# Gregynog 2026 Timetable

## Monday 18th May – Seminar Room 1

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|---|---|---|
| 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

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|---|---|---|---|---|
| 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 radiations: 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

| Time | Seminar Room 1 | Speaker | Seminar Room 2 | Speaker |
|---|---|---|---|---|
| 8:00 – 9:00 | Breakfast: Dining Room | | | |
| 9:00 – 9:50 | Diameter of pseudo-finite semigroups | Victoria Gould | | |
| 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 | Effective response of randomly inhomogeneous media | John Willis | | |
| 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 $\mathrm{End}(A)$ 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

$$S_n, \mathrm{End}(S_n), \mathrm{End}(\mathrm{End}(S_n)), \ldots$$

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 procedures 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

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W. A. Mozart - Fantasia in C minor, K.396
F. Chopin - Polonaise–Fantasie 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

**Eskşehir 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, Ashdod, 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