Titles and Abstracts

Interfacial curvature flow and its fluctuation in Glauber-Kawasaki dynamics

Funaki Tadahisa(舟木直久)
Beijing Institute of Mathematical Sciences and Applications(BIMSA)

We discuss derivation of interface motion from Glauber-Kawasaki dynamics, that is, interacting random walks with hard core exclusion and creation/annihilation of particles. Then its fluctuation is discussed in a simple situation and certain SPDEs are derived.

Homogenization for heat equation with nonlocal random singular potential

Wei Wang(王伟)
Nanjing University

In this talk we present a recent work on the homogenization for a heat equation with nonlocal random singular Gaussian potential. Represent the solution an infinite series by Duhamel formula and we then show the homogenized equation is an SPDEs with nonlocal spatial white noise.

On the Navier-Stokes equations and Bellman dynamic principle on group of volume preserving diffeomorphisms

Xiangdong Li(李向东)
Chinese Academy of Science(CAS)

In this talk, I will present my recent work on a new derivation of the incompressible Navier-Stokes equation via the Bellman dynamic programming principle on the group of volume preserving diffeomorphisms $G=SDiff(M)$ over a Riemannian manifold M. Joint work with G.-P. Liu (HUST, Wuhan).

Large Deviations Principle for the Fluctuating Boltzmann Equation

Liu Hong(洪柳)
Sun Yat-sen University

The Boltzmann equation plays a fundamental role in the fields of gas dynamics and non-equilibrium

thermodynamics. In this study, by introducing a stochastic picture of the binary collision of particles, we reformulate the Boltzmann equation into a broader Markov-chain model. The corresponding Kolmogorov forward equations and Liouville equation in either discrete or continuous time and state space are constructed respectively, both of which offer stochastic generalizations of the classical Boltzmann equation. Then by using the WKB method, the large deviations principle for the fluctuating Boltzmann equation is constructed, which on one hand explains the probabilistic origin of the H-theorem, on the other hand provides time-reversible generalizations of the Boltzmann equation in a Hamiltonian structure. In a similar way, the diffusion limit is discussed too.

Large deviations for stochastic generalized porous media equations driven by Lévy noise

Jianliang Zhai(翟建梁)
University of Science and Technology of China

We establish a large deviation principle for a class of stochastic porous media equations driven by L\'evy-type noise on a \sigma -finite measure space (E,\scrB (E),\mu), with the Laplacian replaced by a negative definite self-adjoint operator. One of the main contributions is that we do not assume the compactness of embeddings in the corresponding Gelfand triple.

Functional Tipping Indicators via Schrödinger Bridge

Ting Gao (高婷)
Huazhong University of Science and Technology

Action functionals between two meta-stable states in stochastic dynamical systems are good tools to study the critical transitions and tipping. We will present our recent findings on tipping indicators based on the Onsager-Machlup action functional and Schrödinger bridge. The latter also extends the transition paths to be pathway measures between two given invariant manifolds. To validate our framework, we apply our methodology to some neural models as well as real brain data, such as EEG and fMRI from epilepsy and Alzheimer's disease.

Bernoulli Functional Approach to Quantum Walks on Hypercubes

Ce Wang(王策)
Tsinghua University

In this talk, we firstly would like to introduce some backgrounds and recent developments about the quantum walk. Some interesting facts which are different from classical random walks are also mentioned. Then we would introduce our recent work for quantum walk on Hypercube.

Quantum Algorithms for Linear Stochastic Differential Equations:A Schrödingerization Approach

Wei Wei(魏巍)
Shanghai Jiao Tong University

Quantum computers are known for its potential to achieve exponential speedup compared to classical computers. In this talk, I will introduce numerical schemes for stochastic differential equations based on the Schrödingerisation method. Different from existing methods, our schemes are applicable to stochastic differential equations driven by stable processes. Our algorithms demonstrate a quantum advantage over the Euler-Maruyama scheme on classical computers in high dimensional scenarios. In the case under Gaussian noise, we show the convergence of strong sense with order 1/2 of the approximation equation under mean square norm. The algorithm is verified for the Ornstein–Uhlenbeck processes, geometric Brownian motions and one-dimensional Lévy flights.

