GPOTS 2016 - TITLES AND ABSTRACTS

1. Plenary 50 and 30 min Talks

- **Michael Brannan** (mbrannan@math.tamu.edu) Texas A&M University

Title: *Quantum channels from quantum group invariants*

Abstract. Quantum channels are trace-preserving completely positive maps between matrix algebras, and these objects are of central importance in quantum information theory. Thanks to Stinespring's Dilation Theorem, the structure of a given quantum channel is encoded in a certain subspace of a tensor product of two finite dimensional Hilbert spaces. Thus, to construct "interesting" quantum channels, one has to find "interesting" subspaces of tensor product Hilbert spaces. In practice, one relevant property of the subspace is that it is highly entangled, in the sense that the subspace is very far from the cone of decomposable tensors in the tensor product. In this talk I will describe a class of highly entangled subspaces arising from the invariant theory of free orthogonal quantum groups. It turns out that the rich structure of the quantum group invariants we are considering allows us to gain a good understanding of the corresponding quantum channels (such as minimum output entropy estimates and the outputs of tensor products of these channels).

(*) This is based on joint work with Benoit Collins.

- **Raúl E. Curto** (raul-curto@uiowa.edu) University of Iowa

Title: *Moment infinitely divisible weighted shifts*

Abstract. We say that a weighted shift W_α with (positive) weight sequence $\alpha : \alpha_0, \alpha_1, \ldots$ is *moment infinitely divisible* (MID) if, for every $t > 0$, the shift with weight sequence $\alpha^t : \alpha_0^t, \alpha_1^t, \ldots$ is subnormal; for example, the Agler shifts are MID. In joint work with C. Benhida and G. Exner, we show that W_α is MID if and only if $\alpha_i \leq 1$ for all i and the sequence α is log completely alternating. This enables us to recapture and improve a number of previous results proved rather differently, as well as to establish new results and examples.

Completely alternating sequences have been studied extensively, but it is important to note that usually there is the assumption that the sequence is positive (the study is in the context of semigroups, in particular $\mathbb{R}_+$) while here we allow negative terms. We prove that the class of completely alternating sequences whose terms are all positive is a proper subset of the class of log completely alternating sequences (the argument uses Agler shifts). Moreover, if a sequence (x_n) is completely alternating then its Cesàro transform $(C(x_n))$ is completely alternating.

Our results allow us to establish that the Aluthge transform of a MID shift is again MID. Similarly, if the weights of a shift W_α form a completely alternating sequence, then the mean transform of W_α is MID, and hence subnormal; for example, the mean transform of the Bergman shift is MID. Finally, our results have applications to the class of Toeplitz operators on the Hardy space of the unit circle.

Date: May 24, 2016.

• **Ken Dykema** (kjd@tamu.edu) Texas A&M University
Title: *Determinants associated to traces on operator bimodules*

Abstract. Generalizations of the Fuglede-Kadison determinant are constructed. Let M be a von Neumann algebra. The Fuglede-Kadison determinant is a positive determinant defined on M, arising from the trace on M. As was shown by Haagerup and Schultz, the domain of definition of the Fuglede-Kadison determinant is a larger class of affiliated operators. We consider more general M-bimodules of affiliated operators equipped with traces. These include the Dixmier traces (in the type II_1 setting). For each such bimodule and trace, we construct a multiplicative, positive determinant.

(*) This is joint work with Fedor Sukochev and Dmitriy Zanin.

• **Ruy Exel** (ruyexel@gmail.com) Universidade Federal de Santa Catarina, Brazil
Title: *The ideal structure of algebraic partial crossed products*

Abstract. Given a partial action of a discrete group G on a Hausdorff, locally compact, totally disconnected topological space X, we consider the correponding partial action of G on the algebra $L_c(X)$ consisting of all locally constant, compactly supported functions on X, taking values in a given field K. This talk will concentrate on the study of ideals in the algebraic partial crossed product $L_c(X) \rtimes G$.

• **Carla Farsi** (carla.farsi@colorado.edu) University of Colorado, Boulder
Title: *Representations and wavelets of k-graph algebras*

Abstract. In our collaborative work we address semibranching systems, representations of k-graph algebras, and associated wavelets. In this talk I will and present some of our key ideas and expand on our results as arising from the interplay of the above concepts.

References: Separable representations, KMS states, and wavelets for higher-rank graphs Carla Farsi, Elizabeth Gillaspy, Sooran Kang, Judith Packer J. Math. Anal. Appl. 434 (2016), no. 1, 241-270.

Wavelets and graph C^*-algebras Carla Farsi, Elizabeth Gillaspy, Sooran Kang, Judith Packer Submitted

Wavelets and spectral triples for fractal representations of Cuntz algebras Carla Farsi, Elizabeth Gillaspy, Antoine Julien, Sooran Kang, Judith Packer Contemp. Math, to appear

• **Don Hadwin** (don@unh.edu) University of New Hampshire
Title: *Tracially stable C^*-algebras*

Abstract. Weak semiprojectivity is a stability property for C^*-algebras says that if its generators approximately satisfy the defining relations, then it is actually norm close to generators that actually satisfy the relations. For separable C^*-algebras semiprojectivity can be expressed in terms of ultraproducts. This means that a unital *-homomorphism from the algebra into a C^*-ultraproduct can be "eventually" lifted to unital $*$-homomorphisms into the factors. We introduce the notion of *tracially stable C^*-algebra*, in which ultraproducts are replaced with tracial ultraproducts. We define different types of tracial stability. We completely characterize matricially tracially stable tracially nuclear C^*-algebras and we show that tracial stability for a separable C^*-algebra $C(X)$ is equivalent to an interesting topological property for X.

(*) Joint with Tatiana Shulman.

- **William Helton** (Helton@math.ucsd.edu) University of California, San Diego
  Title: *Free analytic function theory on free convex sets*

  Abstract. Free convex sets (aka matrix convex sets) are known to be given by free Linear Matrix Inequalities, a type of constraint which appears heavily in linear systems engineering. Interest in free analytic functions has been building over the last decade. Recently there has been substantial progress in developing a function theory on free convex sets. The talk will mention the main results of this type, describe the two main techniques which dominate recent progress, and then focus on free bianalytic maps between free convex domains.

  (*) The work is joint with Igor Klep, Scott McCullough and Augat Meric.

- **Marcelo Laca** (laca@uvic.ca) University of Victoria, Canada
  Title: *C^*-algebraic invariants for systems from number theory*

  Abstract. I will introduce several C^*-algebraic dynamical systems constructed from algebraic number fields, and I will discuss how various C^*-algebraic invariants such as equilibrium states, primitive ideal space, and K-theory, may be used to shed light on the structure and classification of number fields. Most of the talk will consist of a survey of recent and not so recent constructions and applications, but I also aim to include a glimpse of current and future research directions.

