Operator algebras and applications
Algèbres d'opérateurs et applications
(Org: **Thierry Giordano** (Ottawa), **Ian Putnam** (Victoria) and/et **Aaron Tikuisis** (Ottawa))

MARTIN ARGERAMI, University of Regina
Affine Operator Systems

We consider operator systems generated by commuting tuples of normal operators. We obtain a complete classification of such operator systems, thus solving several cases where the situation was poorly understood. We also explore the relation with Arveson's essential normality conjecture.

IONUT CHIFAN, University of Iowa
New examples of W and C*-superrigid groups*

In the thirties F. J. Murray and J. von Neumann found a natural way to associate a von Neumann algebra L(G) to every countable discrete group G. Classifying L(G) in terms of G emerged overtime as a natural yet quite challenging problem as these algebras tend to have very limited "memory" of the underlying group. This is perhaps best illustrated by Connes' famous result asserting that all icc amenable groups give rise to isomorphic von Neumann algebras; thus in this case, besides amenability, the algebra has no recollection of the structure of underlying group. However, in the non-amenable regime the situation is far more complex; examples where the von Neumann algebraic structure is sensitive to various algebraic group properties have been discovered via Popa's deformation/rigidity theory. In this talk I will present new instances of groups G that are completely recognizable from L(G). Our classes of examples include amalgamated free products, HNN extensions, and co-induced groups. In addition, I will discuss several applications to the study of rigidity in the C*-setting. This is based on recent joint works with A. Diaz-Arias and D. Drimbe.

RAPHAËL CLOUÂTRE, University of Manitoba
Finite dimensionality in the non-commutative Choquet boundary

The non-commutative Choquet boundary of an operator algebra consists of $*$-representations with a certain unique extension property. In this talk, I will investigate the question of existence of finite-dimensional boundary points, which is a non-trivial issue even for finite-dimensional operator algebras. I will explain how this question is related to the residual finite-dimensionality of the C^*-envelope, and how finite-dimensional boundary points can be detected by tools from non-commutative function theory. Furthermore, I will explore the extremal case of C^*-liminal operator algebras – where all boundary points are finite-dimensional – via some recent developments in matrix convexity. This is joint work with Ian Thompson.

JASON CRANN, Carleton University
Amenable dynamical systems through Herz-Schur multipliers

A generalized theory of Herz-Schur multipliers for dynamical systems has recently emerged through independent work of Bédos-Conti and McKee-Todorov-Turowska. In this talk, we generalize the well-known Herz-Schur multiplier characterizations of amenability to W*- and C*-dynamical systems over arbitrary locally compact groups. As byproducts of our results, we (1) answer a question of Anantharaman-Delaroche and obtain a Reiter type characterization of amenable W*-dynamical systems, and (2) show that a commutative C*-dynamical system is amenable if and only if the underlying action is topologically amenable. Combined with recent work of Buss-Echterhoff-Willett, this latter result implies the equivalence between topological amenability and measurewise amenabilty for G-spaces X when both G and X are second countable. This is joint work with Alex Bearden.

KEN DAVIDSON, U. Waterloo
Strongly Peaking Representations and Compressions of Operator Systems

An operator system is *fully compressed* if the compression to any proper subspace fails to be completely isometric. We completely characterize fully compressed separable operator systems in terms of strongly peaking representations, and also in terms of the representation theory of its C*-envelope. The fully compressed representation is unique up to unitary equivalence. The notion of matrix convexity underlies the main ideas.

This is joint work with Ben Passer.

ANDREW DEAN, Lakehead University
Classification of nonsimple real AI algebras

We shall discuss the classification of not necessarily simple real C*-algebras that arise as inductive limits of real forms of finite direct sums of matrix algebras over the continuous functions on the unit interval using Cuntz semigroups.

This is joint work with Luis Santiago.

GEORGE ELLIOTT, University of Toronto
A garden of simple C-algebras*

A (very) brief status report is given on the classification of C*-algebras, and of group actions on them.

HEATH EMERSON, University of Victoria
Zeta functions of Heisenberg cycles and dynamics

Along the orbit of a smooth ergodic flow on a compact manifold$M$, placing a Dirac-Schrodinger operator $x + \frac{d}{dx}$ determines a spectral triple over $C(M) \rtimes \mathbf{R}_d$, the crossed product of $C(M)$ by the group of real numbers with the discrete topology, acting on M by the flow. Such Heisenberg cycles generate analytic zeta functions $\zeta(f) = \mathrm{trace}(fH^{-s})$, with $H = -\frac{d^2}{dx^2} + x^2$ the harmonic oscillator, and as we show, the meromorphic and pole structure of these zeta functions seems to detect fine information about ergodic averages in dynamics. We demonstrate this for the periodic flow on the circle, and the Krönecker flow on $\mathbf{T}^2$, and briefly summarize various applications to K-theory.

