

Gregynog 2026 Timetable

Monday 18th May – Seminar Room 1

16:00 – 16:28			Tea: Blayney Room
Time	Seminar Room 1		Speaker
16:30 – 16:35	Welcome		
16:35 – 17:25	Beyond Homogenisation		John Willis
17:30 – 18:20	Introduction to quantum estimation and metrology		Madalin Guta
18:25 – 18:55	Asymptotic view on equatorial and polar waves		A. and N. Movchan
19:00 - 20:00			Dinner: Dining Room

Tuesday 19th May

8:00 – 9:00				Breakfast: Dining Room	
Time	Seminar Room 1		Speaker	Seminar Room 2	Speaker
9:00 – 9:50	A Taste of Semigroup Theory		Victoria Gould		
9:55 – 10:25	Multi-factorisations and Divisor Functions		Matthew Lettington	When the Earth Demands New Mathematics	Vladi Frid
10:25 – 10:55	The sum of left and right circulant matrices		Karl Michael Schmidt	Multimode approximations for thin FGM coatings	Barış Erbaş
11:00 – 11:30			Tea: Blayney Room		
11:30 – 12:20	Local asymptotic normality in quantum statistics		Madalin Guta		
12:25 – 12:55	Synthetic metric and Lorentzian geometry		Tobias Beran	Acoustic lattice resonances and generalised Rayleigh–Bloch waves	Malte Peter
13:00 – 14:00			Lunch: Dining Room		

Tuesday 19th May

Time	Seminar Room 1	Speaker	Seminar Room 2	Speaker
14:00 – 14:20	Exploring how metabolism comes into play with regulations: a mechanistic approach	Damian Bimbenet	Noncommutative Morse Theory	Manab Mukherjee
14:20 – 14:40	Travelling Fronts and Wave Speeds in a Scalar Reaction-Diffusion Equation with Nonlinear Diffusion	Bingqi Wang	An Introduction to Higher-Rank Graph C^* -algebras	Taliesin Griffith
14:45 – 15:05	Investigating the Effect of Inter-Bubble Adhesion on Coarsening in Wet Foams	Rory McCranor	Measurement incompatibility under extremal pure decoherence	William Townsend
15:05 – 15:25	Stability analysis for neutral stochastic McKean-Vlasov differential equations with state and law delays under non-Lipschitz coefficients	Xinwei Li	Volatility spillover in Bitcoin	Gabriela Filipkowska
15:30 – 15:50	The Chordal Distance Transform of Geometric Loops and its Persistent Homology	James Binnie	Large Deviation Principle for Stochastic Systems	Zhaohang Wang
16:00 – 16:30	Tea: Blayney Room			
Time	Seminar Room 1	Speaker	Seminar Room 2	Speaker
16:30 – 16:50	One-Dimensional Three-Colour Scenery Reconstruction	Yi Xu	Selection and Reduction	Erin-Jana Hoare
16:50 – 17:10	Eigenvalue Bounds for Perturbed Periodic Dirac Operators	Ghada Shuker Jameel	Coefficient Distortion in Surrogate-based Vertical Federated Logistic Regression for Credit Risk Scoring	Zhonghao Lyu
17:15 – 17:35	Breaking down factorisations further	Harry Hylock	Sparse approximation of functions using stochastic particle flows	Alexandra Zverovich
17:35 – 17:55	A Robust Extension of User-Centric Connectivity Model	Jiaxuan Wang	Introspective Imitation Dynamics and the Limits of Extrinsic Update Rules in Heterogeneous Public Goods Games	Harry Foster
18:00 – 18:20			Pricing exotic options based on Fractal Activity Time Geometric Brownian Motion Model	Zhiqin Yang
19:00	Dinner: Dining Room			
Time	Music Room			
20.15 – 21.30	Piano Recital	Tamara Kokilashvili		

Wednesday 20th May

Breakfast: Dining Room				
Time	Seminar Room 1	Speaker	Seminar Room 2	Speaker
8:00 – 9:00				
9:00 – 9:50	Effective response of randomly inhomogeneous media	John Willis		
9:55 – 10:25	On spectral factorization of matrix functions	Lasha Ephremidze	Scrutinising approximation algorithms and ratios for multiple domination in graphs	Andrei Gagarin
10:25 – 10:55	Revisiting water waves problem	Gennady Mishuris	Equilibrium behaviour for the Traitors game show	Vincent Knight
11:00 – 11:30		Tea: Blayney Room		
11:30 – 12:00	How Mathematics Uncovers Subtle Load-Induced Phenomena in Solids and Structures	Davide Bigoni		
12:00 – 12:50	Diameter of pseudo-finite semigroups	Victoria Gould		
13:00 – 14:00		Lunch: Dining Room		