- **Christian Le Merdy** (clemerdy@univ-fcomte.fr) University of Franche-Comté, France
  Title: *S^1-boundedness of triple operator integrals*

  Abstract. Let H be a separable Hilbert space, and let $S^2(H)$ and $S^1(H)$ denote the Hilbert-Schmidt class and the trace class on H, respectively. Let A, B, C be normal operators on H, and let $\lambda_A, \lambda_B, \lambda_C$ be scalar valued spectral measures associated to A, B and C, respectively. For any $\phi \in L^\infty(\lambda_A \times \lambda_B \times \lambda_C)$, one may define a 'triple operator integral'

  $$\Gamma^{A,B,C}(\phi)\colon S^2(H) \times S^2(H) \longrightarrow S^2(H),$$

  which can be regarded as a continuous bilinear Schur product with respect to the spectral decompositions of A, B, C. Our main result is a characterization of the functions ϕ for which the bilinear map $\Gamma^{A,B,C}(\phi)$ is actually valued in $S^1(H)$. We show that this holds true if and only if there exist a Hilbert space K and two functions $a \in L^\infty(\lambda_A \times \lambda_B; K)$ and $b \in L^\infty(\lambda_B \times \lambda_C; K)$ such that $\phi(\omega_1, \omega_2, \omega_3) = \big\langle a(\omega_1, \omega_2), b(\omega_2, \omega_3)\big\rangle_K$ almost everywhere. This is a bilinear analogue of a Theorem of Peller characterizing two variable functions whose associate double operator integrals are bounded $S^1(H) \to S^1(H)$.

  (*) This is joint work with Clément Coine (Besançon), Fedor Sukochev (UNSW, Sydney) and Anna Tomskova (UNSW, Sydney).

• **Debbie Leung** (wcleung@uwaterloo.ca) University of Waterloo, Canada
Title: *Embezzlement of entanglement, conservation laws, and nonlocal games*

Abstract. Consider two remote parties Alice and Bob, who share quantum correlations in the form of a pure entangled state. Without further interaction, the "Schmidt coefficients" of the entangled state are invariant; in particular, the amount of entanglement is conserved. van Dam and Hayden found that reordering these coefficients (corresponding to allowed local operations) can effect an apparent violation of the conservation law nearly perfectly. We discuss how the same mathematics can explain coherent manipulation of spins in NMR and other approximate violation of conservation laws. We show how this phenomenon gives rise to a quantum generalization of nonlocal games that cannot be won with finite amount of entanglement.

Joint work with Ben Toner, John Watrous and Jesse Wang.

• **Huaxin Lin** (hlin@uoregon.edu) University of Oregon
Title: *A look of classification of simple C^*-algebras of finite rank*

Abstract. In this talk, we plan to discuss one part of the proof of the isomorphism theorem of the recent classification theorem for unital separable finite simple C^*-algebras with finite nuclear dimension. We will focus on asymptotic (one parameter) unitary equivalence of homomorphisms from one classifiable C^*-algebras to another.

• **Tao Mei** (tao_mei@baylor.edu) Baylor University
Title: *Free Hilbert Transforms*

Abstract. This talk is based on a recent joint work with Eric Ricard on an analogue of the classical Hilbert transforms in the context of amalgamated free products of finite von Neumann algebras. In the case of free group von Neumann algebra, our result says that the decomposition of free group into reduced words starting with distinct free generators are completely L^p-unconditional. I will also talk on a few related results, time permitting.

Let $\mathbb{F}_2$ be the free group with two free generators a, b, and λ_g be the left regular representations of $g \in \mathbb{F}_2$. Let $\mathcal{L}_{a^+}$ be the subsets of $\mathbb{F}_2$ of reduced words starting with a. For $x = \sum_{g\in\mathbb{F}_2} c_g\lambda_g, c_g \in \mathbb{C}$ a finite sum, define

$$L_{a^+}x = \sum_{g\in\mathcal{L}_a^+} c_g\lambda_g.$$

L_{a^+} clearly extends to a norm 1 Herz-Schur multiplier on $L^2(\hat{\mathbb{F}}_2)$, i.e. $\tau(x^*x) \leq \tau(L_{a^+}x)^*(L_{a^+}x)$. Here τ is the canonical trace sending x to c_e. We wonder whether L_{a^+} is bounded on $L^p(\hat{\mathbb{F}}_2)$ for other p. For $p = 4$, this is to ask whether

$$\tau[(L_{a^+}x)^*(L_{a^+}x)]^2 \leq c\tau(x^*x)^2?$$

What we can say in the context of Voiculescu's amalgamated free products?

• **James Mingo** (mingo@mast.queensu.ca) Queen's University, Canada
Title: *Second order asymptotics of Wigner matrices*

Abstract. In the roughly thirty years that free probability has been around a large number of theorems and techniques have been established and many of these are having a significant impact outside of operator theory/operator algebras. Many of these theorem begin with the assumption that some collection of operators is free. Thus it is quite important to know we get freeness.

About twenty five years ago Voiculescu showed that certain random matrix ensembles are asymptotically free, i.e. freeness is obtained in the large N-limit. Roland Speicher and I developed a theory of second order freeness to analyze the fluctuations of these random matrix ensembles. I will illustrate this theory in the context if Wigner matrices.

Apart from the results themselves, a technique of interest is the use of matrix algebras as graphical operads which becomes planar in the large N-limit.

(*) Joint work with Roland Speicher.

• **Vern Paulsen** (vpaulsen@uwaterloo.ca) University of Waterloo, Canada
Title: *Quantum chromatic numbers*

Abstract. It is possible to characterize the chromatic number of a graph in terms of a game. It is the fewest number of colours for which a winning strategy exists using classical random variables to a certain graph colouring game. If one allows the players to use quantum experiments to generate their random outcomes, then for many graphs this game can be won with far fewer colours.

This leads to the definition of the quantum chromatic number of a graph. However, there are several mathematical models for the set of probability densities generated by quantum experiments and whether or not these models agree depends on deep conjectures of Connes and Tsirelson. Thus, there are potentially several "different" quantum chromatic numbers and computing them for various graphs gives us a combinatorial means to test these conjectures.

In this talk I will present these ideas and some of the results in this area. I will only assume that the audience is familiar with the basics of Hilbert space theory and assume no background in quantum theory.

• **Gilles Pisier** (pisier@math.tamu.edu) Texas A&M University
Title: *Sidon sets in bounded orthonormal systems*

Abstract. We will recall some of the classical theory of Sidon sets of characters on compact groups (Abelian or not). We will then give several recent extensions to Sidon sets, randomly Sidon sets and subgaussian sequences in bounded orthonormal systems, following recent work by Bourgain and Lewko, and by the author, both currently available on arxiv. The case of matricial systems, analogous to Fourier-Peter-Weyl series on compact groups, connects the subject to random matrix theory.