MATTHEW KENNEDY, University of Waterloo
Amenability, proximality and higher order syndeticity

I will discuss new descriptions of some universal flows associated to a discrete group, obtained using what we view as a kind of "topological Furstenberg correspondence." The descriptions are algebraic and relatively concrete, involving subsets of the group satisfying a higher order notion of syndeticity. We utilize them to establish new necessary and sufficient conditions for strong amenability and amenability. Throughout, I will discuss connections to operator algebras. This is joint work with Sven Raum and Guy Salomon.

MASOUD KHALKHALI, Western Ontario
Phase transition in some Dirac Ensembles

After a quick introduction to some of the ideas of random matrix theory, I shall focus on current efforts to prove the existence of phase transition in some random matrix models suggested by noncommutative geometry. The talk is based on my recent joint papers arXiv:2006.02891: Phase transitions in random noncommutative geometries; and arXiv:1906.09362: Random finite noncommutative geometries and topological recursion.

MARCELO LACA, University of Victoria
Universal Toeplitz algebras and their boundary quotients

I will present a universal model for the Toeplitz algebra of a submonoid of a group, define its universal boundary quotient, and characterize their faithful representations and their uniqueness and simplicity properties. To give a context for our results I will start by reviewing classical work of Coburn, Douglas, and Cuntz on C*-algebras generated by isometries and also generalizations due to Nica, Li, and Raeburn and myself. This is recent joint work with Camila F. Sehnem.

BOYU LI, University of Victoria
Dilation theory for right LCM semigroup dynamical systems

We consider the dilation theory for a certain type of semigroup dynamical systems that encode the right LCM structure of the semigroup. This leads to a generalized Naimark dilation theorem and Stinespring's dilation theorem for these semigroup dynamical systems. As an application, we prove a dilation result for contractive representations of the boundary quotient. This is a joint work with Marcelo Laca.

JAMES MINGO, Queen's University
Free compression and Standard Young Tableau

In 1959 H. Kesten found a probability measure whose moments count the number of closed walks on a free group with d generators, now known as the Kesten-McKay law. For non-integer $d \geq 1$ there is still a probability measure but no group, however the $2n^{th}$ moment is still a polynomial of degree n with coefficients in the positive integers; the odd moments being 0. Nica and Speicher showed that the free compression of a Bernoulli random variable has the same law. In this talk we shall show that these moments can also be interpreted in terms of standard Young tableau with specified shape. This is joint work with Iris Arenas Longoria.

JUDITH PACKER, University of Colorado, Boulder
Cocycles on groupoids associated to $\mathbb{N}^k$-actions, and dynamics on the associated C^*-algebra

We construct a locally compact Hausdorff etale groupoid $\mathcal{G}$ from k commuting surjective local homeomorphisms acting on a compact metric space X. We characterize the continuous 1-cocycles in the groupoid $\mathcal{G}$ taking on values in $\mathbb{R}$, in terms of k-tuples of continuous real-valued functions on the unit space of $\mathcal{G}$ satisfying certain canonical identities. Under appropriate conditions, we construct a one-parameter automorphism group acting on the groupoid C^*-algebra $C^*(\mathcal{G})$ corresponding to the continuous 1-cocycle on $\mathcal{G}$. The question of the existence of KMS states on $C^*(\mathcal{G})$ associated to these one-parameter automorphism groups is addressed. The work discussed is joint with C. Farsi, L. Huang, and A. Kumjian.

SARAH PLOSKER, Brandon University
Complete order equivalence of spin operator systems

Spin systems are finite sets of anticommuting selfadjoint unitary matrices. We focus on complete order isomorphisms between the operator systems generated by these sets: linear isomorphisms such that the matricial order within these spaces is preserved. We extend our work to the case of countable many unitaries. We also consider the C*-envelope associated to such operator systems.

CHRIS RAMSEY, MacEwan University
The isomorphism problem for tensor algebras of multivariable dynamical systems

We show that unitary equivalence after a conjugation for multivariable dynamical systems is a complete invariant for complete isometric isomorphisms between their tensor algebras. The result is achieved by way of Mobius transformations in this context. This is joint work with Elias Katsoulis (ECU).

SARAH REZNIKOFF, Kansas State University
A picture of Cartan subalgebras in twisted k-graph algebras

In 2008, Renault proved that every topologically principal groupoid C*-algebra contains a Cartan subalgebra. We recall work with Duwenig and Gillaspy that shows certain non-topologically principal twisted groupoid C*-algebras contain Cartan subalgebras, and in the case that the groupoid is the path groupoid of a k-graph we describe certain subgroupoids that give rise to these subalgebras. This is joint work with Anna Duwenig, Elizabeth Gillaspy, Rachael Norton, and Sarah Wright.

PAUL SKOUFRANIS, York University
Bi-Free Entropy with Respect to a Completely Positive Map

Free entropy, as developed by Voiculescu in the 1990s, is an essential concept in free probability and is used to prove numerous results in operator algebras. The non-microstate version of free entropy, which is based on a conjugate variable system and a notion of free Fisher information, was generalized by Shlyakhtenko to incorporate a completely positive map. In this talk, we will examine this notion of free entropy with respect to a completely positive map, its applications, and its extension to the bi-free setting.

