Discrete spectrum, essential influence, continuous support

A day in honour of Marco Marletta

24 June 2026
Isaac Newton Institute, Cambridge

Book of abstracts

All talks are in Seminar Room 1, Isaac Newton Institute for Mathematical Sciences, Cambridge.

Scientific organisers: Matteo Capoferri (Università degli Studi di Milano and Heriot-Watt University) and Sabine Boegli (Durham University)

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Wednesday 24 June 2026

09:30–09:55: Registration

09:55–10:00: Opening remarks

10:00–10:30

Christiane Tretter — University of Bern

Challenges for non-selfadjoint spectral problems in analysis and computation

Non-selfadjoint spectral problems appear frequently in a wide range of applications. Reliable information on their spectra is therefore crucial, yet extremely difficult to obtain. These challenges have been the driving force of my more than 25 years of successful collaboration with Marco. The most recent highlight on our journey to master problems such as spectral pollution or spectral invisibility is the concept of essential numerical range for unbounded linear operators with its rich theory and wide impact for spectral approximations of PDEs by projection methods or domain truncation methods, as well as striking applications e.g. to Maxwell problems with conductivity

(joint work with S. Boegli, M. Marletta, and F. Ferraresso)

10:30–11:00

Matthew Colbrook — University of Cambridge

Can AI Compute Marco's Favourite Eigenvalues? A Verified Adventure in Spectral Computation

Marco Marletta's work has repeatedly shown that eigenvalue problems can be both mathematically beautiful and computationally treacherous. In this talk I will take Marco's two favourite eigenvalues (confirmed by email!): one self-adjoint problem, which is relatively well behaved, and one non-normal problem, where the spectrum is much less forgiving.

Both examples arise from natural computational questions with links to applications, in the spirit of Marco's broad influence on spectral theory, differential operators, operator pencils, and mathematical physics. The twist is that I will try to compute—and rigorously verify—the relevant eigenvalues to ten decimal places using an AI-assisted workflow driven entirely by prompts.

The resulting experiment is part mathematics, part live cautionary tale, and part birthday tribute. It asks what AI can already do for spectral computation, where it remains dangerously overconfident, and what a trustworthy future for computer-assisted spectral analysis might look like. **WARNING**: Everything in this talk — except the speaker (and responsibility for errors?) — was AI-generated.

11:00–11:30: Coffee break

11:30–12:00

Sabine Boegli — **Durham University**

Numerical range methods for Schrödinger operators

In this talk I will demonstrate how numerical range methods can be used to bound not only individual eigenvalues (which is classical) but also eigenvalue sums and even the number of discrete eigenvalues. By applying the results to Schrödinger operators, we find a generalisation of the Cwikel-Lieb-Rozenblum (CLR) inequality for complex-valued potentials. This talk is based on joint work with Sukrid Petpradittha (Durham).

12:00–12:30

Francesco Ferraresso — **Università di Verona**

A model (wave)guide: about Marco, Maxwell, and cylindrical ends

I will present some recent joint work with Marco about the essential spectrum of the Maxwell system with 'asymptotically locally constant coefficients' in unbounded domains with finitely many straight cylindrical ends. I will show that the essential spectrum can be retrieved as the union of the essential spectra of a suitably defined Maxwell operator restricted to each cylindrical end. The analysis is particularly delicate as the direct application of standard techniques such as the Dirichlet-Neumann bracketing or localization arguments is not possible. Most importantly, I will discuss how Marco enabled me to grow as a researcher during my postdoc in Cardiff.

12:30–14:00: Lunch break

We will take speakers for lunch at Churchill College — other participants are welcome to join at their own expenses.

14:00–14:30

Ian Wood — **University of Kent**

Some spectral results for non-selfadjoint Maxwell problems

This talk will review some spectral results for non-selfadjoint Maxwell problems. In particular, we will consider the time-harmonic Maxwell equations with two half-spaces separated by a flat interface. The two half-spaces are filled with media whose electric permittivity is frequency-dependent and varies as a function of the distance from the interface only. No specific model for the frequency dependence is assumed. For the associated operator pencil, we characterise subsets of the resolvent set and separate subsets of the Weyl spectrum corresponding to radiation away from the interface and along the interface, respectively. If the media are periodic in the direction orthogonal to the interface, a more explicit description of these sets can be given in terms of Floquet theory of related Sturm-Liouville equations.

14:30–15:00

Beatrice Pelloni — Heriot-Watt University

Spectra and surprises of third order differential operators

I will start from simple linear third-order boundary value problems, and consider their spectrum. In particular, I will show surprising phenomena that appear unexpectedly in the properties of the spectrum and in the regularity of the solution, depending on the choice of boundary conditions and on the precise regularity of the initial condition.

15:00–15:30

Lyonell Boulton — Heriot-Watt University

Pseudospectrum and pseudo-modes: symmetries and asymmetries

The pseudospectrum of a linear operator encodes information about the stability of its spectrum. When the latter is real, the pseudospectrum characterises departure from selfadjointness and well-posedness of the associated time-evolution equation. For unbounded operators, this realises in concrete manner through the shape of the pseudospectrum at infinity and the corresponding resolvent norm asymptotics. Most rigorous results concerning these asymptotics for differential operators depend upon the construction of pseudo-modes. Broadly, the systematic construction of these has been either semi-classical or via an evolved form of the WKB method. Unfortunately, both approaches lead to pseudo-modes which are localised and therefore blind to boundary conditions. In this talk we will discuss resolvent norm asymptotics for highly symmetric differential operators, when an interaction of boundary and transmission conditions is the reason for ill-posedness of the time-evolution. We will see how, for operators with a dislocation, pseudo-modes are created by breaking the symmetry of this interaction.

During the talk I will report on joint work conducted with Prof. Marletta from 2019-2024, and more recently with R. Constable, C. Drysdale, D. Krejčiřík and T. Nguyen Duc.

15:30–16:00: Coffee break

16:00–16:30

Michael Levitin — University of Reading

The exterior Steklov problem

We will discuss various formulations of the Steklov eigenvalue problem in an exterior Euclidean domain, concentrating on resulting geometric inequalities and differences with the classical Steklov problem in a bounded domain.

16:30–17:00

Dmitri Vassiliev — **University College London**

The operator curl acting on a closed 3-manifold: spectral analysis

We study the spectrum of the operator curl acting on a connected oriented closed Riemannian 3-manifold. The spectrum is asymmetric about zero and this spectral asymmetry is the focus of our analysis. Spectral asymmetry is a major subject in pure mathematics and theoretical physics. The traditional measure of spectral asymmetry is the so-called eta invariant, a real number. The classical definition of the eta invariant is by means of analytic continuation of the eta function, an analogue of the Riemann zeta function for non-semi-bounded operators. We prove that the eta invariant for the operator curl can equivalently be obtained as the trace of the difference of positive and negative spectral projections, appropriately regularised. Our construction is direct, in the sense that it does not involve analytic continuation, and is based on the use of pseudodifferential techniques. This is joint work with Giovanni Bracchi and Matteo Capoferri.

17:00–17:10: Closing remarks and goodbyes