• **Marc A. Rieffel** (rieffel@math.berkeley.edu) University of California, Berkeley
Title: *Vector bundles for "Matrix algebras converge to the sphere"*

Abstract. In the high-energy quantum-physics literature one finds statements such as "matrix algebras converge to the sphere". Earlier I provided a general setting for understanding such statements, in which the matrix algebras are viewed as compact quantum metric spaces, and convergence is with respect to a quantum Gromov-Hausdorff-type distance. I will indicate briefly how this works.

But physicists want, even more, to treat structures on spheres such as vector bundles, Yang-Mills functionals, Dirac operators, etc., and they want to approximate these by corresponding structures on matrix algebras. The main part of my talk will consist of indicating how to do this for vector bundles. One would like to be able to say that for two compact quantum metric spaces that are close together, to a given vector bundle on one of them there corresponds a unique vector bundle on the other. Even for ordinary compact metric spaces and ordinary Gromov-Hausdorff distance it is not so obvious how to do this.

• **Dimitri Shlyakhtenko** (shlyakht@math.ucla.edu) University of California, Los Angeles
Title: *Von Neumann algebras of sofic groups with $\beta_1^{(2)} = 0$ are strongly 1-bounded*

Abstract. We show that if Γ is a finitely generated finitely presented sofic group with zero first L^2 Betti number and containing an element of infinite order, then the von Neumann algebra $L(\Gamma)$ is strongly 1-bounded in the sense of Jung. In particular, $L(\Gamma) \ncong L(\Lambda)$ if Λ is any group with free entropy dimension > 1, for example a free group. The key technical result is a short proof of an estimate of Jung using non-microstates entropy techniques.

• **Graeme Smith** (gsbsmith@gmail.com) IBM Research
Title: *Additivity of entropic formulas*

Abstract. Information theory quantifies the optimal rates of resource interconversions, usually in terms of entropies. However, nonadditivity often makes evaluating entropic formulas intractable. In a few auspicious cases, additivity allows a full characterization of optimal rates. We study uniform additivity of formulas, which is easily assessed and captures all known additive quantum formulas. Our characterization of uniform additivity exposes an interesting new additive quantity and identifies a surprising coincidence—the classical and quantum uniformly additive functions are identical.

• **Piotr Sołtan** (piotr.soltan@fuw.edu.pl) Department of Mathematical Methods in Physics, Faculty of Physics, University of Warsaw
Title: *Homomorphisms of locally compact quantum groups, quantum subgroups and integrability*

Abstract. Operator algebras provide a very efficient framework to study locally compact quantum groups. After a brief introduction to the theory of locally compact quantum groups I will describe the concept of a homomorphism from one locally compact quantum group to another and several related notions. I will present recent results about integrability of actions of locally compact quantum groups associated to homomorphisms. The results will be applied to special kinds of homomorphisms, namely those identifying one quantum group with a closed quantum subgroup of another.

• **Reiji Tomatsu** (tomatsu@math.sci.hokudai.ac.jp) Hokkaido University, Japan
Title: *A characterization of fullness of continuous cores of type III free product factors*

Abstract. We show that the fullness of the core von Neumann algebra of a free product factor follows from the triviality of Connes' τ-invariant.

(*) Joint work with Yoshimich Ueda.

• **Andrew Toms** (atoms@purdue.edu) Purdue University
Title: *Regularity in C^*-dynamical systems*

• **Bogdan Udrea** (bogdanteodor-udrea@uiowa.edu) University of Iowa
Title: *The structural properties of the generalized q-gaussian von Neumann algebras with coefficients*

Abstract. We report on recent progress in the study of the generalized q-gaussian von Neumann algebras with coefficients introduced by Marius Junge and myself. These von Neumann algebras were shown to possess a number of remarkable structural properties, notably relative strong solidity, when the Hilbert space they are built over is finite dimensional. Our recent results show that the generalized q-gaussians are relatively strongly solid for infinite dimensional separable Hilbert spaces as well.

(*) This is joint work with Marius Junge.

• **Dan-Virgil Voiculescu** (dvv@math.berkeley.edu) University of California, Berkeley
Title: *The bi-free extension of free probability*

Abstract. I will discuss the recent extension of free probability to systems with left and right variables. This includes the bi-free R- , S- and T- transforms for the computation of the three bi-free convolutions in the plane and bi-free extreme values in the plane.

• **Quanhua Xu** (qxu@univ-fcomte.fr) Université de Franche-Comté, France
Title: *Free group hypercontractivity*

Abstract. We discuss some recent results on the optimal hypercontractivity for the Poisson semigroup $(P_t)_{t>0}$ of a free group von Neumann algebra $vN(\mathbb{F})$. The optimal hypercontractivity conjecture for $(P_t)_{t>0}$ asserts that

$$\|P_t\|_{p\to q} \leqslant 1 \;\Leftrightarrow\; t \geqslant \log\sqrt{\frac{q-1}{p-1}}\,,$$

for any $1 < p < q < \infty$, where $\|P_t\|_{p\to q}$ denotes the norm of P_t from $L_p(vN(\mathbb{F}))$ to $L_q(vN(\mathbb{F}))$, $L_p(vN(\mathbb{F}))$ being the noncommutative L_p-space associated to $vN(\mathbb{F})$.

We confirm this conjecture in the case where $p = 2$ and $q \geqslant 4 - \varepsilon_0$ for some $\varepsilon_0 > 0$. The proof is based on the following noncommutative martingale convexity inequality: For any finite von Neumann algebra $\mathcal{M}$ and any von Neumann subalgebra $\mathcal{N} \subset \mathcal{M}$

$$\|x\|_p^2 \geqslant \|\mathcal{E}(x)\|_p^2 + (p-1)\|x - \mathcal{E}(x)\|_p^2, \quad x \in L_p(\mathcal{M}),\ 1 < p \leqslant 2,$$

where $\mathcal{E}$ is the trace preserving conditional expectation from $\mathcal{M}$ onto $\mathcal{N}$. This inequality extends the celebrated Ball-Carlen-Lieb convexity inequality for Schatten classes.

(*) The talk is based on a joint work with Eric Ricard.

• **Guoliang Yu** (guoliangyu@math.tamu.edu) Texas A&M University

Title: *Algebraic K-theory of group algebras and the Kaplansky conjecture*

Abstract. The Kaplansky conjecture states that there exists non nontrivial idempotent for group algebras when the group is torsion free. I will explain how computations of algebraic K-theory can be used to prove this conjecture under certain finiteness condition on the group.

(*) This is joint work with Zhizhang Xie.

