THE FIELDS INSTITUTE
FOR RESEARCH IN MATHEMATICAL SCIENCES

ABSTRACTS 1.2

DAVID HANDELMAN
University of Ottawa

Two-sided noncommutative fractional linear transformations

Let C and D be two square complex matrices of size n. Define the (two-sided) fractional linear transformation $\phi\; X \mapsto (I - CXD)^{-1}$, which in general is only a densely defined map from the square matrices to itself. Motivated by problems of determing harmonic functions (aka traces on a nice dimension group) on certain Markov chains, we study *phi*'s fixed points and their nature.

For example, if ϕ admits more than $C(2n, n)$ fixed points, it admits a topological disk of fixed points; moreover, among those ϕ (which depend of course on the choice of C and D) which admit a fixed point, the set of them which have exactly $C(2n, n)$ fixed points is open and dense (so this is a generic property).

The set of fixed points of a particular ϕ admits the structure of a graph (with vertices being the fixed points of course). Generically it is connected, and there are some other restrictions on the graph. Generically (among those which have a fixed point) there is both an attractive and a repulsive fixed point, although it is easy to construct examples which have one but not the other. There are various other properties of the fixed points, but the basic idea is that if you can find one of them, you can find the rest.

XIAODONG HU
University of Toronto

Spectral triples and transversally elliptic operators

We present a spectral triple corresponding to a noncommutative algebra and a transversally elliptic operator relative to a compact Lie group action. We show how to compute the Connes-Moscovici local index formula for such a spectral triple. We also study the geometry determined by it.

CRISTIAN IVANESCU
University of Toronto

On the classification of simple C-algebras which are inductive limits of continuous-trace C*-algebras whose spectrum is homeomorphic to the closed interval [0,1]*

A classification is presented of certain separable nuclear C*-algebras not necessarily of real rank zero. In particular, a classification of those stably AI algebras which are inductive limits of hereditary sub-C*-algebras of interval algebras is obtained. Also an isomorphism theorem for building blocks will be discussed. This isomorphism theorem is an ingredient of the proof of the isomorphism theorem for the inductive limits.

MASOUD KHALKHALI
University of Western Ontario

From transverse index theory to Hopf-cyclic cohomology via the local index formula

In this talk I will explain the path, traversed by Connes and Moscovici, that led to the discovery of a cyclic cohomology theory for Hopf algebras. I will then describe a new approach based on invariant cyclic cohomology that led to extensions of this theory by myself and my collaborators. I will also explain a new definition of a "quantum groupoid" dictated by cyclic cohomology theory.

DAVID KRIBS
University of Guelph

Non-selfadjoint directed graph operator algebras

Every directed graph generates a family of operator algebras. This class has received recent attention because it has been possible to link deep properties of the algebras with simple properties of the underlying directed graphs, and, at the same time, many new interesting examples have been discovered. The C*-algebras in this class are often referred to as Cuntz-Krieger or C-K-Toeplitz graph algebras. On the other hand, recent advances have opened the door for studying non-selfadjoint versions of these algebras. I shall discuss my work on these algebras, emphasizing joint works with Michael Jury, Elias Katsoulis and Stephen Power.

DAN KUCEROVSKY
University of New Brunswick

Absorption: What is it, where do we find it, and what is it good for?

We define the absorption property, give a list of algebras giving rise to this property – including certain type I algebras – and give some applications

PHILIPPE LAROCQUE
University of Waterloo

A model for λ-commuting isometries

In this talk, I will describe a model for m isometries satisfying $V_iV_j = \lambda_{i,j}V_jV_i$ (in a Hilbert space). The main result is that for (almost) every such m-tuple, there exists a subset M of $\mathbb{Z}^m$ which can be chosen so that m isometries can be defined on $\ell^2(M)$ and these isometries are approximately unitarily equivalent to the original ones. I will also briefly discuss a generalisation of this result for representations of abelian semigroups (the above is a twisted representation of $\mathbb{Z}_+^m$).

HANFENG LI
University of Toronto

On the C^*-algebras and smooth algebras generated by projective representations of finitely generated abelian groups

Given a finitely generated abelian group and a 2-cocyle on it, one can consider the twisted group algebra and its smooth counterpart. This class of algebras includes the noncommutative tori as the special case where the group is torsion-free.

We shall show that every such algebra is Morita equivalent to the direct sum of finitely many copies of some noncommutative torus. As consequences, we extend some known results about noncommutative tori such as the description of derivations and properties of the ordered K0-groups to this class of algebras. We also classify these algebras up to Morita equvalence at the C*-algebra level, in terms of K-theory and centers.