Global Well-posedness for 2d Generalized Parabolic Anderson Model Via Paracontrolled Calculus

Prof. Zhu Xiangchan(朱湘禅)
Chinese Academy of Science(CAS)

This article revisits the problem of global well-posedness for the generalized parabolic Anderson model on $\mathbb{R}^+\times \mathbb{T}^2$ within the framework of paracontrolled calculus \cite{GIP15}. The model is given by the equation:

\begin{equation*}

(\partial_t-\Delta) u=F(u)\eta

\end{equation*}

where $\eta\in C^{-1-\kappa}$ with $1/6>\kappa>0$, and $F\in C_b^2(\mathbb{R})$. Assume that $\eta\in C^{-1-\kappa}$ and can be lifted to enhanced noise, we derive new a priori bounds. The key idea follows from the recent work

\cite{CFW24} by A.Chandra, G.L. Feltes and H.Weber to represent the leading error term as a transport type term, and our techniques encompass the paracontrolled calculus, the maximum principle, and the localization approach (i.e. high-low frequency argument).

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

Jianglun Wu(吴奖伦)
Beijing Normal University-Hong Kong Baptist University United International College

This talk is concerned with a 3D 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).

Long time behaviors of mean field interacting particle systems and McKean-Vlasov equations

Wei Liu(刘伟)
Wuhan University

In this talk, we will present our recent studies about the long time behaviors of mean-field interacting particle systems and the McKean-Vlasov equation, by using two different methods: coupling method and functional inequalities. This talk is based on the joint works with Arnaud Guillin, Liming Wu and Chaoen Zhang.

Rough Dynamical Systems

Hongjun Gao(高洪俊)
Southeastern University

We will report our recent advances for SDE(SPDEs) driven by rough path.

Dynamics of nonlocal Kuramoto-Sivashinshy equations with white noise

Xiaopeng Chen (陈晓鹏)
Shantou University

In this talk, we discuss the long time dynamic properties of nonlocal Kuramoto-Sivashinsky equation with white noise. First of all, we consider the dynamic properties of the original problems via the conjugation which the stochastic nonlocal Kuramoto-Sivashinsky equations are transformed into the associated conjugated random differential equation. Next, we prove the existence and uniqueness of solutions for the conjugated random differential equations in the the theory of random dynamical systems. So we can establish the existence and uniqueness of pullback random attractor for the stochastic Kuramoto-Sivashinsky equation.

Multi-bubble blow-ups and multi-solitons to stochastic nonlinear Schrödinger equations

Deng Zhang(张登)
Shanghai Jiaotong University

This talk focuses on the long time behavior of solutions to focusing stochastic nonlinear Schrödinger equations. We will mainly show the construction and conditional uniqueness of multi-bubble Bourgain-Wang type blow-up solutions and non-pure multi-solitons, which provide new examples for the mass quantization conjecture and the soliton resolution conjecture. In the low asymptotic regime, the refined uniqueness is also derived in the deterministic case. Moreover, we show the construction of stochastic multi-solitons in the mass critical and subcritical cases, for which the classical pseudo-conformal symmetry is absent.

Asymmetric Transport computations in Dirac Models of Topological insulators

Zhongjian Wang(王中剑)
Nanyang Technological University

In this talk we will present a fast and accurate algorithm for computing transport properties of two-dimensional Dirac operators with linear domain walls, which model the macroscopic behavior of the robust and asymmetric transport observed at an interface separating two two-dimensional topological insulators. Our method is based on reformulating the partial differential equation as a corresponding volume integral equation, which we solve via a spectral discretization scheme.
We demonstrate the accuracy of our method by confirming the quantization of an appropriate interface conductivity modeling transport asymmetry along the interface, and moreover, confirm that this quantity is immune to local perturbations. We also compute the far-field scattering matrix

generated by such perturbations and verify that while asymmetric transport is topologically protected the absence of back-scattering is not.