2. Contributed Talks

- **Konrad Aguilar** (konrad.aguilar@du.edu) University of Denver
  Title: *Quantum ultrametrics on AF algebras and the Gromov-Hausdorff propinquity*

Abstract. We construct quantum metric structures on unital AF algebras with a faithful tracial state, and prove that for such metrics, AF algebras are limits of their defining inductive sequences of finite-dimensional C^*-algebras for the quantum propinquity metric. We then study the geometry, for the quantum propinquity, of three natural classes of AF algebras equipped with our quantum metrics: the UHF algebras and the Effros-Shen AF algebras associated with continued fraction expansions of irrationals, which both form continuous images of the Baire space, and the Cantor space, on which our construction recovers traditional ultrametrics.

(*) Joint work with Frédéric Latrémolière.

- **Wafaa Albar** (walbar2@illinois.edu) University of Illinois at Urbana-Champaign
  Title: *The noncommutative AGM inequality*

Abstract. Arithmetic geometric mean inequality is one of the important inequality in analysis since it has many application in mathematics. In this project, we generalize the concept of AGM inequality in operator sense. We study both inequalities for self-adjoint operators in order sense and norm sense,

$$\frac{1}{n!}\sum_{\sigma\in S_n} A_{\sigma(1)}\cdots A_{\sigma(n)} \leqslant \left(\frac{1}{n}\sum_{j=1}^{n} A_j\right)^n$$

and

$$\left\|\frac{1}{n!}\sum_{\sigma\in S_n} A_{\sigma(1)}\cdots A_{\sigma(n)}\right\| \leqslant \left\|\left(\frac{1}{n}\sum_{j=1}^{n} A_j\right)^n\right\|.$$

Inspired by Pisier's interpretation for Rota's result on Möbius transforms for partitions and some other simple techniques from basic analysis, we prove the NC-AGM inequalities in norm and order sense. In this talk I will present these results with interesting applications for the AGM inequalities for random matrices.

(*) This is joint work with Marius Junge and Mingyu Zhao.

- **Dawn Archey** (archeyde@udmercy.edu) University of Detroit Mercy
  Title: *Permanence of stable rank one for centrally large subalgebras and crossed products by minimal homeomorphisms*

Abstract. (draft) We define centrally large subalgebras of simple unital C^*-algebras, strengthening the definition of large subalgebras in previous work. We prove that if A is any infinite dimensional simple separable unital C^*-algebra which contains a centrally large subalgebra with stable rank one, then A has stable rank one. We also prove that large subalgebras of crossed product type are automatically centrally large. We use these results to prove that if X is a compact metric space which has a surjective continuous map to the Cantor set, and $h\colon X \to X$ is a minimal homeomorphism, then $C^*(\mathbb{Z}, X, h)$ has stable rank one, regardless of the dimension of X or the mean dimension of h. In particular, the Giol-Kerr examples give crossed products with stable rank one but which are not stable under tensoring with the Jiang-Su algebra and are therefore not classifiable in terms of the Elliott invariant.

(*) This is joint work with N. Christopher Phillips.

• **Rene Ardila** (rene-ardila@uiowa.edu) University of Iowa
Title: *Morita equivalence of W^*-correspondences and their Hardy algebras*

Abstract. We extend the notion of Morita equivalence of C^*-correspondences, developed by Muhly and Solel, to the setting of W^*-correspondences and show that if two W^*-correspondences, E and F, are (weakly) Morita equivalent, then their Hardy algebras, $H^\infty(E)$ and $H^\infty(F)$, are weakly Morita equivalent as dual operator algebras. We give applications of this result to the study of induced representations of Hardy algebras of W^*-graph correspondences.

• **Richard Baker** (richard-baker@uiowa.edu) University of Iowa
Title: *Labeled Leavitt path algebras: finiteness conditions*

Abstract. We introduce, over arbitrary fields, **Labeled Leavitt Path Algebras** associated to labeled graphs. We state the **Direct Sum Uniqueness Theorem** for these algebras. We define **Finiteness Conditions** for such algebras. Using the direct sum uniqueness theorem, we show that certain labeled Leavitt path algebras that satisfy these finiteness conditions are algebraically isomorphic to the (plain) Leavitt path algebra of the underlying directed graph of the labeled graph.

• **Choiti Bandyopadhya** (choiti@ualberta.ca) University of Alberta, Canada
Title: *Analysis on semihypergroups*

Abstract. The theory of hypergroups and semihypergroups allows a detailed study of various important measure algebras. These concepts are sufficiently general to cover a variety of interesting special cases such as coset and double coset spaces, certain orbit spaces, orthogonal polynomial spaces *etc.*, but yet have enough structure to allow an independent theory to develop.

Since their introduction back in 1972, the theory of hypergroups has developed in several directions including the area of commutative hypergroups, weighted hypergroups and amenability of several function spaces on it. But unfortunately no systematic study as been done so far on semihypergroups. In our talk, we will present a brief overview of some analytic properties associated to semihypergroups including semihypergroup actions, free products, ideals and homomorphisms and several function spaces on it.

• **Angshuman Bhattacharya** (angshu@uga.edu) University of Georgia
Title: *Kirchberg's factorization property for discrete quantum groups*

Abstract. In 1964, Takesaki showed that the product of the left and right regular representations of the reduced C^*-algebra of the free group on two generators on $l^2(\mathbb{F}_2)$ is not continuous. Later Wasserman showed that the product representation is continuous if the full group algebra is considered instead of the reduced one. Kirchberg isolated this property for discrete groups and called it the factorization property. In this talk we will introduce the factorization property for discrete quantum groups and show that the discrete duals to the universal orthogonal and unitary compact quantum groups have this property for all natural numbers other than 3.

(*) This is joint work with Shuzhou Wang.

- **Tristan Bice** (Tristan.Bice@gmail.com) Federal University of Bahia
  Title: *C^*-algebra distances*

  Abstract. We discuss some non-symmetric distances that naturally arise in C^*-algebras and demonstrate their utility in simplifying and generalizing certain order theoretic aspects of C^*-algebra theory. For example, we outline how to use them to extend the C*-algebra semicontinuity theory of Akemann, Brown and Pedersen to more general ordered Banach spaces. We also show how they provide a new perspective on the norm/quantum filters in C^*-algebras introduced by Farah and Weaver.

- **James Boland** (jaboland@tcd.ie) Trinity College Dublin, Ireland
  Title: *Approximating quasinilpotents by generalised nilpotents*

  Abstract. Generalised nilpotents are operators, $T \in \mathcal{B}(X)$, on a Banach space X such that $\cup_{n=1}^{\infty} \ker T^n$ is dense in X. We show that quasinilpotents, i.e. operators with spectral radius equal to 0, can be approximated by generalised nilpotents on spaces X that have a finite dimensional p-block decomposition, or spaces where the dual X^* has such a decomposition. We present some applications of this result to the norm closure of the hypercyclic operators on such spaces including isomorphic preduals of ℓ^1 such as the complexification of the Argyros-Haydon space and variants due to Tarbard and Kania & Laustsen.

