Operator Algebras
Algèbres d'opérateurs
(Org: **George Elliott** (Toronto) and/et **Mikael Pichot** (McGill))

MAN-DUEN CHOI, University of Toronto
The Principle of Locality made simpler but harder

In physics, the Principle of Locality states that an object is influenced directly only by its immediate surroundings. This could be transformed to a simple mathematical statement of NO wisdom at all. Nevertheless, with extravagant assumption (on the obvious truth) and fascinating explanation (of the ultimate nonsense), the Principle may become a big Law/Theory/Theorem or an incredible Paradox to shake your heart/body.

This is an expository talk of my own adventure in the quantum wonderland (concerning the mathematical problems on direct sums and tensor products – the basic structure in the theory of operator algebras). No working knowledge of quantum information is required in this talk.

RAPHAEL CLOUATRE, University of Manitoba
Absolute continuity for commuting row contractions

Absolutely continuous Hilbert space contractions admit a functional calculus which is weak-$*$ continuous. Over the years, this finer continuity property has been exploited with great success to tackle a variety of important problems. At the root of this success is the fact that absolutely continuous contractions can be understood through the dual space of the disc algebra $A(\mathbb{D})$.

Turning to the topic of multivariate operator theory, we investigate the analogous notion of absolutely continuous commuting row contractions, and provide a complete characterization for it in measure theoretic terms. On the surface, the statements of our results are reminiscent of the corresponding classical single variable theorems. However, the underlying operator algebra $\mathcal{A}_d$ consists of multipliers on the Drury-Arveson space, and thus is vastly different from $A(\mathbb{D})$. In particular, it is not a uniform algebra. We highlight the new tools that must be used to circumvent this difficulty. (joint work with Ken Davidson)

KENNETH R. DAVIDSON, University of Waterloo
Ideals in a multiplier algebra on the ball

We study the ideals of the closure of the polynomial multipliers on the Drury-Arveson space. Structural results are obtained by investigating the relation between an ideal and its weak-$*$ closure, much in the spirit of the corresponding classical facts for the disc algebra. Zeros sets for multipliers are also considered and are deeply intertwined with the structure of ideals.

This is joint work with Raphaël Clouâtre.

ANDREW DEAN, Lakehead University
Classification of locally representable actions of finite dimensional quantum groups on AF C*-algebras

A K-theoretic classification of locally representable actions of finite dimensional quantum groups on AF C*-algebras will be given.

GEORGE ELLIOTT, University of Toronto
The classification of unital simple C*-algebras of finite nuclear dimension

The recent history of the (now complete) classification of unital simple C*-algebras of finite nuclear dimension (assumed to be separable—an essential hypothesis—and to satisfy the UCT—possibly redundant) is outlined. (Just the most recent part

takes up about five hundred pages, and necessary earlier work is spread out over another five hundred pages—with perhaps thirty authors directly involved.)

The question of other classes—for instance non-unital simple algebras—is still a challenging one.

DOUG FARENICK, University of Regina
Fidelity preservation in operator algebras

The notion of fidelity has its origins in communication theory, where a quantitative measure of the accuracy of information transmission is sought. Not surprisingly, this concept has carried over to quantum information theory and has, in this latter setting, a formulation involving density operators and channels. The question of which channels preserve fidelity was answered by L. Molnar in 2001. Nevertheless, researches have returned to the issue in recent years, tweaking various hypotheses. With the aim of understanding the algebraic content of Molnar's result, I will report on joint work with S. Jaques and M. Rahaman in which we introduce, for unital C*-algebras with a faithful tracial state, the notion of fidelity for pairs of positive elements of unit trace. Our main result is a characterisation of the structure of unital positive linear maps on the algebra that preserve fidelity.

REMUS FLORICEL, University of Regina
CCR subproduct systems

In this presentation, we describe the subproduct systems of a class of quasi-free quantum dynamical semigroups of the CCR algebra. This is a joint work with A. Alzulaibani.

