodular random network is a local limit of some finite network sequence. This conjecture was disproved by [1] and [2]. By the way, we will briefly describe that the local limit of uniform random fullerenes is the planar hexagonal lattice, which is proved by [3] and confirms Conjecture 1 in A. Bille, V. Buchstaber, S. Coste, S. Kuriki and E. Spodarev [(2023), Random eigenvalues of graphenes and the triangulation of plane. arXiv: 2306.01462[math.SP]].

[1] L. Bowen, M. Chapman, A. Lubotzky, T. Vidick. (2024). The Aldous-Lyons Conjecture I: Subgroup tests. arXiv:2408.00110 [math.GR], Preprint.

[2] L. Bowen, M. Chapman, T. Vidick. (2025). The Aldous-Lyons conjecture II: Undecidability. arXiv:2501.00173 [quant-ph], Preprint.

[3] Liu Jing (刘景), Xiang Kainan, Zou Lang (邹浪). (2025+). Local weak convergence of uniform random fullerenes.

From super-Brownian motions to time-fractional super-Brownian

Wei Xu

Beijing Institute of Technology

Abstract: Consider a sequence of nearly critical interacting particle systems with chain-reaction and decay. Under some fast decay assumption, we show that the particle systems can be well approximated by a super-Brownian motion after a suitable time-spatial scaling. On the other hand, under some regular variation condition on the decay, we proved the weak convergence of the rescaled interacting particle systems to a novel non-Markovnian super-process, named as time-fractional super-Brownian motion, that can be fully characterized by the Fourier-Laplace functional given in the form of unique solution to a time-fractional F-KPP equation. In particular, the time-fractional super-Brownian motion on the real line is proved to be absolutely continuous with respect to Lebesgue measure. Moreover, the density process is the unique weak solution to a time-fractional parabolic semilinear SPDE driven by a Gaussian white noise. This talk is based on joint works with Chongyang Ren (University of Science and Technology of China)..

Long time behaviour of parabolic Anderson model on hyperbolic space

Weijun Xu

Peking University

Abstract: We establish the exact quenched asymptotic growth of the solution to the parabolic Anderson model (PAM) in the hyperbolic space with a regular, stationary, time-independent Gaussian potential. More precisely, we show that with probability one, the solution to PAM with constant initial data has pointwise growth asymptotics \exp (L t^{5/3}). Both the power t^{5/3} on the exponential and the exact value of the

constant L^* are different from their counterparts in the Euclidean situation. They are determined through an explicit optimisation procedure. Joint work with Xi Geng and Sheng Wang (both at University of Melbourne).

A class of time fractional functional differential equations driven by the fractional Brownian motion

Litan Yan

Donghua University

Abstract: In this talk, we discuss a class of time fractional functional differential equations driven by fractional Brownian motion. We establish the existence and uniqueness of solutions for such equations and study their viability. As an application, we also present the existence of positive solutions.

Schauder estimates for symmetric non-local operator of divergence form

Saisai Yang

University of Science and Technology of China

Abstract: In this talk, we consider about a class of non-local parabolic operator, which is associated with symmetric Dirichlet forms. We try to use the perturbation technique to establish the interior Schauder estimates for the non-local parabolic PDEs on generalized H\"older spaces. The regularity estimates of the translation invariant non-local operator and the generalized Campanato space we construct will play a crucial role.

Large N limit of the Langevin dynamics for the spin O(N) model

Wenjie Ye

Fujian Normal University

Abstract: In this paper, we prove that the large N limit of the Langevin dynamics for the spin O(N) model is given by a mean-field stochastic differential equation (SDE) in both finite and infinite volumes. We establish uniform in N bounds for the dynamics, which enable us to demonstrate convergence to the mean-field SDE with polynomial interactions. Furthermore, the mean-field SDE is shown to be globally well-posed for suitable initial distributions. We also prove the existence of stationary measures for the mean-field SDE. For small inverse temperatures, we characterize the large N limit of the spin O(N) model through stationary coupling. Additionally, we establish the uniqueness of the stationary measure for the mean-field SDE.

Stochastic transport equation with Levy noise

Jianliang Zhai

University of Science and Technology of China

Abstract: We prove well-posedness theorems for the linear transport equation with a globally Holder continuous and bounded vector field driven by a non-degenerate Levy noise of α-stable type. This extends the results proved in F. Flandoli, M. Gubinelli and E. Priola(2010) in the Brownian case and shows regularization by noise phenomena with Levy noises. Indeed, uniqueness is restored by the presence of pure jump Levy noise since without the noise term the transport equation has in general many solutions.

The Ergodic Linear-Quadratic Optimal Control Problems for Stochastic Mean-Field Systems with Periodic Coefficients

Qi Zhang

Fudan University

Abstract: We concern with the ergodic linear-quadratic closed-loop optimal control problems, in which the state equation is the mean-field stochastic differential equation with periodic coefficients. We first study the asymptotic behavior of the solution to the state equation and get a family of periodic measures depending on time variables within a period from the convergence of transition probabilities. Then, with the help of periodic measures and periodic Riccati equations, we transform the ergodic cost functional on infinite horizon into an equivalent cost functional on a single periodic interval without limit, and present the closed-loop optimal controls for our concerned control system. Finally, an example is given to demonstrate the applications of our theoretical results. This is a joint work with Jiacheng Wu.

Φ^4_3 theory from many-body quantum Gibbs states

Rongchan Zhu

Beijing Institute of Technology

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. To be precise, starting from many-body quantum mechanics, where the problem is linear and regular but involving non commutative operators, we justify the emergence of the Φ^4_3 measure as a semiclassical limit which captures the formation of Bose--Einstein condensation just above the critical temperature. We employ and develop several tools from both stochastic quantization and many-body quantum mechanics. Since the quantum problem is typically formulated using a nonlocal interaction potential, our first key step involves approximating the Φ^4_3 measure through a Hartree measure with nonlocal interaction, achieved by developing new techniques in paracontrolled calculus. The connection between the quantum problem and the Hartree measure emerges through a variational interplay between classical and quantum models.