Operator Algebras
Algèbres d'opérateurs
(Org: **Berndt Brenken** (Calgary), **George Elliott** (Toronto) and/et **Cristian Ivanescu** (Alberta))

SERBAN BELINSCHI, University of Saskatchwan
Convolution semigroups in operator-valued probability

In this talk we shall discuss from an analytic perspective non-commutative convolution semigroups of distributions with values in a C^*-algebra B. It turns out that these semigroups can be naturally indexed by sub-semigroups included in the space of completely positive maps on B. This is joint work with M. Anshelevich, M. Fevrier and A. Nica.

JULIAN BUCK, Francis Marion University
Strict Comparison for Crossed Products of Certain Non-Simple, Non-Commutative C-Algebras*

Crossed product C^*-algebras of the form $C^*(\mathbb{Z}, X, h)$, where X is a compact metric space and h is a minimal homeomorphism, have been studied extensively over the past 20 years and their structure is quite well-understood for many good cases. A recent result of particular interest is a theorem of Toms and Winter that states such crossed products are stable under tensoring with the Jiang-Su algebra $\mathcal{Z}$, and consequently have strict comparison of positive elements. In this talk we will discuss related results for crossed products of algebras of the form $C(X, A)$, where X is a compact metric space and A is a C^*-algebra with appropriate properties. In particular, we will show that the approximating subalgebra for the crossed product (corresponding to the subalgebras A_Y introduced by Putnam for the Cantor set case and generalized by Q. Lin and N.C. Phillips to compact metric spaces) are $\mathcal{Z}$-stable under sufficient assumptions on X and A, and that $A_{\{y\}}$ is a large subalgebra of the crossed product in an appropriate sense. It will follow that the crossed product has strict comparison of positive elements. This is joint work with Aaron Tikuisis.

MAN-DUEN CHOI, Department of Mathematics, University of Toronto
Normal Dilations Made Simple but Difficult

Which operators can be dilated to normal operators with some prescribed spectra? This turns out to be useful for the illustration of Naimark's theorem about the structure of a unital positive linear map from C(X) to B(H). Even in the finite dimensional cases, there are very hard problems of unknown depth in matrix analysis , related to the recent development of quantum information.

KEN DAVIDSON, University of Waterloo
Semicrossed products of the disk algebra

If α is the endomorphism of the disk algebra, $\mathrm{A}(\mathbb{D})$, induced by composition with a finite Blaschke product b, then the semicrossed product $\mathrm{A}(\mathbb{D}) \times_\alpha \mathbb{Z}^+$ imbeds canonically, completely isometrically into $\mathrm{C}(\mathbb{T}) \times_\alpha \mathbb{Z}^+$. Hence in the case of a non-constant Blaschke product b, the C*-envelope has the form $\mathrm{C}(\mathcal{S}_b) \times_s \mathbb{Z}$, where $(\mathcal{S}_b, s)$ is the solenoid system for $(\mathbb{T}, b)$. In the case where b is a constant, then the C*-envelope of $\mathrm{A}(\mathbb{D}) \times_\alpha \mathbb{Z}^+$ is strongly Morita equivalent to a crossed product of the form $\mathrm{C}(\mathcal{S}_e) \times_s \mathbb{Z}$, where $e\colon \mathbb{T} \times \mathbb{Z}^+ \longrightarrow \mathbb{T} \times \mathbb{Z}^+$ is a suitable map and $(\mathcal{S}_e, s)$ is the solenoid system for $(\mathbb{T} \times \mathbb{Z}^+, e)$.

VALENTIN DEACONU, University of Nevada, Reno
Residually AF embeddable C^*-algebras

(Joint work with M. Dadarlat). Suppose that a separable exact C^*-algebra A is KK-equivalent to a commutative C*-algebra and that A has a separating sequence of unital $*$-homomorphisms into simple AF algebras. Under these conditions we show that A embeds unitally in a simple AF algebra. We apply this result to a class of amenable groups.

ANDREW DEAN, Lakehead University
Classification of C-dynamical systems*

We shall discuss recent progress in classification of C^*-dynamical systems.