THIERRY GIORDANO, Université d'Ottawa
$\mathbb{Z}^d$-*odometers and Cohomology*

$\mathbb{Z}$-odometers are well-known examples of Cantor minimal systems. In particular, any two orbit equivalent $\mathbb{Z}$-odometers are conjugate. In this talk, we will use two equivalent formulations of $\mathbb{Z}^d$-odometers to show that there exist orbit equivalent $\mathbb{Z}^2$-odometers which are not conjugate. It is a joint work with I. Putnam and C.F. Skau.

MICHAEL HARTZ, University of Waterloo
Completely contractive representations of multiplier algebras of Nevanlinna-Pick spaces

Nevanlinna-Pick spaces are Hilbert function spaces which mirror some of the fine structure of the classical Hardy space on the unit disc. Their multiplier algebras are an important class of non self-adjoint operator algebras. In the spirit of previous work of Agler and Douglas-Misra-Sarkar, we investigate completely contractive representations of these multiplier algebras. In particular, we obtain a dilation result from a certain positivity property of the reproducing kernels. Moreover, we give a description of all boundary representations of a particular class of multiplier algebras. This is joint work with Raphaël Clouâtre.

CRISTIAN IVANESCU, MacEwan University
The Cuntz semigroup of the tensor product of C-algebras*

We study how the Cuntz semigroup of the tensor product, $A \otimes A$, of two identical C*-algebras relates to the Cuntz semigroup of the C*-algebra A. We restrict our attention to C*-algebras which are unital, simple, nuclear, stably finite, Z-stable, satisfy the UCT, with finitely generated K-theory, trivial K_1-group and have stable rank one. This is joint work with Dan Kucerovsky (University of New Brunswick)

MATTHEW KENNEDY, University of Waterloo
An intrinsic algebraic characterization of C-simplicity for discrete groups*

A discrete group is said to be C*-simple if its reduced C*-algebra is simple. It is not difficult to see that a group with this property does not have any non-trivial normal amenable subgroups, however it was an open question for many years to determine whether the converse holds. Recent examples constructed by Le Boudec show that the answer to this question is negative, but raise the question of whether there is an intrinsic algebraic characterization of C*-simplicity. In this talk I will discuss recent work providing such a characterization.

MASOUD KHALKHALI, Western Ontario
Logarithmic Sobolev Inequalities in Noncommutative Spaces

Unlike the classical Sobolev inequality, Gross' logarithmic Sobolev inequality is dimension independent. As such it plays an important role in analysis and probability theory on infinite dimensional spaces. The noncommutative analogue of a log Sobolev inequality for C*-algebras seems to be an exceedingly difficult problem. In this talk I shall report on ongoing work and progress for noncommutative tori (joint work with S. Sadeghi).

DAVID KRIBS, University of Guelph
Private algebras in quantum information

The complementarity of finite-dimensional private and correctable subsystems in quantum cryptography and error correction is a central example of the interplay between system and environment duality in open quantum system dynamics. In this talk, I will discuss a generalized notion of private quantum subsystems at the level of von Neumann algebras and present a generalized complementarity theorem with correctable subalgebras in arbitrary dimensions. This is joint work with Jason Crann, Rupert Levene and Ivan Todorov.

DAN KUCEROVSKY, University of New Brunswick at Fredericton
Can C-algebraic quantum groups be classified by K-theory?*

We report on extending the Elliott classification program to certain classes of quantum groups. We review first our results on compact-type AF Hopf C*-algebras. In this case, we always have a tracial Haar state. Assuming a tracial Haar state is a very restrictive condition. We give classification results in the nontracial case for certain classes.

References:

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MARTINO LUPINI, California Institute of Technology
The noncommutative Poulsen simplex

The Poulsen simplex is the unique metrizable Choquet simplex with dense extreme boundary. I will explain how one can define the natural noncommutative analog of such an object in the context of operator systems.