- **Jonathan Brown** (jbrown10@udayton.edu) University of Dayton
  Title: *Purely infinite etale groupoid C^*-algebras*

  Abstract. Many C^*-algebras, including graph and higher-rank graph algebras, have etale groupoid models. So the classification of etale groupoid C^*-algebras has wide applicability. The seminal work of Kirchberg and Phillips showed that simple nuclear purely infinite C^*-algebras (Kirchberg Algebras) satisfying the UCT can be classified by their ordered K-theory. It is thus interesting from a classification perspective to know which etale groupoids yield Kirchberg algebras and for this it is essential to understand precisely when an etale groupoid yields a purely infinite C^*-algebra. In this talk we show that a simple etale groupoid C^*-algebra is purely infinite if the nonzero positive elements of a canonical Cartan MASA are infinite. We further reduce these criteria in the case of higher rank graph groupoids.

  (*) This work is joint with L. Clark and A. Sierakowski.

- **Branimir Ćaćić** (branimir@math.tamu.edu) Texas A&M University
  Title: *Spectral triples for discrete groups*

  Abstract. The Pontrjagin dual of an Abelian discrete group is a compact topological group, but if the Abelian discrete group is finitely generated, then its dual is actually a Lie group. The reduced group C^*-algebra of a non-Abelian discrete group is certainly a compact quantum group, but under what conditions can we endow it with the structure of a noncommutative manifold? In this talk, I'll recall Connes's construction of spectral triples for discrete groups endowed with a proper length function, and then I'll discuss how to refine this construction for discrete groups endowed with a proper array, e.g., groups with the Haagerup property together with a witnessing proper 1-cocycle, at the price of working with unbounded KK-cycles.

  (*) This is joint work in progress with Steve Avsec.

• **José Carrión** (j.carrion@tcu.edu) Texas Christian University
Title: *Order zero approximations of nuclear C^*-algebras*

Abstract. Nuclear C*-algebras enjoy a number of approximation properties, most famously the completely positive approximation property. The CPAP was sharpened by Hirshberg, Kirchberg and White, who arranged the incoming maps to be sums of order zero maps. We discuss a further improvement where the outgoing maps can be chosen asymptotically order-zero. The approximations can be improved further under some quasidiagonal assumptions. This is joint work with Nate Brown and Stuart White.

• **Simone Cecchini** (cecchini.s@husky.neu.edu) Northeastern University, Boston
Title: *Callias-type operators in C^*-algebras and positive scalar curvature on noncompact manifolds*

Abstract. A Dirac-type operator on a complete Riemannian manifold is of Callias-type if its square is a Schrödinger-type operator with a potential uniformly positive outside of a compact set. We present an index theorem for Callias-type operators twisted with Hilbert C^*-module bundles. As an application, we derive an obstruction to the existence of Riemannian metrics of positive scalar curvature on noncompact spin manifolds in terms of closed submanifolds of codimension one.

• **Alexandru Chirvasitu** (chirva@uw.edu) University of Washington
Title: *Residual finite-dimensionality for C^* pushouts*

Abstract. We provide a necessary and sufficient condition for the residual finite-dimensionality of an amalgamated free product $A *_D B$ of unital C^*-algebras in terms of finite-dimensional representations of A and B that agree on D. This extends results by Exel, Li, Armstrong, Dykema, Shen and Li that provide analogous criteria when D is finite-dimensional, as well as a result of Korchagin regarding the residual finite-dimensionality of pushouts of commutative C^*-algebras.

• **Raphael Clouatre** (raphael.clouatre@umanitoba.ca), University of Manitoba, Canada
Title: *Representations of multiplier algebras of complete Pick spaces on the ball*

Abstract. We study a concrete class of non-self-adjoint operator algebras, namely multiplier algebras of certain complete Pick spaces on the unit ball. Rather than focusing on function theory, we adopt a representation theoretic point of view.

Based on previous work of Agler and Ambrozie-Engliš-Müller, we show that every completely contractive representation can be co-extended to a $*$-homomorphism of the associated Toeplitz-type algebra. We also describe when these representations have the unique extension property, and calculate the Choquet boundary and C^*-envelope.

(*) This is joint work with Michael Hartz.

- **Danny Crytser** (crytser@ksu.edu) Kansas State University
  Title: *Traces arising from regular inclusions*

  Abstract. We study the problem of extending a state on an abelian C^*-subalgebra to a tracial state on the ambient C^*-algebra. We propose an approach that is well-suited to the case of regular inclusions, in which there is a large supply of normalizers of the subalgebra. Conditional expectations onto the subalgebra give natural extensions of a state to the ambient C^*-algebra; we prove that these extensions are tracial states if and only if certain invariance properties of both the state and conditional expectations are satisfied. In the example of a groupoid C^*-algebra, these invariance properties correspond to invariance of associated measures on the unit space under the action of bisections. Using our frame- work, we are able to completely describe the tracial state space of a Cuntz-Krieger graph algebra. Along the way we introduce certain operations called graph tightenings, which both streamline our description and provides connections to related finiteness questions in graph C^*-algebras. Our investigation has close connections with the so-called unique state extension property and its variants.
  (*) Joint work with Gabriel Nagy.

- **Valentin Deaconu** (vdeaconu@unr.edu) University of Nevada, Reno
  Title: *The Cuntz-Pimsner algebra of a group representation*

  Abstract. Given a locally compact group G and a unitary representation $\rho : G \to U(\mathcal{H})$ on a Hilbert space $\mathcal{H}$, we construct a C^*-correspondence $\mathcal{E} = \mathcal{H} \otimes_{\mathbb{C}} C^*(G)$ over $C^*(G)$ and study the Cuntz-Pimsner algebra $\mathcal{O}_{\mathcal{E}}$. We prove that for G compact, $\mathcal{O}_{\mathcal{E}}$ is strongly Morita equivalent to a graph C^*-algebra, so its K-theory can be computed from the incidence matrix of the graph. If G is infinite, discrete and amenable we show that $\mathcal{O}_{\mathcal{E}}$ constructed from the left regular representation is simple and purely infinite, with the same K-theory as $C^*(G)$. If G is compact abelian, any representation decomposes into characters and determines a skew product graph. We illustrate with some examples.

- **Andrew Dean** (andrew.j.dean@lakeheadu.ca) Lakehead University, Canada
  Title: *Classification of inductive limit type actions of finite dimensional quantum groups on AF C^*-algebras*

  Abstract. A K-theoretic classification is given for actions of finite dimensional quantum groups arising from inductive limits of inner actions on finite dimensional C^*-algebras. The invariant used consists of the ordered K_0 of the smash product constructed from the action, endowed with a module structure and a distinguished element.