Abstracts for invited speakers

Speaker: **Victoria Gould**

Title: **A Taste of Semigroup Theory**

Semigroups are the abstraction of functions under composition, in the same way that groups are the abstraction of bijections under composition. Further, for any mathematical structure A the set of self-maps of A preserving the structure form a semigroup with identity, the endomorphism monoid $\text{End}(A)$ of A . Added to this, almost any algebra (in the sense of universal algebra) one ever sees is a semigroup in at least one way, as are many relational structures such as lattices! Thus, semigroups pervade mathematics. How, then, to begin to describe what semigroup theorists do?

In this talk I will give an overview of some areas of semigroup theory. I will then describe something that this semigroup theorist has done recently. I will introduce the so-called endomorphism tower

$$S_n, \text{End}(S_n), \text{End}(\text{End}(S_n)), \dots$$

of S_n , where S_n is the familiar finite symmetric group from undergraduate mathematics. Surely everything must be known about this tower? Well, it transpires that that isn't true. The story is fascinating and far from over.

The recent work is joint with Ambroise Grau, Marianne Johnson and Jamie Smith.

Speaker: **Victoria Gould**

Title: **Diameter of pseudo-finite semigroups**

A semigroup S is said to be *right pseudo-finite* if the universal relation $S \times S$ on S , regarded as a right congruence, can be generated by a finite set of pairs U , and such that there is a bound on the length of derivations for an arbitrary pair (s, t) of elements of S as a consequence of those in U . The *right diameter* of such a semigroup is then the smallest bound taken over all finite generating sets. There is a dual notion of being *left pseudo-finite* and of *left diameter*.

The properties of being right, or left, pseudo-finite are finitary conditions, in that any finite S is both right and left pseudo-finite with right and left diameter 0 (if S is trivial, take U to be empty) or 1 (take $U = S \times S$). If S is a group, the notion of generation we use is exactly the analogue of subgroup generation, and it follows that a group is pseudo-finite if and only if it is finite and so has diameter 0 or 1. On the other hand, some well-known uncountable semigroups also have right and left diameter 1.

This talk will introduce the notion of pseudo-finiteness and diameter, explaining how they arise from a number of diverse sources, including the original motivation from Banach algebras. We then focus on the right and left diameter of some natural semigroups of mappings of sets, and of order-preserving mappings of chains. In the latter case, the right diameter is determined by the structure of the chain.

So far, for all 'natural' right or left pseudo-finite semigroups, the corresponding diameter has been found to be at most 4.

The work presented comes from many sources: the most recent is joint work with James East, Craig Miller, Tom Quinn-Gregson and Nik Ruškuc.

Speaker: **Madalin Guta**

Title: **Introduction to quantum estimation and metrology**

Abstract: We are currently in the midst of a second quantum revolution where quantum effects such as entanglement and superposition are harnessed in new applications ranging from computing and cryptography to sensing and metrology.

While quantum systems make exquisite precision sensors, their sensitivity to perturbations can also be detrimental in applications where coherence is an important resource. This puts parameter estimation at the heart of modern quantum science: the experimenter needs to have accurate knowledge about the state of the quantum device and the learning process is intimately connected with the probabilistic nature of quantum mechanics.

In this lecture I will give a broad introduction to some of the problems and mathematical tools related to quantum estimation including quantum tomography, the quantum Cramer-Rao bound and quantum enhanced metrology.

Speaker: **Madalin Guta**

Title: **Local asymptotic normality in quantum statistics**

Local asymptotic normality is a key concept in mathematical statistics, which underlies the asymptotic achievability of the Cramer-Rao bound and the asymptotic normality of optimal estimators.

Quantum local asymptotic normality (QLAN) shows that in the limit of large “sample size”, certain quantum statistical models can be approximated by simpler Gaussian models where the unknown parameter is encoded linearly in the mean of the canonical variables. This simplification provides a procedure for constructing optimal estimators with normally distributed errors. I will discuss two settings in which QLAN holds: ensembles of identical, independent systems, and quantum Markov chains.