ROBERT MARTIN, University of Cape Town
Aleksandrov-Clark theory for the Drury-Arveson multiplier algebra

The classical Aleksandrov-Clark theory for contractive analytic functions b on the unit disk studies the spectral and associated function theory of a family of rank-one unitary perturbations of the restriction of the backward shift to the deBranges-Rovnyak space $K(b)$. (Recall $K(b)$ is a reproducing kernel Hilbert space of analytic functions in the disk which is contractively contained in the Hardy space H^2).

We will present recent progress on extending this theory to the closed unit ball of the multiplier algebra of vector-valued Drury-Arveson space. This will include the development of a noncommutative Herglotz representation formula, solutions to the Gleason problem in $K(b)$, and a connection between (quasi-)extreme points and boundary representations of the Cuntz-Toeplitz algebra relative to a certain symmetrized subsystem of the Cuntz-Toeplitz operator system.

JAMIE MINGO, Queen's University
Freeness and the Partial Transpose

The partial transpose has been of interest for some time in quantum information theory. Recent joint work with Mihai Popa and Emily Redelmeier has shown that the partial transpose of a block matrix can be asymptotically free from itself. I will present some recent results on Wishart and Haar distributed unitary/orthogonal random matrices.

MATTHIAS NEUFANG, Carleton University and University Lille 1
Measures of Arens regularity and irregularity

The bidual of a Banach algebra is naturally equipped with two products, the left and right Arens products. The algebra is called Arens regular if these multiplications coincide, which is the case for all operator algebras. We shall present various ways in which one can measure the degree of Arens regularity and irregularity, considering mainly algebras associated with locally compact groups and quantum groups. This includes the affirmative solution to the Ghahramani-Lau conjecture (formulated in 1995) stating that the measure algebra of any locally compact group is strongly Arens irregular, in the sense of Dales-Lau; the latter is joint work with V. Losert, J. Pachl and J. Steprans.

ZHUANG NIU, University of Wyoming
The classification of finite simple unital nuclear C*-algebras

Consider the class of simple unital separable nuclear C*-algebras which can be rationally tracially approximated by subhomogeneous C*-algebras with one-dimensional spectra. Then the Jiang-Su stable UCT algebras in this concrete class can be classified by the Elliott invariant. On the other hand, any finite unital UCT algebra with finite nuclear dimension is actually in this class, and hence this gives a classification of the unital UCT C*-algebras with finite nuclear dimension.

The talk is based on joint works with George A. Elliott, Guihua Gong and Huaxin Lin.

ANNALISA PANATI, McGill and University of Toulon
Energy conservation, return to equilibrium and modular theory

Using methods of spectral analysis and modular theory of operator algebras, we study the energy transfers between a small system $\mathcal{S}$ and a reservoir $\mathcal{R}$ in the process of return to equilibrium. More precisely, we consider a microscopic Hamiltonian model describing a finite level quantum system S coupled to an infinitely extended thermal reservoir $\mathcal{R}$ at inverse temperature β, where the coupling strength depend on a constant λ. We consider the measures $P_{S,\lambda,t}$ and $P_{R,\lambda,t}$ obtained through a two measurement protocol at times 0 and t, for fixed λ. Assuming that the coupled system is mixing, we can show that in a suitable limit regime for λ and t, the limiting measures coincide. This result strengthens the first law of thermodynamics for open quantum systems, which is a statement concerning only the averages of $P_{S,\lambda,t}$ and $P_{R,\lambda,t}$ (joint work with V. Jaksic, J. Panangaden, C-A. Pillet).

TIMOTHY RAINONE, University of Waterloo
Noncommutative Topological Dynamics and Finiteness in C*-Crossed Products

We will discuss group actions on C*-algebras by interpreting dynamical phenomena K-theoretically, that is, by the induced actions on the K_0- group and the Cuntz semigroup. K-theoretic characterizations of minimality, topological freeness, and topological transitivity are given and used to generate examples of noncommutative systems with these properties. In the

presence of sufficiently many projections we introduce the noncommutative type semigroup which witnesses the finite or rather infinite nature of the underlying action.