- **Gilles de Castro** (gillescastro@gmail.com) Universidade Federal de Santa Catarina, Brazil
  Title: *An inverse semigroup approach to C^*-algebras of labeled graphs*

  Abstract. The notion of C^*-algebras of labelled graphs was developed by Bates and Pask. Such algebras generalize, among others, Cuntz-Krieger algebras, Exel-Laca algebras and graph algebras. The main goal of this work is to use Exel's framework on how to construct a C^*-algebra from an inverse semigroup applied to one that is defined from the C^*-algebras defined by Bates and Pask. When studying the spectrum of the diagonal C*-subalgebra, we realize that we need to make a small modification to the definition given by Bates and Pask, in order for it to be homeomorphic to tight spectrum arising from the inverse semigroup.

• **Abdelkader Dehici** (dehicikader@yahoo.fr) University of Souk-Ahras, Algeria
Title: *West decomposition of Riesz operators on the Schlumprecht space S and the space of Gowers-Maurey X_{GM}*

Abstract. In (1966), T. West showed that if X is a Hilbert space, then each Riesz operator R can be written under the form $R = K + Q$ where K is a compact operator and Q is quasinilpotent (its spectrum is reduced to the set $\{0\}$), twenty years after, K. Davidson and D. Herrero (1986) established this decomposition for Riesz operators on the spaces l_p $(1 \leq p < \infty)$ and c_0 or more generally on the spaces having finite dimensional p-Block decomposition (FDPBD) written as an infinite direct sum of finite dimensional spaces. In (1988), H. Zhong proved that this decomposition is true if $X = L_p(\mu)$ $(1 < p < \infty)$ or more generally if X is B-convex Banach space and finally in (1995), the last author proved that the result holds for the case of local strong subprojective Banach spaces, in particular, he proved its validity on the Tsirelson space. On the other hand, as each Banach space X has a Rademachers type $p(X) \in [1, 2]$ and the fact that $1 < p(X)$ is equivalent to the fact that X is a B-convex Banach space implies the necessity to show the West decomposition of Riesz operators on Banach spaces with type 1. In this talk, we show that this decomposition is true on the case of arbitrary distortable Banach space of Schlumprecht S, its dual S^*, the space of Gowers-Maurey X_{GM} and its dual X^*_{GM}.

• **Jack Dodson** (dodson.jackw@gmail.com) The University of Memphis
Title: *The nonrelativistic limit of the Klein-Gordon equation*

Abstract. Two of the major pillars of twentith century physics are relativity and quantum mechanics. According to the correspondence principle in physics, relativistic quantum mechanics should reduce to nonrelativistic quantum mechanics in the appropriate limit. This is usually taken as a postulate by physicists, although rigourous mathematical proofs exist. We expand and simplify the current proof in the case of the Klein-Gordon equation by using pertubation theory and the spectral theorem for selfadjoint operators.

• **Allan Donsig** (adonsig@unl.edu) University of Nebraska-Lincoln
Title: *Cartan pairs, inverse semigroups, and bimodules*

Abstract. Recently, Adam Fuller, David Pitts, and I developed a reformulation of Feldman-Moore's classification of von Neumann algebras containing Cartan MASAs in terms of certain extensions of inverse semigroups. We apply this formulation to study the (Bures-closed) bimodules of Cartan MASAs, including von Neumann subalgebras. Then we show how the reformulation extends to von Neumann algebras containing a regular abelian subalgebra with a conditional expectation onto the commutant of the subalgebra.

• **Adam Dor-On** (adoron@uwaterloo.ca) University of Waterloo, Canada
Title: *Matrix convex sets: dilations, inclusions and completely positive interpolation*

Abstract. A matrix convex set is a stratified set of the form $\mathcal{S} = \cup_{n\geq 1}\mathcal{S}_n$, where each $\mathcal{S}_n$ is comprised of d-tuples of $n \times n$ matrices, and is closed under taking direct sums and applying unital completely positive maps from M_n to M_k.

Given two matrix convex sets $\mathcal{S}$ and $\mathcal{T}$, we find geometric conditions on $\mathcal{S}$ or o n $\mathcal{T}$, to ensure that $\mathcal{S}_1 \subset \mathcal{T}_1$ implies $\mathcal{S} \subset C \cdot \mathcal{T}$ for some constants $C > 0$. Under various symmetry conditions on $\mathcal{S}$ we can guarantee that $C = d$, the number of variables, and that this is optimal in a sense.

Our results have implications to spectrahedral inclusion problems and completely positive interpolation, as studied recently by Helton, Klep, McCullough and Schweighofer.

(*) Joint work with Kenneth R. Davidson, Orr Moshe Shalit and Baruch Solel.

• **Catalin Dragan** (draganc n@mail.uc.edu) University of Cincinnati
Title: *Norms associated to weights in von Neumann algebras*

Abstract. Given a normal, semifinite weight on a von Neumann algebra we associate a norm to it. The study of these norms was initiated by Popa and Radulescu when looking at the ideal of compact operators in a semifinite von Neumann algebra. Using the notion of singular values we give a complete description in the case where the algebra is a semifinite factor or the weight is a trace. We show that these norms are useful in generalizing to the von Neumann algebra setting the classical Hilbert space result: the dual of the ideal of compact operators is the ideal of trace class operators.

(*) This is jont with Victor Kaftal and Laszlo Zsido.

• **Dorin Dumitraşcu** (ddumitrascu@adrian.edu) Adrian College
Title: *A direct proof of K-amenability for T-menable groups*

Abstract. For amenable groups, the maximal group C^*-algebra $C^*(G)$ and the reduced groups C^*-algebra $C^*_r(G)$ are isomorphic. In the early 1980's, Cuntz, for discrete groups, then Julg and Valette, for non-discrete groups, introduced a weaker concept of K-amenability, which implies the isomorphism of these two group C^*-algebras at the level of K-theory. In the late 1990's, Higson and Kasparov proved the Baum-Connes conjecture for all the a-T-menable groups. These are groups that admit a continuous affine isometric and metrically proper action on some real Hilbert space H. As a consequence of the Baum-Connes conjecture, it follows that the a-T-menable groups are K-amenable. In this presentation we give a new proof of this result. Our approach is new in at least two aspects. First, we construct a homotopy between the unit 1_G in the representation ring of G and a Fredholm G-module whose representations are weakly contained in the left-regular representation. Second, we perform our computations in the bivariant K-theory for C^*-algebras, called KE-theory, constructed by the presenter.

(*) This is joint work with Nigel Higson.

