Three Days on Dynamics, Geometry and Analysis

University of Melbourne, Australia
May 4-6, 2026

Analytic Microlocal Analysis and Inverse Problems

Speaker: Leonard Busch (University of Amsterdam)

Abstract. Does knowledge of the volumes of embedded minimal hypersurfaces in a compact Riemannian manifold (M, g) with boundary uniquely determine the metric g? By measuring at the surface of the earth the response of an induced seismic wave, can one uniquely recover the speed of sound below ground? What bridges these otherwise unrelated inverse problems is that both naturally give rise to transforms that are Fourier integral operators (FIOs). Thereby motivated, upon presenting basic tools of analytic microlocal analysis relating support and analytic wavefront set, we develop a recipe that reduces uniqueness questions to the following analytic microlocal statement that we prove: one can recover the analytic wavefront set of a distribution from its image under a general class of elliptic analytic FIO. Exploiting this framework, we show that the conformal perturbation of an analytic metric can be recovered in a Hölder stable way from minimal hypersurface volume data, provided a sufficiently rich family of minimal hypersurfaces exists. For the seismic inversion problem we show that perturbations of an analytic sound speed are uniquely determined by boundary measurements under some geometric conditions. This talk is based partly on joint work with Tony Liimatainen, Mikko Salo and Leo Tzou.

Pathwise well-posedness of stochastic nonlinear dispersive equations with multiplicative noises

Speaker: Andreia Chapouto (Monash University)

Abstract. Over the last decades, the well-posedness issue of stochastic dispersive PDEs with multiplicative noises has been extensively studied. However, this study was done primarily from the viewpoint of Itô solution theory, and pathwise well-posedness remained completely open. In this talk, I will present the first pathwise well-posedness results for stochastic nonlinear wave equations (SNLW) and stochastic nonlinear Schrodinger equations (SNLS) with multiplicative white-in-time/coloured-in-space noise. Here, we combine the operator-value controlled rough paths adapted to dispersive flows, together with random

tensor estimates, and the Fourier restriction norm method adapted to controlled rough paths.

TBD

Speaker: Yann Chaubet (Nantes Université)

Abstract. TBD.

The spectral gap of the Laplacian with a potential in convex domains in hyperbolic space

Speaker: Julie Clutterbuck (Monash University)

Abstract. We consider the problem of minimising the difference between the first two Dirichlet eigenvalues for a domain in hyperbolic space. In the Euclidean setting, the gap for any convex potential is bounded below by the gap for a constant potential. We show that this is not the case in hyperbolic space, via an explicit example.

This is joint work with Xuan Hien Nguyen and Frieder Jaeckel.

Equivalence of Sobolev norms for Kolmogorov operators with scaling-critical drift

Speaker: Xuan Duong (Macquarie University)

Abstract. We consider the ordinary or fractional Laplacian plus a homogeneous, scaling-critical drift term. This operator is non-symmetric but homogeneous and generates scales of L^p-Sobolev spaces which we compare with the ordinary homogeneous Sobolev spaces. Unlike in previous studies concerning Hardy operators, i.e., ordinary or fractional Laplacians plus scaling-critical scalar perturbations, handling the drift term requires an additional, possibly technical, restriction on the range of comparable Sobolev spaces, which is related to the unavailability of gradient bounds for the associated semigroup. This is a joint work with The Anh Bui and Konstantin Merz in the journal Nonlinearity 2026.

Well-posedness of the Navier-Stokes equation in the Besov space

Speaker: Zihua Guo (Monash University)

Abstract. The Cauchy problem to the barotropic compressible Navier-Stokes equation in critical Besov spaces is considered. We prove global well-posedness with small data in the optimal critical Besov space assuming some low frequency condition on the initial density and momentum. The main ingredients of the proof consist of: a novel nonlinear transform that uses momentum formulation for low-frequency and effective velocity method for high frequency, and estimate of parabolic-dispersive semi group that enables a L^p-framework for low

frequency. The harmonic analysis tools, in particular, Hardy space boundedness for the wave operator, has played a fundamental role in the proof. We will also talk about our recent results on the 3D rotating incompressible Navier-Stokes equation.

The scattering map for Schrödinger evolution with a time-dependent metric

Speaker: Andrew Hassell (Australian National University)

Abstract. We consider global solutions $u(x,t)$ to the Schrödinger equation

$$\partial_t u = -i\Delta_{g(t)} u,$$

where $g(t)$ is a family of metrics on $\mathbb{R}^n$ and $\Delta_{g(t)}$ is the associated Laplace-Beltrami operator. For simplicity we assume that g agrees with the Euclidean metric outside of a compact set in spacetime, and that $g(t)$ is nontrapping for each t.

It is known that global solutions have a leading asymptotic as t tends to either $\pm\infty$:

$$u \sim t^{-n/2} e^{i|x|^2/4t} f_\pm(x/t), \quad t \to \pm\infty.$$

The functions $f_\pm$ are known as asymptotic data or final states, and the scattering map S by definition maps $f_- \to f_+$.

With Qiuye Jia (ANU), building on previous work with Gell-Redman (Melbourne) and Gomes (Helsinki), we have shown that S is a Fourier integral operator of a new type, namely a '1-cusp' FIO, where 1-cusp refers to a geometric structure at infinity on the space on which $f_\pm$ are defined. In this talk, I will concentrate on discussing the geometry of classical rays, and try to explain how a clear understanding of this geometry aids in proving an analytic result of this type.

Expanding Ricci solitons, minimal surfaces and Higgs bundles

Speaker: Ramiro Lafuente (University of Queensland)

Abstract. In this talk, I will report on recent joint work with Adam Thompson (Muenster), in which we produce multi-parameter families of expanding Ricci solitons (including Einstein manifolds) using a symmetry, dimensional-reduction Ansatz. The equations reduce to a coupled system involving a harmonic map equation and minimal surfaces in non-compact symmetric spaces. To produce solutions we exploit a new link with Hitchin's theory of Higgs bundles. I will assume no familiarity with any of these concepts throughout the talk.

Semi-discrete linear curvature flow of piecewise linear curves with and without boundaries

Speaker: James McCoy (Royal Melbourne Institute of Technology)

Abstract. Situations where curvature flow equations are linear are exceptionally rare. One interesting such situation arises from a definition of "curvature" for piecewise linear curves. With this definition in hand, one can consider curvature flow of arbitrary even spatial order as a system of linear ordinary differential equations. I will describe settings with and without boundary including flows of both parabolic and hyperbolic type. One can also flow one curve to another via variants of such flows, potentially through specific transition states, related to a problem of Yau in the setting of smooth, closed curves. This is joint work with Jahne Meyer and Rohan St Hill.

Quasilinear parabolic SPDE with critical data

Speaker: Pierre Portal (Australian National University)

Abstract. We present a complete well-posedness result (uniqueness, global existence, maximal regularity) for divergence form quasilinear parabolic SPDE over full space, with transport noise of Itô type, and with bounded uniformly continuous data. Our solutions are bounded, respecting the scaling of the deterministic problem. This is in contrast with other results in the literature that deal with subcritical data and bounded domains (or tori). Our approach can be described as a bootstrap from these subcritical results, combining them with a critical linear stochastic result, and a critical quasilinear deterministic result. This is joint work with Pascal Auscher and Sebastian Bechtel (Paris-Saclay).