EMILY REDELMEIER,

SUTANU ROY, Carleton University
Duality for convex monoids

Every C*-algebra gives rise to an effect module and a convex space of states, which are connected via Kadison duality. We explore this duality for the finite-dimensional Hopf algebras coming from finite groups. When the Hopf algebra is the function algebra or the group algebra of a finite group, the resulting state spaces form convex monoids. We will prove that both these convex monoids can be obtained from the other one by taking a coproduct of density matrices on the irreducible representations. We will also show that the same holds for a tensor product of a group and a function algebra. This is a joint work with Frank Roumen.

ANAMARIA SAVU, University of Alberta
Spectral gap of a class of unbounded, positive-definite operators

The spectra of Toeplitz operators is well understood. We use the properties of the spectra of Toeplitz operators to understand the spectra of a class of unbounded, positive-definite operators.

CHRIS SCHAFHAUSER, University of Waterloo
MF Traces and Crossed Products

We give a definition of MF traces are C^*-algebras which is an analogue of the quasidiagonal traces defined by N. Brown. Roughly, a tracial state τ on a C^*-algebras A is MF if there is a sequence of finite rank *-linear functions on A which are asymptotically multiplicative and asymptotically recover the trace τ. Given an action of a group G on a C^*-algebra A and an invariant trace τ on A, we consider when the induced trace on $A \rtimes G$ is MF.

ADAM SIERAKOWSKI, University of Victoria
The general linear group as a complete invariant for C-algebras*

In 1955 Dye proved that two von Neumann factors not of type I_{2n} are isomorphic (via a linear or a conjugate linear *-isomorphism) if and only if their unitary groups are isomorphic as abstract groups. We consider an analogue for C*-algebras. We show that the topological general linear group is a classifying invariant for simple, unital AH-algebras of slow dimension growth and of real rank zero, and the abstract general linear group is a classifying invariant for unital Kirchberg algebras in UCT. This is join work with Prof Thierry Giordano.

NICO SPRONK, University of Waterloo
On similarity for completley bounded representations of Fourier algebras

Let G be a locally compact group. Dixmier's unitarization theorem for bounded continuous group representations may be restated as follows: if G is amenable, then every bounded representation for the group algebra on a Hilbert space, $\pi : L^1(G) \to \mathcal{B}(\mathcal{H})$, admits an invertible S in $\mathcal{B}(\mathcal{H})$ for which

$$S\pi(\cdot)S^{-1} \text{ is a } *\text{-representation, and } \|S\|\|S^{-1}\| \leq \|\pi\|^2. \tag{$\dagger$}$$

In the '90s, Pisier showed that (†) implies amenability of G. The Fourier algebra $A(G)$ is the dual object to $L^1(G)$ in a manner which generalizes Pontryagin duality. It is a commutative self-adjoint Banach algebra of functions on G which is the predual of the von Neuman algebra generated by the left regular representation of G. As such, the operator space structure on $A(G)$ is generally non-trivial. However, every $*$-representation of $A(G)$ factors through the commutative C*-algebra of continuous functions vanishing at infinity $\mathcal{C}_0(G)$, and hence is completley bounded. Due to the considerations around the duality of $A(G)$ with $L^1(G)$, we suspect that for any completely bounded representation $\pi : A(G) \to \mathcal{B}(\mathcal{H})$ that there is an S in $\mathcal{B}(\mathcal{H})$ for which an analogue of (†) holds. H.H. Lee (Seoul) and E. Samei (Saskatchewan) and I have found a proof for this result for a wide class of groups which includes amenable groups and small-invariant neighbourhood (hence discrete) groups.

