Durham University

North-East and Midlands Stochastic Analysis Seminar

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Organisers:

Zdzislaw Brzezniak (York), David Elworthy (Warwick), Chunrong Feng (Durham), Zhongmin Qian (Oxford), Huaizhong Zhao (Durham)

Department of Mathematical Sciences, Durham University
Venue: MCS001, Hybrid Zoom ID: 6974011449, 31 March 2022

Talks

14:00-15:00: **Anke Wiese (Heriot-Watt)**
Series Expansion and Direct Inversion for the Heston Model

15:00-15:30: Break

15:30-16:30: **Ilya Chevyrev (Edinburgh)**
Stochastic quantisation of Yang-Mills

16:30-17:30: **Greg Pavliotis (Imperial College)**
Phase Transitions, Logarithmic Sobolev Inequalities, and uniform-in-time propagation of chaos for weakly interacting diffusions

All are welcome and please use your real name with affiliation when joining the Zoom. If you have any queries, please contact Chunrong Feng (chunrong.feng@durham.ac.uk) or Huaizhong Zhao (huaizhong.zhao@durham.ac.uk). If you join us for tea/coffee during the break time and/or dinner in the evening, please do a same day covid-19 lateral flow test yourself in advance. Thank you.

All timings are in GMT time.

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Anke Wiese (Heriot-Watt): *Series Expansion and Direct Inversion for the Heston Model*

Abstract: The Heston model, introduced by Heston in 1993, is one of the most well-known stochastic volatility models. It models jointly the evolution of the price process of an investment asset and the stochastic variance of the asset's log-returns. The variance process is given as a Cox-Ingersoll-Ross process, also known as mean-reverting square root process, a process used widely in financial and other applications. While the Heston model provides tractability to a certain extent, its numerical treatment is well-known to be very challenging. Key components in the model are the variance process and its time integral conditioned on the variance values at the end points of the integral. We derive a new series representation for the latter quantity. For this we explore the connection of the CIR process to squared Bessel processes and bridges. The new representation has the advantage that truncation errors decay exponentially, and that building blocks of this series are random variables that are independent of the model parameters. Based on this new representation, we derive high-accuracy direct inversion methods that enable the efficient sampling of the Heston model. This talk is based on joint work with SJA Malham and J Shen.

Ilya Chevyrev (Edinburgh): *Stochastic quantisation of Yang-Mills*

Abstract: Yang-Mills theories are the basis for our model of forces in quantum mechanics. However, a rigorous study of these theories at the quantum level is still lacking, even in cases where the universe is replaced by a 2- or 3-dimensional space. In this talk, I will review recent works which aim to make progress on the study of such theories using stochastic quantisation. I will show how the associated stochastic quantisation equation can be renormalised, paying special attention to how symmetries are used to show that renormalisation does not break gauge covariance. Based on arXiv:2201.03487, which is a joint work with Ajay Chandra, Martin Hairer, and Hao Shen.

Greg Pavliotis (Imperial College): *Phase Transitions, Logarithmic Sobolev Inequalities, and uniform-in-time propagation of chaos for weakly interacting diffusions*

Abstract: We present recent results on the mean field limit of weakly interacting diffusions for confining and interaction potentials that are not necessarily convex. In particular, we explore the relationship between the large N limit of the constant in the logarithmic Sobolev inequality (LSI) for the N-particle system and the presence or absence of phase transitions for the mean field limit. The non-degeneracy of the LSI constant is shown to have far reaching consequences, especially in the context of uniform-in-time propagation of chaos and the behaviour of equilibrium fluctuations. Our results extend previous results related to unbounded spin systems and recent results on propagation of chaos using novel coupling methods. This is joint work with Matias Delgadino, Rishabh Gvalani and Scott Smith.