- **Kimberly Duran** (kimalduran@gmail.com) University of Memphis
  Title: *Spaces of matrix affine functions as real operator systems*

  Abstract. Matrix affine maps on matrix convex sets are a noncommutative generalization of scalar-valued affine maps on convex sets. It is known that certain subspaces of the bounded operators on a Hilbert space can be characterized as spaces of complex matrix affine maps. In this paper we provide a concrete characterization of the two-dimensional operator systems and demonstrate that this differs from complex spaces.

  (*) Joint work with R. Araiza, H. Buyu, K. DURAN, D. Hay, R. Morris, S. Samarakoon

- **Keenan Eikenberry** (keikenbe@asu.edu) Arizona State University
  Title: *k-graphs from Cayley graphs*

  Abstract. Higher-rank graphs, or k-graphs, are higher-dimensional analogues of directed graphs, and as with ordinary directed graphs, there are various C^*-algebraic objects that can be associated with them, including Cuntz-Krieger and Toeplitz algebras. In this talk, I will explain how to obtain k-graphs from the Cayley graphs of finitely generated groups. Moreover, it is shown that the process of going from a group to a graph algebra is functorial: there is a functor from a category of finitely generated groups to the category of C^*-algebras.

- **Farzad Fathizadeh** (farzadf@caltech.edu) California Institute of Technology
  Title: *Modular forms in the spectral action of Bianchi-IX gravitational instantons*

  Abstract. In a succession of papers, physicists and mathematicians have achieved an explicit parameterization of Bianchi-IX gravitational instantons in terms of theta functions with characteristics. By exploiting the latter, in this talk, I will shed light on a rationality phenomena in the spectral action of $SU(2)$-invariant Bianchi-IX metrics. This will be done by showing that for the instantons, each term in the expansion of their spectral action gives rise to a modular form of weight 2 that can be written explicitly in terms of well-known modular forms, namely the Eisenstein series and the modular discriminant. An elegant proof of the rationality result will also be presented, which is based on expressing Seeley-de Witt coefficients as noncommutative residues of Laplacians.

  (*) This talk is based on joint works with Wentao Fan and Matilde Marcolli.

- **Li Gao** (ligao3@illinois.edu) University of Illinois at Urbana-Champaign
  Title: *Continous perturbations of Heisenberg relations and of noncommutative tori*

  Abstract. The Heisenberg commutation relation, $PQ - QP = -iI$, is one of the fundamental relations of quantum mechanics. U. Haagerup and M. Rørdam proved that for an infinite multiplicity representation (P, Q) of the Heisenberg relation on a Hilbert space H, there exists a commuting pair of self-adjoint operators (P_0, Q_0) on H such that $P - P_0$ and $Q - Q_0$ are bounded. This was applied to construct $\mathrm{Lip}^{\frac{1}{2}}$ continous paths u, v from $[0, 1]$ into the unitary group $U(H)$ such that $u(\theta)v(\theta) = e^{2\pi\theta i}v(\theta)u(\theta)$ for all $\theta \in [0, 1]$. Each pair $(u(\theta), v(\theta))$ is a canonical generator of the rotation C^*-algebra A_θ, the universal C^*-algebra generated by two unitaries u, v satisfying $uv = e^{2\pi\theta i}vu$.

  In this talk, we will construct a continuous perturbation of Heisenberg relations as a combination of the two results above. Moreover this is generalized to dimension $d \geqslant 2$ for noncommutative Euclidean spaces and noncommutative tori.

• **Elizabeth Gillaspy** (elizabeth.gillaspy@colorado.edu) University of Colorado, Boulder
Title: *Irreducible representations of nilpotent groups generate classifiable C^*-algebras*

Abstract. In 2015, Eckhardt and McKenney proved that for any finitely generated torsion-free nilpotent group G, the C^*-algebra $C^*_\pi(G)$ generated by a faithful irreducible representation π of G is classifiable by its Elliott invariant. This talk will present the generalization of the Eckhardt-McKenney result to the case of arbitrary finitely generated nilpotent groups, which relies primarily on showing that $C^*_\pi(G)$ satisfies the UCT. Along the way, we also show that $C^*_\pi(G)$ is a cutdown of a twisted group C^*-algebra.

(*) This is joint work with Caleb Eckhardt.

• **Andrew Greene** (andrew.greene@manhattan.edu) Manhattan College, Riverdale, NY
Title: *Completely contractive Hilbert module extensions over directed graph tensor algebras*

Abstract. Completely contractive Hilbert space representations of a directed graph can be described in terms of row operators corresponding to collections of edges terminating at a common vertex. We use Schur parameters to study extensions of their completely contractive Hilbert modules.

• **Manjul Gupta** (manjul@iitk.ac.in) Department of Mathematics and Statistics, Indian Institute of Technology Kanpur, Kanpur 208 016, UP, India.
Title: *q-Frequent hypercyclicity in spaces of operators*

Abstract. For $q \in \mathbb{N}$ (the set of natural numbers), an operator T defined on a separable Banach space X is said to be *q-frequently hypercyclic* if there exists a vector $x \in X$, called a *q-frequently hypercyclic vector,* such that for any non-empty open subset U of X, the set $N(x,U) = \{n \in \mathbb{N} : T^n(x) \in U\}$ has positive q-lower density; where the *q-lower density* of $A \subset \mathbb{N}$ is defined as

$$q - \underline{\text{dens}}(A) = \liminf_{N\to\infty} \frac{\text{card}\{n \in A : \ n \leq N^q\}}{N}.$$

In this talk, we consider conditions for linear maps of the form $C_{R,T}(S) = RST$ to be q-frequently hypercyclic on spaces of operators on separable Banach spaces. In particular, if R is a bounded operator satisfying the q-Frequent Hypercyclicity Criterion, then the maps $C_R(S) = RSR^*$ is shown to be q-frequently hypercyclic on the space $\mathcal{K}(H)$ of all compact operators and the real topological vector space $\mathcal{S}(H)$ of all self-adjoint operators on a separable Hilbert space H. Further, a condition for $C_{R,T}$ to be q-frequently hypercyclic on the Schatten von-Neumann classes $\mathcal{S}_p(H)$ has also been provided. Finally, we also consider some applications to the weighted shift operators on sequence spaces.

(*) Joint work with Aneesh M.

• **Michael Hartz** (mphartz@uwaterloo.ca) University of Waterloo, Canada
Title: *von Neumann's inequality for commuting weighted shifts*

ABSTRACT. von Neumann's inequality asserts that if T is a contraction on a Hilbert space and p is a polynomial, then

$$\|p(T)\| \leqslant \sup\{|p(z)| : |z| \leqslant 1\}.$$

While Ando's dilation theorem implies an analogous inequality for pairs of commuting contractions, the corresponding statement for triples of commuting contractions is false. The first counterexamples were found by Kaijser-Varopoulos and Crabb-Davie in the early seventies, but this phenomenon is still not well understood.