CHARLES STARLING, University of Ottawa
C*-algebras generated by partial isometries and amenability

If G is a discrete countable group, then the following are equivalent

– G is amenable

– The action of G on a point is amenable

– Every action of G is amenable

– $C^*(G)$ is nuclear

Here we address the question of how to generalize the above list to when G is replaced by an inverse semigroup S. This generalization is motivated by the fact that many C*-algebras are generated by sets of partial isometries closed under adjoint and product, and such a set is necessarily an inverse semigroup. Hence such algebras will be quotients of the universal C*-algebra $C^*(S)$ of some inverse semigroup S. We show that the last three points above are equivalent for an inverse semigroup S when "a point" is replaced by "its spectrum", and propose that these statements furnish a good candidate for the definition of amenability for an inverse semigroup.

ALESSANDRO VIGNATI, York University
On Ulam stability

We prove some stability results for certain classes of C*-algebras. We prove that whenever A is a finite-dimensional C*-algebra, B is a C*-algebra and $\phi\colon A \to B$ is approximately a $*$-homomorphism then there is an actual $*$-homomorphism close to ϕ by a factor depending only on how far is ϕ from being a $*$-homomorphism and not on A, B or ϕ. Proceeding further we extend our results to other classes of C*-algebras, hinting some applications. This is joint work with Paul McKenney.

MARIA-GRAZIA VIOLA, Lakehead University
C*-algebras non-isomorphic to their opposite algebras and the UCT

There are several examples in the literature of factors of type II_1 and type III which are not isomorphic to their opposite algebras. Since a C^*-algebra isomorphism of von Neumann algebras is necessarily a von Neumann algebra isomorphism, these are also examples of simple C^*-algebras not isomorphic to their opposite algebras. However, none of these examples is separable or exact in the C*-algebra sense. We show that there exist uncountably many mutually nonisomorphic simple separable stably finite unital exact C^*-algebras which are not isomorphic to their opposite algebras. In particular, we prove that there are uncountably many possibilities for the K_0-group, the K_1-group, and the tracial state space of such an algebra. We also show that these C^*-algebras satisfy the Universal Coefficient Theorem. This is joint work with C. Phillips.

QINGYUN WANG, University of Toronto
Classification of certain inductive limit actions of compact groups on AF algebras

An action of a compact group on an AF algebra is called an inductive limit action, if there is a sequence of finite-dimensional subalgebras, each of which is invariant under the action, whose union is dense. If the restrictions on the finite-dimensional

subalgebras are inner (induced by representations of the group), then such actions are classified by equivariant K-theory, by the result of David Handelman and Wulf Rossmann. We shall show that equivariant K-theory is not enough to classify if the restrictions on finite dimensional C*-algebras are not inner, and give a complete classification of a more general class of inductive limit actions by introducing some new invariants.

MATTHEW WIERSMA, University of Waterloo
Weak* tensor products for von Neumann algebras

The category of C*-algebras is blessed with many different tensor products. In contrast, virtually the only tensor product ever used in the category of von Neumann algebras is the normal spatial tensor product. We propose a definition of what a generic tensor product in this category should be and study properties of von Neumann algebras in relation to these tensor products.

MITSURU WILSON, Western University
Isospectral deformation: 3-spheres S_θ^3 and its geometric invariance

The development of formulae for the curvatures in noncommutative geometry is a fairly recent achievement. This is based on heat equation techniques and pseudodifferential calculus. However, the definition of connections dates back to Connes's 1980 paper *C*-algebres et geometrie differentielle*. The noncommutative version of the Levi Civita theorem, for noncommutative tori with strong Diophantine approximation property, was proved in 2013 by Rosenberg. In my talk, I will present our result extending Rosenberg's by the tools Arnlind and I developed for the noncommutative 3-spheres S_θ^3.

DILIAN YANG, University of Windsor
The Yang-Baxter Equation and Affine Actions

In this talk, I will report the ongoing work on the relations between solutions of the Yang-Baxter equation and affine actions on groups. On the way, I will show how to use affine actions to unify some known constructions on solutions of the Yang-Baxter equation. Also, one connection with C*-algebras will be given.