JAMES A. MINGO
Queen's University

Fluctuations of Eigenvalue distributions and Orthogonal Polynomials

In 1998, Kurt Johansson showed that the eigenvalue fluctuations of a class of random matrices are asymptotically Gaussian and the fluctuations can be diagonalized by Chebyshev polynomials.

Thierry Cabanal-Duvillard showed how to extend the result to an independent family of self-adjoint Gaussian random matrices. I will show how this can be extended to an independent family of Wishart matrices. This is joint work with T. Kusalik, A. Nica, and R. Speicher.

MATHIAS NEUFANG
Carleton University

Completely isometric representations of mutiplier algebras

We present a common representation theoretical framework for various Banach algebras arising in abstract harmonic analysis, such as the measure algebra $M(G)$ and the completely bounded multipliers of the Fourier algebra $M_{cb}A(G)$ for a locally compact group G. The image algebras are intrinsically characterized as certain normal completely bounded bimodule maps on $B(L_2(G))$. The study of our representations, in particular our bicommutant results, reveals various intriguing properties of the algebras. Moreover, it provides a very simple description of their (Kac algebraic) duality. We finally discuss several extensions of our program, especially to non-normal maps.

Part of this work is joint with Zhong-Jin Ruan and Nico Spronk.

N. CHRISTOPHER PHILLIPS
University of Oregon

Crossed products by actions with the tracial Rokhlin property

The tracial Rokhlin property for an action of a finite group on a C*-algebra, or for an automorphism (action of $\mathbb{Z}$), differs from the usual Rokhlin property in that a “small” leftover projection is permitted. Formally, it is related to the usual Rokhlin property in roughly the same way that Lin’s definition of a tracially AF C*-algebra is related to the definition of an AF algebra. It is easy to produce examples showing that, for finite groups, the tracial Rokhlin property does not imply the Rokhlin property. For actions of $\mathbb{Z}$, the situation is unclear.

We consider the structure of crossed products $C^*(G, A, \alpha)$ for $G = \mathbb{Z}/n\mathbb{Z}$ or $G = \mathbb{Z}$, for A simple and tracially AF, and for actions α with the tracial Rokhlin property. When $G = \mathbb{Z}/n\mathbb{Z}$ and A is unital, $C^*(G, A, \alpha)$ is again tracially AF. When $G = \mathbb{Z}$ and A is unital, $C^*(G, A, \alpha)$ has real rank zero and stable rank one, and the order on projections over $C^*(G, A, \alpha)$ is determined by traces. When $G = \mathbb{Z}$ and A is unital and has a unique tracial state, we believe we are close to proving that $C^*(G, A, \alpha)$ is again tracially AF.

Applying Lin’s classification theorem, we prove, or hope to prove, that various C*-algebras are in the class for which Elliott’s classification is known to hold, including:

- All simple higher dimensional noncommutative toruses.
- Crossed products by noncommutative Furstenberg transformations.
- Simple quotients of the C*-algebras of certain discrete subgroups of nilpotent Lie groups.
- Special cases of transformation group C*-algebras of free minimal actions of $\mathbb{Z}^d$ on the Cantor set.

The first talk will describe the background, give the definitions and some results, and describe the consequences. The second talk will give some indication of the ideas of the proofs.

Some of this is joint work with Hiroyuki Osaka

ANA SAVU
University of Toronto

Closed functions versus exact functions in interacting particle systems

The main difficulty in deriving the hydrodynamic scaling limit of a non-gradient model is to show that the Hilbert space of ”closed functions” decomposes as the direct sum of the Hilbert space of ”exact functions” and an extra direction.

I will discuss this problem in the case of the fourth order Ginzburg-Landau model for surface diffusion. Algebraic topology connections will also be outlined.

ROLAND SPEICHER
Queen's University

Fluctuations of random matrices and cyclic Fock spaces

I will report on a recent joint work with J. Mingo about the description of global fluctuations of Gaussian and Wishart random matrices. In particular, I will present an operator-algebraic description in terms of cyclic Fock spaces which allows to diagonalize these fluctuations.

ANDREW TOMS
The Fields Institute

On the classifiability of nuclear C-algebras*

The Elliott invariant has been very successful in classifying simple nuclear C*-algebras over the past twenty-five years. Recent examples stemming from the work of Villadsen have shown that the assumptions of simplicity, nuclearity, and infinite-dimensionality will not suffice for the classification of C*-algebras via this invariant. We present some such examples, and discuss progress on the search for a maximal class of C*-algebras classified by the Elliott invariant.