Titles and Abstracts

Guo Chuan Thiang (Peking University)

Trace formulae for large-scale indices

I will revisit the idea of coarse index theory, with the aim of explaining how it numerically measures quantized large-scale properties of low-lying spectrum. Using fundamental examples from physics, I will also discuss traces of commutators and explain how they can be rationally quantized.

Jianchao Wu (Fudan University)

Hilbert-Hadamard spaces and the equivariant coarse Novikov conjecture

A major theme in noncommutative geometry is centered around a circle of K-theoretic conjectures that are inspired by the Novikov conjecture and include the (rational) strong Novikov conjecture, the (coarse) Baum-Connes conjecture, etc. In addition to yielding some of the best positive results to the Novikov conjecture, these conjectures also give powerful results regarding positive scalar curvature. A fruitful idea in the study of these conjectures is the condition of coarse embeddability of groups and metric spaces into well-behaved "model" spaces, such as the Hilbert space or other "nice" Banach spaces. Inspired by an earlier result (joint with Sherry Gong and Guoliang Yu) on the rational strong Novikov conjecture, we consider coarse embeddability into Hilbert-Hadamard spaces, which are a kind of (typically infinite dimensional) nonpositively curved manifold-like metric spaces. In a joint work with Liang Guo, Qin Wang, and Guoliang Yu, we verify the rational equivariant coarse Novikov conjecture for metric spaces that are equivariantly embeddable into admissible Hilbert-Hadamard spaces and have equivariant bounded geometry.

Tsuyoshi Kato (Kyoto University)

Homotopy type of finitely propagated unitary operators and its applications

I will explain our computational results of homotopy type of finitely propagated unitary operators. As the applications, we induce qualitative properties on distributions of zeros of vector fields and of critical points of Morse functions over amenable covering spaces of compact manifolds. These are based on joint works with D. Kishimoto and M. Tsutaya.

Adam Rennie (University of Wollongong)

The Levi-Civita connection on noncommutative differential forms

By combining Hilbert module and algebraic techniques, we give necessary and sufficient conditions for the existence of Hermitian and torsion-free connections on noncommutative one-forms, such as those arising from spectral triples. With additional structure we give a sufficient condition for uniqueness. Our methods are constructive, use standard definitions, and allow computation of curvature with comparable difficulty to the differential geometry case. Joint work with Bram Mesland. arXiv:2403.13735 and 2404.07957

Xiang Tang (Washington University)

Symplectic Morse Theory and Witten Deformation

In this talk, we will introduce a Morse type cohomology for symplectic manifolds using gradient flows and integration of the symplectic form over spaces of gradient flow lines. We will study this symplectic Morse cohomology using the Witten deformation method. In particular, we will explain that the symplectic Morse cohomology is isomorphic to the cohomology of differential forms introduced by Tsai, Tseng, and Yau for symplectic manifolds. This talk is based on joint works with David Clausen and Li-Sheng Tseng.

Rufus Willett (University of Hawaii)

The HK and Baum-Connes conjectures

K-theory C*-algebras associated to groupoids (for example, holonomy groupoids of foliations or coarse groupoids of universal covers) are important as receptacles for generalized indices. However, the K-theory is often difficult to compute, and groupoid homology is easier to deal with due to the presence of tools from homological algebra. The two are related by the HK (Homology and K-theory) conjecture of Matui. I will sketch how one can use the Baum-Connes conjecture in C*-algebra K-theory to relate groupoid homology and K-theory, particularly in the setting of sheaf theory as employed by Baum, Raven, and Schneider around twenty years ago. Based on joint work with Robin Deeley.

Mathai Varghese (University of Adelaide)

Projective families index for small bundle gerbes

I will discuss a more general context for the projective families index, which involves small bundle gerbes. These are essentially finite dimensional bundle gerbes. I will show that there are many small bundle gerbes with non-torsion Dixmier-Douady class, which uses some recent results. Some applications to positive scalar curvature will also be discussed. This is joint work with Richard Melrose (MIT).

Fei Han (National University of Singapore)

Generalizations of two classical theorems in Riemannian Geometry

The classical theorem in Riemannian geometry, the Myers's theorem, says that a compact Riemannian manifold with positive Ricci curvature has finite fundamental group. Another classical theorem, the Bochner theorem, asserts that a compact Riemannian manifold with negative Ricci curvature has finite isometry group. In this talk, I will show how to generalize these two classical theorems to the almost nonnegative Ricci curvature and almost nonpositive Ricci curvature cases respectively. Our main tools are the Atiyah-Singer index theorem and certain rigidity theorems. This represents our joint work with Xiaoyang Chen and Jian Ge.

Angus Alexander (University of Wollongong)

Levinson's theorem as an index pairing

For Schrödinger operators on $L^2(\mathbb{R}^n)$, the wave operators of scattering theory can be shown to have a rather simple universal form. This form allows us to recognise the classical Levinson's theorem, which computes the number of eigenvalues, as an index pairing between the K-theory class of the scattering operator and an appropriate spectral triple. A careful analysis of the high and low energy behaviour of the scattering operator allows us to use the topological flexibility of this framework construct an explicit representative of the K-theory class of the scattering operator and to prove Levinson's theorem in all dimensions.

Galina Levitina (Australian National University)

Traces on simply generated ideals

In this talk we present a unified approach to construction of traces on simply generated ideals. This approach gives rise to a bijective mapping between classes of all (continuous) traces on two different simply generated ideals. Notably, this mapping fails to be a bijection between classes of Dixmier traces.

Schedule

	Monday	Tuesday	Wednesday	Thursday
9:30-10:30	Fei Han	Tsuyoshi Kato	Mathai Varghese	Adam Rennie
10:45-11:45	Rufus Willett	Jianchao Wu	Xiang Tang	Galina Levitina
12:00-1:30	Lunch			
1:30-2:30	Guo Chuan Thiang	Student Session -Angus Alexander		
2:45-3:45				