GEORGE ELLIOTT, University of Toronto
Some remarks on the classification of C-algebras*

The effectiveness of the Cuntz semigroup as an invariant in the classification of C*-algebras will be briefly reviewed.

DOUG FARENICK, University of Regina
Representations of operator systems

An operator system S is an involutive complex vector space equipped with a matricial order and an Archimedean order unit. The fundamental representation theorem of Choi and Effros asserts that an abstract operator system is completely order isomorphic to an operator system that acts nondegenerately on a Hilbert space; thus, every operator system S embeds in a unital C*-algebra generated by a copy of S. In this lecture I will review the maximal representation of Kirchberg and Wassermann, the minimal representation of Hamana, and describe the connections of Hamana's theory with Arveson's noncommutative Choquet boundary. I will also give some examples and a discuss some recent applications.

CRISTIAN IVANESCU, MacEwan University and University of Alberta
The Cuntz semigroup of dimension drop C-algebras*

Recently R. Antoine, F. Perera and L. Santiago obtained for the first time the Cuntz semigroup for dimension drop C*-algebra. In our talk we calculate the Cuntz semigroup of dimension drop C*-algebras based on a new and simpler method that uses strict comparison of positive elements. Even though many years have passed since Cuntz introduced what we now call the Cuntz semigroup, only recently, starting with the work of Andrew Toms, the remarkable relevance of the Cuntz semigroup in the C*-algebra's classification program has become clear. In fact at the 2010 COSY meeting held in Fredericton, George Elliott reformulated his famous conjecture in terms of the Cuntz semigroup and K_1-group. Computation of the Cuntz semigroup is an important part of the classification of C*-algebras, because it provides the range of the invariant.

DAVID KERR, Texas A&M University
Sofic dimension for measured groupoids

The notion of soficity for discrete groups was introduced by Gromov as an external finite approximation property that simultaneously generalizes amenability and residual finiteness. One can also apply this concept more generally to probability-measure-preserving groupoids. In this context we define an invariant which measures the asymptotic growth of the number of sofic models and can be viewed as a discrete analogue of free entropy dimension. The value of this sofic dimension is realized on any generating set, which renders it accessible to computation and enables us to establish free product formulas. We thereby obtain a combinatorial approach to the study of orbit equivalence for measure-preserving actions that complements the theory of cost. This is joint work with Ken Dykema and Mikael Pichot.

BRADY KILLOUGH, Mount Royal University
A Ring Structure on the K-theory of Certain C-Algebras.*

We consider the C^*-algebras associated to a Smale space. Ian Putnam showed that one of these algebras has an asymptotically abelian action that gives rise to a product on K-theory via the E-theory of Connes and Higson. In the case that the Smale space is a shift of finite type, the K-theory groups have a concrete description as an inductive system. We describe the ring structure in terms of the inductive system and show an example in which the K-theory ring is non-commutative. This is joint work with Ian Putnam.

MICHAEL LAMOUREUX, University of Calgary
Outer preserving linear operators

A natural question about linear operators on Hardy space is answered, motivated by work in geophysical imaging. We exam the question of what bounded linear operators on Hardy space preserve the set of all shifted outer functions. This semigroup of operators is of interest in studies of geophysical imaging because of their utility in modeling certain physical processes. A complete characterization is determined, which allows an explicit construction of all such operators. Every operator that preserves the set of shifted outer functions is necessarily a product-composition operator, consisting of composition with a shifted outer function followed by multiplication with a (possibly different) shifted outer function.

Some applications to seismic imaging will be discussed, concerning the modeling of propagation of seismic wave energy through the earth.

FREDERIC LATREMOLIERE, University of Denver
Isomorphisms of Non Commutative Domain Algebras

Noncommutative domain algebras were introduced by Popescu as the non-selfadjoint operator algebras generated by weighted shifts on the Full Fock space, and they generalise noncommutative disk algebras. They provide a setting for extending the theory of functions in several complex variables to multivariate operator theory. In a joint work with A. Arias, we classify a large class of these algebras using the classification of domains in Hermitian spaces up to biholomorphic maps, including the work of Sunada and Thullen on Reinhardt domains. This talk will present our results, emphasising the connection with complex analysis, and proving that there are indeed many non-isomorphic domain algebras. We will provide a few examples.

