At the Interface of Geometry and Analysis

Department of Mathematics
University of Auckland

19-21 February 2025

Schedule

Time/Date	Wednesday 19 Feb	Thursday 20 Feb	Friday 21 Feb
10am	Melrose: Lecture 1	Melrose: Lecture 3	Le
11am	Refreshments	Refreshments	Refreshments
11:30am	Melrose: Lecture 2	Melrose: Lecture 4	Blitz
2pm	Li		
3pm	Dai		Melrose: Colloquium
4pm			Reception

All the talks are in room **302-G20**, except for Prof. Melrose's colloquium on Friday at 3pm which is in room **303-G23**. The reception after the colloquium will be held in the tea room on level 4 of the Science building (303).

The **workshop dinner** will be at Mudbrick Vineyard and Restaurant on Waiheke Island on Thursday 20 February at 6:30pm. Please indicate your interest when registering.

Lectures by Richard Melrose (MIT)

Title: Rings and Modules of Pseudodifferential Operators

Abstract:

(a) Operators and kernels

(b) Manifolds with corners

(c) Compactification and resolution

(d) Some applications

Public Lecture (Colloquium)

Title: A modern view of Huygens principle

Abstract: In the 17th century, Christiaan Huygens proposed an explanation for the evolution of wave fronts in propagation phenomena, for instance for light. Despite its success this has some obvious flaws, even after modifications by Augustin-Jean Fresnel in the 19th century. Around 55 years ago Lars Hörmander gave an elegant and full explanation. I will describe this and some subsequent developments, as time permits.

Abstracts

Speaker: Qiongling Li (Chern Institute of Mathematics, Nankai University)

Title: Index and total curvature of minimal surfaces in noncompact symmetric spaces and wild harmonic bundles

Abstract: We prove two main theorems about equivariant minimal surfaces in arbitrary non-positively curved symmetric spaces extending classical results on minimal surfaces in Euclidean space. First, we show that a complete equivariant branched immersed minimal surface in a nonpositively curved symmetric space of finite total curvature must be of finite Morse index. It is a generalization of the theorem by Fischer-Colbrie, Gulliver-Lawson, and Nayatani for complete minimal surfaces in Euclidean space.

Secondly, we show that a complete equivariant minimal surface in a nonpositively curved symmetric space is of finite total curvature if and only if it arises from a wild harmonic bundle over a compact Riemann surface with finite punctures. Moreover, we deduce the Jorge-Meeks type formula of the total curvature and show it is an integer multiple of $2\pi/N$ for N only depending on the symmetric space. It is a generalization of the theorem by Chern-Osserman for complete minimal surfaces in Euclidean n-space.

This is joint work with Takuro Mochizuki (RIMS).

Speaker: Song Dai (Tianjin University)

Title: Existence of harmonic metrics on nilpotent Higgs bundles over noncompact Riemann surfaces

Abstract: In this talk, we will first introduce the notions of Higgs bundles and harmonic metrics. Then we will survey some known results on the existence of harmonic metrics over noncompact Riemann surfaces. Our new result is that given a generically regular nilpotent harmonic bundle, there exists a (unique) maximal harmonic metric on the corresponding graded Higgs bundle. We will sketch the proof and show some applications.

This is a joint work with Qiongling Li.

Speaker: Samuel Blitz (Masaryk University)

Title: Some necessary conditions for Kerr-de Sitter spacetimes

Abstract: Kerr-de Sitter spacetimes are physically interesting, as they form a general family of physical black holes. It has been shown by Frolov, Krtouš, and Kubizňák that if a spacetime with positive cosmological constant admits a principal conformal Killing-Yano 2-form, then the spacetime is a Kerr-NUT-de Sitter spacetime, which is a generalization of the Kerr-de Sitter spacetime. Using conformal methods, we construct a series of constraint equations on the conformal infinity of a spacetime to admit such a tensor, and hence are necessary conditions for the spacetime to be asymptotically Kerr-de Sitter.

Speaker: Ian Le (Australian National University)

Title: Legendrian knots, wild character varieties, and cluster structures

Abstract: In this expository talk, I'll explain how any wild character variety can be interpreted as a moduli space of constructible sheaves with prescribed microsupport. This microsupport will be a Legendrian knot/link in the cosphere bundle of a surface. This point of view is convenient for constructing cluster structures on wild character varieties. I will introduce all the objects involved (wild character varieties, microsupport, cluster structure) and illustrate using examples.