Speaker: **John Willis**

Title: **Beyond Homogenisation**

The theory of homogenisation is designed for calculating an appropriate measure of the mean disturbance, when the mean disturbance consists of waves whose wavelength is much greater than the microscopic length scale over which the properties of the medium vary. Over the last several years, the theory has been extended to be applicable to metamaterials whose effective properties include significant unusual couplings at frequencies close to the resonant frequencies of microstructural components. The present concern is the development of theory that is applicable beyond this range. For a random medium, the natural measure of the mean disturbance is the ensemble mean. This is governed by effective properties that are non-local in space and time, significantly complicating the solution of boundary value problems. A further complication is that mean waves decay with distance of propagation and yet energy is conserved. There has been so far just one configuration for which this apparent paradox is explicitly stated and resolved. The energy lost from the mean wave is transferred during propagation to the mean-zero component of the disturbance. This was demonstrated for the mean energy flux during time-harmonic excitation. The need for fully time-dependent solutions provides the motivation for this presentation. A new stochastic variational structure based on the principle of least action is developed, which is applicable also to nonlinear elastic response and to time-dependent microstructures. Rather than concentrating on effective properties, it permits the construction of approximations which make use of limited statistical information, applicable to each individual realisation. When the properties of the medium are time-independent, these approximations are consistent with mean energy conservation, a result stronger than that already obtained in the time-harmonic case.

Speaker: **John Willis**

Title: **Effective response of randomly inhomogeneous media**

The effective response of inhomogeneous media has been of interest for more than a century, including the elastic or plastic response of polycrystalline metals and the viscosity of a liquid in which solid particles are suspended. Theory has been improved over many years but even now some gaps remain. The presentation will begin with a few brief comments. The introduction of so-called metamaterials around the year 2000 provided a new stimulus, particularly for dynamical response. The first “serious” result to be presented here is the development of an explicit general formula for effective response of a randomly inhomogeneous medium, based on a definition of effective properties relating ensemble averages of field variables. In making use of the material’s Green’s function it is restricted to linear relations but otherwise applies to a wide range of properties and phenomena. Its utility for explicit computation is limited but it demonstrates, quite conclusively, the inevitable existence of many constitutive couplings previously unsuspected or at least un-noticed. The remainder of the talk will be devoted to approximation via a stochastic stationary principle, including some results so far not submitted for publication.

Piano Recital – Tamara Kokilashvili

Tamara Kokilashvili is an accomplished pianist. She was recently interviewed as part of the Isaac Newton Institute podcast series about the influence of mathematics on her music: <https://www.newton.ac.uk/media/podcasts/post/episode-16/>

Programme

L.V. Beethoven - Sonata No.26 in E-Flat Major, Op. 81a, “Les Adieux”
F. Schubert - 3 Moments Musicaux, Op. 94, D.780
F. Chopin - Nocturne in F-sharp Major, Op.15, No. 2
F. Chopin - Scherzo in C-sharp minor, Op. 39, No.3

W. A. Mozart - Fantasia in C minor, K.396
F. Chopin - Polonaise-Fantasia in A-flat Major, Op. 61
C. Debussy - Estampes

List of Participants

University of York

Victoria Gould

University of Nottingham

Madalin Guta

University of Cambridge

John Willis

University of Liverpool

Alexander Movchan

Natasha Movchan

Eskişehir Technical University, Türkiye

Nihal Ege

Bariş Erbaş

Ivane Javakhishvili Tbilisi State University, Georgia

Natalia Chinchaladze

Grigori Giorgadze

Gega Gulagashvili

Giorgi Makatsaria

Kutaisi International University, Georgia

Lasha Ephremidze

Sami Shamoon College of Engineering, Ash- dod, Israel

Vladi Frid

University of Augsburg, Germany

Malte A. Peter

University of Trento, Italy

Davide Bigoni

Prifysgol Abertawe, Swansea University

Edwin Beggs

Damian Bimbenet

Jonathan Davies

Lukas Ertl

Kristian Evans

Antonella Giorgio

Qikai Lu

Xinwei Li

Manab Mukherjee

Bingqi Wang

Zhaohang Wang

Yi Xu

Prifysgol Aberystwyth University

Zachary Bufton

Simon Cox

Tudur Davies

D. Gwion Evans

Taliesin Griffith

Shubh Joshi

Kim Kenobi

Jukka Kiukas

Gennady Mishuris

Helen MacDougall

Rory McCranor

Alex Pitchford

William Townsend

Adam Vellender

Prifysgol Caerdydd, Cardiff University

Tobias Beran

James Binnie

Gabriela Filipkowska

Harry Foster

Andrei Gagarin

Erin-Jana Hoare

Harry Hylock

Ghada Shuker Jameel

Vincent Knight

Matthew Lettington

Zhonghao Lyu

Xiangyun Meng

John Pryce

Prachi Sahjwani

Karl Michael Schmidt

Jiaxuan Wang

Fan Wu

Zhiqin Yang

Alexandra Zverovich