TERRY LORING, University of New Mexico
Topological insulators and real almost commuting matrices

We will discuss variations on Lin's theorem discovered jointly with with Adam Sørensen. Two almost commuting real symmetric matrices are uniformly close to commuting real symmetric matrices. The same is true for self-adjoint, self-dual matrices, or equivalently for self-adjoint matrices over the quaternions. These represent partial results related to the many conjectures made with Matthew Hastings regarding real C^*-algebras and topological insulators.

JAMIE MINGO, Queen's University
Graphs and Random Matrices

For the last twenty years free probability has been used to model the large N limit of independent random matrices. Recently Roland Speicher and I have developed the theory of second order freeness to analyse the fluctuations of these random variables around their limiting distributions.

As was found by Voiculescu in the case of first order freeness in 1991, many standard ensembles of random matrices used in physics and statistics exhibit second order freeness. I will explain how a analysis of some graphs can be used to analyse the fluctuations of Wigner ensembles. This is joint work with Roland Speicher.

NISHAN CHARITHA MUDALIGE, University of Guelph
Normal Compressions of Higher Rank Numerical Ranges

The classical numerical range has been studied extensively by mathematicians interested in the areas of functional analysis and matrix analysis since the 1930's. The higher rank numerical range generalizes the classical numerical range of an operator and is a much newer discovery which was first introduced by Choi, Kribs and Zyczkowski in 2006. Research into higher rank numerical ranges has originally been motivated by problems in quantum information theory, in particular the Knill-Laflamme representation of quantum data error correcting code. In this talk, we will discuss some of the basic structure and theory of higher rank numerical ranges and discuss their geometric representation in the complex plane C. We will introduce a general program to describe normal compressions of normal (diagonal) operators and discuss an interesting pair matching problem that arises from 2 x 2 compressions. Finally we discuss continuity results attached to this pair matching problem.

This work was done in collaboration with Dr. J. Holbrook and Dr. R. Pereira of the University of Guelph.

BOGDAN NICA, University of Victoria
Fredholm modules and boundary actions of hyperbolic groups

I will describe some finitely summable Fredholm modules for the crossed product C*-algebra associated to the action of a hyperbolic group on its boundary. These Fredholm modules represent a natural and distinguished K-homology class; in particular, the Fredholm modules we construct are almost always non-trivial. This is joint work with Heath Emerson.

ZHUANG NIU, Memorial University of Newfoundland
Homomorphisms between simple $\mathcal{Z}$-stable C-algebras*

A C*-algebra is called rationally tracially AI if its tensor product with a UHF-algebra is tracially AI. Consider two homomorphisms between any given pair of $\mathcal{Z}$-stable simple amenable rationally tracially AI algebras which satisfy the UCT. It is shown that these two homomorphisms are approximately unitarily equivalent if and only if they induce the same map between the ordered KL-groups, the tracial simplexes and the Hausdorff completions of the algebraic K_1-groups. This is a joint work with Huaxin Lin.

IAN PUTNAM, University of Victoria
Duality and spectral triples for Ruelle algebras

D. Ruelle showed how C*-algebras could be constructed from certain hyperbolic dynamical systems called Smale spaces. These include the Cuntz-Krieger algebras which arise from shifts of finite type. I will discuss a K-theory duality for these algebras (joint work with J. Kaminker and M. Whittaker). Using this duality and building on work of M. Whittaker, I will present some examples of spectral triples for these C*-algebras. This is joint work (in progress) with A. Julien.

MIKE WHITTAKER, University of Wollongong
K-theoretic duality for Smale spaces

K-theoretic duality for a pair of C^*-algebras was formulated by Kasparov to generalize the notion of Poincaré duality for topological spaces. When C^*-algebras A and B are dual there are canonical isomorphisms between the K-theory of A and the K-homology of B and between the K-theory of B and the K-homology of A.

Smale spaces will be introduced by example along with their associated C^*-algebras. In particular, we will discuss the stable and unstable Ruelle algebras of a hyperbolic toral automorphism. These algebras will then be shown to satisfy K-theoretic duality by explicitly constructing the duality classes.

This is joint work with Jerry Kaminker and Ian Putnam.