Department of Mathematics

North-East Midlands Stochastic Analysis Seminar supported by the London Mathematical Society and and Isaac Newton Institute for Mathematical Sciences

Organisers: Z. Brzeźniak (York), H. Boedihardjo, K. D. Elworthy and R. Tribe (Warwick), C. Feng and H.Z. Zhao (Durham), Z. Qian (Oxford)

Tuesday 11th and Wednesday 12th of March 2025

All talks in room Dusa (Tuesday) or Topos (Wednesday) Rooms at the Department of Mathematics

Zoom: https://york-ac-uk.zoom.us/j/94179796574?pwd=cSpDheYqyxvHYMnfdNKUcRPQwfICvg.1

Passcode: 875487

A two-day meeting will be held at the University of York as part of the LMS funded program of the North-East and Midlands Stochastic Analysis (NEMSA).

Speakers: Tuesday, 11th March

14:00-14:50 **Istvan Gyongy (Edinburgh):**

14:50-15:10 Tea and coffee break

15:10-16:00 **Nikolaos Zygouras (Warwick):** The Critical 2d Stochastic Heat Flow and some first properties

16:10-17:00 **Oleg Butkovsky (Berlin):** Weak uniqueness for stochastic equations with singular drifts

17:00 **Discussion**

17:30 *Walk and dinner afterwards*

Speakers: Wednesday, 12th March

09:00-09:50 **Fernanda Cipriano (Lisbon):** Weak solution for stochastic Degasperis-Procesi equation

10:00-10:50 **Lorenzo Zambotti (Paris):** Reflected or Skew S(P)DEs and stochastic sewing

10:50-11:10 Tea and coffee break

11:10-12:00 **Manil T Mohan (Roorkee):** Optimal control of stochastic convective Brinkman-Forchheimer equations: Hamilton-Jacobi-Bellman equation and viscosity solutions

12:10-13:00 Lunch

13:10-14:00 **Oana Pocovnicu (Edinburgh):** Invariant Gibbs dynamics for fractional wave equations in negative Sobolev spaces

14:00-14:30 **Discussion**

14:30 End of meeting

For more information on speakers and events, please contact:

Zdzislaw Brzezniak
Department of Mathematics, The University of York
Heslington, York YO10 5DD, United Kingdom
e-mail: zdzislaw.brzezniak@york.ac.uk

Information for accommodation: http://maths.york.ac.uk/www/VisitorAccommodation

For booking accommodation on campus email:

Travel information: http://www.york.ac.uk/admin/estates/transport

Title and Abstracts:

Nikolaos Zygouras: The Critical 2d Stochastic Heat Flow and some first properties

Abstract: The Critical 2d Stochastic Heat Flow arises as a non-trivial solution of the Stochastic Heat Equation (SHE) at the critical dimension 2 and at a phase transition point. It is a log-correlated field which is neither Gaussian nor a Gaussian Multiplicative Chaos. We will review the phase transition of the 2d SHE, describe the main points of the construction of the Critical 2d SHF and outline some of its features and related questions. Based on joint works with Francesco Caravenna and Rongfeng Sun.

Oleg Butkovsky: Weak uniqueness for stochastic equations with singular drifts

Abstract: Joint work with Leonid Mytnik (Technion - Israel Institute of Technology). We consider the stochastic differential equation
$$
dX_t = b(X_t) dt + dB_t^H,
$$
where the drift b is a Schwartz distribution in the space $\mathcal{C}^\alpha$, $\alpha < 0$, and B^H is a fractional Brownian motion of Hurst index $H \in (0, 1/2]$. If $H = 1/2$, both weak and strong uniqueness theories for this SDE have been developed. However, the situation is much more complicated if $H \neq 1/2$, as the main tool, the Zvonkin transformation, becomes unavailable in this setting. The breakthroughs by Catellier and Gubinelli, and later by Le, established strong well-posedness of this SDE via sewing/stochastic sewing arguments. However, weak uniqueness for this SDE remained a challenge for quite some time, since a direct application of stochastic sewing alone does not seem very fruitful. We put forward a new method (a combination of stochastic sewing with certain arguments from ergodic theory), which allows us to show weak uniqueness in the whole regime where weak existence is known, that is, $\alpha > 1/2 - 1/(2H)$. If time permits, we will also discuss weak uniqueness for stochastic reaction-diffusion equation
$$
d u_t =(\Delta u_t + b(u_t))dt + \xi_t
$$
where ξ is the space-time white noise and $b\in\mathcal{C}^\alpha$, $\alpha > -3/2$.

[1] O. Butkovsky, L. Mytnik (2024). Weak uniqueness for singular stochastic equations. arXiv preprint arXiv:2405.13780.

Fernanda Cipriano: Weak solution for stochastic Degasperis-Procesi equation

Abstract: This work is concerned with the existence of solution to the stochastic Degasperis-Procesi equation with an infinite dimensional multiplicative noise and integrable initial data. Writing the equation as a system composed of a stochastic nonlinear conservation law and an elliptic equation, we are able to develop a method based on the conjugation of kinetic theory with stochastic compactness arguments. More precisely, we apply the stochastic Jakubowski-Skorokhod representation theorem to show the existence of a weak kinetic martingale solution. In this framework, the solution is a stochastic process with sample paths in Lebesgue spaces, which are compatible with peakons and wave breaking physical phenomenon. This is a joint work with Nikolai Chemetov.

Lorenzo Zambotti: Reflected or Skew S(P)DEs and stochastic sewing

Abstract: In this talk I would like to review old results on stochastic (partial) differential equations with coefficients dependent on the local times of the solution and relate them with more recent results based on stochastic sewing techniques.

Manil T Mohan: Optimal control of stochastic convective Brinkman-Forchheimer equations: Hamilton-Jacobi-Bellman equation and viscosity solutions

Abstract: We consider two- and three-dimensional stochastic convective Brinkman-Forchheimer (SCBF) or damped stochastic Navier-Stokes equations in torus. Using the dynamic programming approach, we study the infinite-dimensional second-order Hamilton-Jacobi equation associated with an optimal control problem for SCBF equations. For the supercritical case, we first prove the existence of a viscosity solution for the infinite-dimensional HJB equation, which we identify with the value function of the associated control problem. By establishing a comparison principle, we prove that the value function is the unique viscosity solution and hence we resolve the global unique solvability of the HJB equation in both two and three dimensions.

Oana Pocovnicu: Invariant Gibbs dynamics for fractional wave equations in negative Sobolev spaces

Abstract: In this talk, we consider a fractional nonlinear wave equation with a general power-type nonlinearity (FNLW) on the two-dimensional torus. Our main goal is to construct invariant global-in-time Gibbs dynamics for FNLW. We first construct the Gibbs measure associated with this equation. By introducing a suitable renormalisation, we then prove almost sure local well-posedness with respect to Gibbsian initial data. Finally, we extend solutions globally in time by applying Bourgain's invariant measure argument. Lastly, we also consider the case of stochastic nonlinear PDEs with additive forcing of negative regularity on the d-dimensional torus. We show that they are ill-posed unless one imposes some Fourier-Lebesgue regularity on the forcing.