NICO SPRONK, Uinversity of Waterloo
On operator amenability of Fourier-Stieltjes algebras

Fourier-Stietjes algebras of locally compact groups are dual objects to measure algebras in a manner generalizing Pontryagin duality. For certain considerations around this duality, it is natural to expect that for a Fourier-Stietjes algebra to be operator amenable, it is necessary that the underlying group be compact. This is not true, a shown by Runde and me some years ago, but is true for almost connected groups. I will discuss my method for showing this, which uses some weakly almost periodic topological dynamics.

CHARLES STARLING, Carleton University
Partial isometric representations of semigroups

In his thesis, Tolich described a class of C*-algebras associated to doubly quasi-lattice ordered groups—these are groups G which have a left- and right-invariant order determined by a subsemigroup P. This generalized work of Raeburn and Hancock on the universal C*-algebra generated by a single power partial isometry (i.e. the case where $G = \mathbb{Z}$ and $P = \mathbb{N}$). We generalize this construction further to the case of LCM semigroups P, construct a suitable boundary quotient, and make the case that these algebras are an appropriate two-sided companion to Cuntz-Li algebras associated to such semigroups.

This is joint work with Ilija Tolich.

KAREN STRUNG, Institute of Mathematics, Czech Academy of Sciences
Cuntz-Pimsner algebras associated to C-correspondences over commutative C*-algebras, II*

A full and invertible C*-correspondence over a commutative C*-algebra $C(X)$ is always given by a right module of sections for some line bundle over X, with left multiplication given by composition with a homeomorphism $\alpha : X \to X$. In this case, the C*-correspondence has the structure of a Hilbert $C(X)$-bimodule, and we can think of the associated Cuntz–Pimsner algebra as a generalised crossed product by this bimodule. When the line bundle is trivial, we get the usual crossed product $C(X) \rtimes_\alpha \mathbb{Z}$, but in general what we get is a twisted groupoid algebra where the twist is over the transformation groupoid $X \times_\alpha \mathbb{Z}$. I will discuss these C*-algebras from the point of view of their classification. This talk will be self-contained, but will also be complementary to the earlier talk by Maria Grazia Viola.

Joint work with M. S. Adamo, D. Archey, M. Forough, M. Georgescu, J. A Jeong, and M. G. Viola.

MARIA GRAZIA VIOLA, Lakehead University
Structural properties and classification of Cuntz-Pimsner algebras associated to C-correspondences over commutative C*-algebras*

Cuntz-Pimsner algebras were introduced by Pimsner in the '90s, as generalization of both Cuntz-Krieger algebras and crossed products by the integers. In this talk we discuss several regularities properties of Cuntz-Pimsner algebras arising from full, minimal, non-periodic, and finitely generated projective C*-correspondence over commutative C*-algebras. A large class of examples is obtained considering the set $\Gamma(V, \alpha)$ of continuous sections of a complex vector bundle on a compact metric space X, where left multiplication is given by a twist by a minimal homeomorphism $\alpha\colon X \to X$.

In the case of crossed products by minimal homeomorphisms, the orbit breaking subagebra, defined by I. Putnam, is a large subalgebra in the sense of N. C. Phillips. We show that for a large class of C*-correspondences, the Cuntz-Pismner algebra $\mathcal{O}(\Gamma(V, \alpha))$ also contains a large subalgebras. We will discuss some properties that $\mathcal{O}(\Gamma(V, \alpha))$ and/or its large subalgebra have, focusing on properties needed for classification by the Elliott invariant, like nuclear dimension, $\mathcal{Z}$-stability, etc.

This is joint work with M. S. Adamo, D. Archey, M. Forough, M. Georgescu, J. A Jeong, and K. Strung.

MATTHEW WIERSMA, University of California, San Diego
Cohomological obstructions to lifting properties for full group C- algebras*

We develop a new method, based on non-vanishing of second cohomology groups, for proving the failure of lifting properties for full C*-algebras of countable groups with (relative) property (T). We derive that the full C*-algebras of the groups $\mathbb{Z}^2 \rtimes \mathrm{SL}_2(\mathbb{Z})$ and $\mathrm{SL}_n(\mathbb{Z})$, for $n \geq 3$, do not have the local lifting property (LLP). We also prove that the full C*-algebras of a large class of groups with property (T) do not have the lifting property (LP). This is based on joint work with A. Ioana and P. Spaas.

DILIAN YANG, University of Windsor
Higman-Thompson Like Groups of k-Graph C-Algebras*

Let Λ be a row-finite and source-free k-graph with finitely many vertices. In this talk, we present a notion of the Higman-Thompson like group Λ_{ht} associated to the graph C*-algebra $\mathcal{O}_\Lambda$. We show that Λ_{ht} is closely related to the topological full groups of the groupoid associated with Λ. Some properties of Λ_{ht} are also discussed.