Recent Progress of Stochastic Analysis and Related Fields
(Org: **Yu-Ting Chen** (University of Victoria) and/et **Thomas Hughes** (University of Bath))

ARTURO ARELLANO ARIAS, McGill University

SARAÍ HERNÁNDEZ-TORRES, Instituto de Matemáticas, UNAM
Minkowski content of the scaling limit of 3D loop-erased random walk

The loop-erased random walk (LERW) is a model for random self-avoiding curves. Since its introduction by Lawler in the early 1980s, the scaling limits of LERW have been thoroughly studied. While these limits are well-understood in dimensions 2 and 4 and higher, the three-dimensional case presents unique challenges.

This talk will present recent advances on the Minkowski content of the scaling limit of the three-dimensional LERW. Due to the absence of essential tools in the continuum in this dimension, key parts of the analysis are carried out in discrete space. Specifically, we establish sharp estimates for the one-point function and ball-hitting probabilities for the LERW on $\mathbb{Z}^3$. This talk is based on joint work with Xinyi Li and Daisuke Shiraishi.

YAOZHONG HU, University of Alberta

ZOE HUANG, UNC Chapel Hill

THOMAS HUGHES, University of Bath
Stochastic PDEs with the compact support property: the stable noise regime

A solution to the heat equation with non-negative, non-zero initial data is strictly positive. This property generalizes to most parabolic PDEs, but not necessarily to stochastic PDEs. The solution to a heat equation with multiplicative noise may be a compactly supported function, depending on the regularity of the noise coefficient. I will first discuss some classical theorems of this type when the equation has white Gaussian noise, and then discuss a recent result which proves the compact support property for solutions to a class of stochastic heat equations with white stable noise. Along the way we will develop some heuristics for why this property holds, sketch some proof techniques, and discuss connections with superprocesses.

DAMIR KINZEBULATOV, Université Laval

BROCK KLIPPENSTEIN, University of Manitoba
Fast Analytical-Numerical Hybrid Methods for Solving the Cosmic Ray Fokker-Planck Equation

When energetic particles such as cosmic rays travel through magnetized plasma, they encounter turbulent magnetic fields. This in turn renders the equation of motion very difficult to apply. Hence, we instead work with the Fokker-Planck partial differential equation, which gives us the probability of finding the particle at a certain time, position, and velocity. Here, we talk about methods which allow for fast solving the Fokker-Planck equation.

SHUWEN LOU, Loyola University of Chicago

KODJO RAPHAEL MADOU, McGill University

MATHAV MURUGAN, University of British Columbia

JINNIAO QIU, University of Calgary
Viscosity solutions of a class of second-order Hamilton-Jacobi-Bellman Equations in the Wasserstein Space

The talk is about solving a class of second-order Hamilton-Jacobi-Bellman (HJB) equations in the Wasserstein space, arising from mean field control problems involving common noise. We provide the well-posedness of viscosity solutions to the HJB equation in the sense of Crandall-Lions' definition, under general assumptions on the coefficients. Our approach adopts the smooth metric developed by Bayraktar, Ekren, and Zhang [Proc. Amer. Math. Soc.(2023)] as our gauge function for the purpose of smooth variational principle used in the proof of comparison theorem. Subsequently, we derive further estimates and regularity of the metric, including a novel second-order derivative estimate with respect to the measure variable, in order to ensure its uniqueness and existence. The talk is based on joint work with Hang Cheung and Ho Man Tai.

ZACHARY SELK, Queen's University
Rough Paths above Weierstrass Functions

Although rough paths theory is typically applied to differential equations driven by stochastic processes, it is not inherently a random theory. Weierstrass functions are examples of Hölder continuous yet nowhere differentiable functions. Surprisingly, even though Weierstrass functions are the most classical example of the type of function rough paths theory was invented to handle, until recently no one has constructed a rough path above it. In this talk, we discuss the construction of a rough path above vector valued Weierstrass functions. Joint work with Francesco Cellarosi (arXiv:2304.11646, to appear in C. R. Math. Acad. Sci. Paris).

LUCAS TEYSSIER, Univeristy of British Columbia

TE-CHUN WANG, University of Victoria
Asymptotics and the sub-limit at L^2-criticality of higher moments for the SHE in dimension $d \geq 3$

In this talk, we consider a renormalization of the d-dimensional stochastic heat equation (SHE) when the mollification parameter is turned off. Recently, the limiting higher moments of the two-dimensional mollified SHE have been established, and a phase transition is found at L^2-criticality. In particular, the non-Gaussianity of the limit is proved. By contrast, the above convergences in high dimensions ($d \geq 3$) still remain unknown. To this aim, we will prove this conjecture by showing a completely opposite phenomenon in high dimensions. Moreover, we will provide partial results for a conjecture about the critical coupling constants of the continuous directed polymer.

XIAOWEN ZHOU, Concordia University
Speeds of coming down from infinity for Λ-Fleming-Viot supports

Λ-Fleming-Viot process is a probability-measure valued process that is dual to a Λ-coalescent involving multiple collisions. It is well known that such processes can have the compact support property, i.e. its support becomes finite as soon as $t > 0$ even though the initial measure has an unbounded support.

For Λ-Fleming-Viot processes with Brownian spatial motion and with the associated Λ-coalescents coming down from infinity, applying the lookdown representation we obtain asymptotic results characterizing how fast the supports become finite near time 0. Our results are expressed using the asymptotics of tail distribution of the initial measure and speed function of coming down from infinity for the associated Λ-coalescent.

This talk is based on joint work with Zenghu Li and Huili Liu.