Large deviations of multiscale multivalued McKean-Vlasov stochastic systems

Huijie Qiao(乔会杰)
Southeast University

This work concerns about multiscale multivalued McKean-Vlasov stochastic systems. First of all, we use a contractive mapping principle to establish the well-posedness for fully coupled multivalued McKean-Vlasov stochastic systems under non-Lipschitz conditions. Then for multiscale multivalued McKean-Vlasov stochastic systems with small noises, we prove a large deviation principle by a weak convergence approach. As a by-product, two average principles are obtained.

Analysis for a class of stochastic fractional nonlinear Schr\"odinger equations with L\'evy noise

Yanjie Zhang(张燕杰)
Zhengzhou University

In this paper, we first establish the stochastic Strichartz estimate for the fractional Schr\"odinger equation with α-stable noise. With the help of the deterministic Strichartz estimates, we prove the existence and uniqueness of a global solution to the stochastic fractional nonlinear Schr\"odinger equation in $L^2(\mathbb{R}^n)$. We then show that the stochastic fractional nonlinear Schr\"odinger equation in the Stratonovich sense forms an infinite-dimensional stochastic Hamiltonian system, with its phase flow preserving symplecticity. Finally, we develop a structure-preserving algorithm for the stochastic fractional nonlinear Schr\"odinger equation from the perspective of symplectic geometry. An numerical example is conducted to validate the efficiency of the theory.

Stochastic partial differential equations associated with Feller processes

Jian Song(宋健)
Shandong University

For a class of linear SPDEs associated with Feller processes, we obtain Feynman-Kac type of representations for the Stratonovich and Skorohod solutions as well as for their moments. The regularity of the law and the Hölder continuity of the solutions are also studied.

Mandelbrot Cascades: critical moments, Rajchman measures and Sobolev smoothness

Yanqi Qiu(邱彦奇)
Hangzhou Institute for Advanced Study, UCAS

We introduce a method for estimating weighted sum of random variables on trees. This method on the one hand will allow us to deal with the asymptotic order of moments of Mandelbrot Cascades at critical exponents, and on the other hand will allow us to establish Rajchman property of the random measure arising from the Mandelbrot Cascades, as well as the Sobolev smoothness of the self-convolution of the random measure. The talk is based on joint work with Xinxin Chen, Yong Han and Zipeng Wang.

Quantitative homogenization of elliptic problems in periodic high contrast environments

Wenjia Jin (荆文甲)
Tsinghua University

We consider elliptic equations with periodic high contrast coefficients and study the asymptotic analysis when the periodicity is sent to zero and/or the contrast parameters are sent to extreme values. Those coefficients model small inclusions that have very different physical properties compared to the surrounding environment. Homogenization captures the macroscopic effects of those inclusions. We report some quantitative results such as the convergence rates of the homogenization (with proper correctors) and uniform regularity for the solutions of the heterogeneous equations. The talk is based on joint works with Mr. Xin Fu.

Convergence rates and CLT for 3-D stochastic fractional Boussinesq equations with transport noise

Jianhua Huang(黄建华)
National University of Defense Technology

This talk is devoted to the 3-D stochastic fractional Boussinesq equations on the torus driven by transport noise. Firstly, the existence of weak solutions is established by using the Galerkin approximation and the compactness method. Next, under a suitable scaling of the noise, we prove that the weak solution of stochastic fractional Boussinesq equations converges to the unique solution of the deterministic fractional Boussinesq equations in certain suitable negative Sobolev norm. This means that transport noise regularizes the fractional Boussinesq equations so that it enjoys approximate weak uniqueness. Finally, the central limit theorem with an explicit convergence rate are obtained to interpret the aforementioned limit result as a law of large numbers.

Quantitative periodic homogenization for fractional Laplacian-like operators

Jian Wang(王健)
Fujian Normal University

The homogenization for non-local operators in periodic environments has been studied intensively recently, and all known works are mainly devoted to the qualitative results, that is, to determine the explicit form of the limiting operator. To the best of our knowledge, there is no result concerning the convergence rates of the homogenization for non-local operators in periodic environments. In this talk, we establish a quantitative version of homogenization for fractional Laplacian-like operators with periodic coefficients.