I will talk about a result which shows that von Neumann's inequality holds for a particularly tractable class of commuting contractions, namely multivariable weighted shifts. This provides a positive answer to a question of Lubin and Shields from 1974.

• **Leonard Huang** (lhuang@ku.edu) The University of Kansas
Title: *A twisted-equivariant version of Kasparov's Stabilization Theorem*

ABSTRACT. Kasparov's Stabilization Theorem states that for any given C^*-algebra A, every countably generated Hilbert A-module is isomorphic to an orthogonal direct summand of the standard Hilbert A-module $\mathcal{H}_A$. This result plays an important role in operator KK-theory. Ralf Meyer proved an equivariant version of it by specifying, for any C^*-dynamical system (G, A, α), necessary and sufficient conditions for a Hilbert (G, A, α)-module to be isomorphic to a G-invariant orthogonal direct summand of the countable direct sum $\bigoplus_{n=1}^{\infty} \big(L^2(G) \otimes A, \Gamma\big)$, where Γ is a suitably defined strongly continuous G-action on $L^2(G) \otimes A$ by linear isometries. In my attempt to construct generalized fixed-point algebras for square-integrable representations of a twisted C^*-dynamical system (G, A, α, ω) for my doctoral dissertation, I was led to the concept of a Hilbert (G, A, α, ω)-module, which I realized could be used to formulate a twisted-equivariant version of Kasparov's Stabilization Theorem. This talk will present the details of my result.

• **Marius Ionescu** (ionescu@usna.edu) United States Naval Academy
Title: *Obstructions to lifting cocycles on groupoids to the associated C^*-algebras*

ABSTRACT. Given an etale groupoid Γ and an abelian group A, the set $Z_\Gamma(A)$ of continuous cocycles from Γ to A forms an abelian group and it is a functor. A short exact sequence of abelian groups induces a left exact sequence of the group of cocycles. The obstruction to lifting a cocycle is given by a twist over Γ. In this talk that is based on join work with Alex Kumjian I will present some properties of these groupoid twists. The main results implies that the C^*-algebra of such a twist is *-isomorphic to the induced algebra as described in work by Raeburn, Rosenberg, and Williams.

• **Cristian Ivanescu** (ivanescuc@macewan.ca) MacEwan University
Title: *The Cuntz semigroup of the tensor product C^*-algebras*

ABSTRACT. In the early 2000s, work by A. Toms prompted major questions regarding the Cuntz semigroup. In our work we study how the Cuntz semigroup of the tensor product of two identical algebras $A \otimes A$ relates to the Cuntz semigroup of A. A natural tensor product map can be constructed. We report on surjectivity property of this map.

(*) Joint work with Dan Kucerovsky (UNB).

• **Victor Kaftal** (Kaftalv@ucmail.uc.edu) University of Cincinnati
Title: *The integer in Kadison's Pythagorean Theorem and essential codimension*

Abstract.

Theorem 1 (Kadison's Pythagorean Theorem, 2002)**.** *Let d_n with $1 \geqslant d_n \geqslant 1$ and*

$$a = \sum_{d_n \leqslant \frac{1}{2}} d_n \qquad \text{and} \qquad b = \sum_{d_n > \frac{1}{2}} (1 - d_n),$$

then the sequence $\{d_n\}$ is the diagonal of a projection $q \in B(\mathcal{H})$ ($d_n = (qe_n, e_n)$ $\forall n$ for some o.n. basis $\{e_n\}$) if and only if either

(i) $a + b = \infty$, *or*
(ii) $a + b < \infty$ *and* $a - b \in \mathbb{Z}$.

Arveson (2007), Kaftal, Ng, Zhang (2009), and Argerami (2015) also proved the integrality condition ($a - b \in \mathbb{Z}$). Kaftal and Larson noticed that the KNZ proof showed that $a - b$ is the index of a frame transform associated with the projection and its diagonal sequence. Douglas suggested *essential codimension* (thanks!).

Theorem 2. *If $a + b < \infty$, and p the projection on span$\{e_n \mid d_n > \frac{1}{2}\}$, then*

(i) $q - p$ *is Hilbert-Schmidt;*
(ii) $a - b = [q : p]$, *the essential codimension of q and p;*
(iii) $a - b = ind\{q, p\}$, *the index of the Fredholm pair $\{p, q\}$.*

The same method provides also a simpler proof of the integrality condition in the Bownik and Jasper (2015) extension of Kadison's Pythagorean Theorem to selfadjoint operators with finite spectrum.

I will give a brief introduction to the notions of essential codimension, its generalization of Fredholm pairs, with a cameo appearance for generic position of two projections and connection with frame transforms.

(*) This is a report on joint work with Jireh Loreaux.

• **Byung-Jay Kahng** (kahngb@canisius.edu) Canisius College
Title: *On a class of C^*-algebraic locally compact quantum groupoids*

Abstract. Motivated by the purely algebraic notion of "weak multiplier Hopf algebras", we develop the definition of a locally compact quantum groupoid in the $C*$-algebra framework. Existence of a certain canonical idempotent element plays an important role. As in the quantum group case, we require left and right Haar weights but the antipode is not explicitly defined. From the Haar weights, we construct two fundamental partial isometries, which are in general not unitary.

In this talk, after giving a brief overview of the defining ingredients, we will turn our attention to discussing how the antipode map is constructed from the axioms. While the overall approach is similar to the quantum group case, we will point out some uniquely nontrivial issues, arising from the fact that the comultiplication is no longer non-degenerate and the partial isometries are not unitary. This class would contain all locally compact quantum groups, and form a self-dual category.

(*). This is based on an on-going joint work with Alfons Van Daele (Leuven).

- **Steve Kaliszewski** (kaliszewski@asu.edu) Arizona State University
  Title: *Exotic crossed products and noncommutative duality*

  Abstract. When a locally compact group G acts on a C^*-algebra A, we have both full and reduced crossed products, each carries a dual coaction of G, and each has its own version of crossed-product duality. Inspired by work of Brown and Guentner on new C^*-completions of group algebras, we have begun to understand what we call "exotic" crossed products — C^*-algebras that lie between the familiar full and reduced crossed products — and more generally, "exotic coactions". Some of these satisfy a corresponding exotic crossed product duality, intermediate between full and reduced duality; they are also related to the crossed-product functors used recently by Baum, Guentner, and Willett in a new approach to the Baum-Connes conjecture.
  (*) This is joint work with Magnus Landstad and John Quigg.

- **Ehssan Khanmohammadi** (ehssan@fandm.edu) Franklin and Marshall College
  Title: *On the positivity of Kirillov's Character Formula*

  Abstract. Kirillov proved his character formula for simply connected nilpotent Lie groups in 1962 and conjectured its universality. The validity of this conjecture has been verified for some other classes of Lie groups, most notably for the case of tempered representations of reductive Lie groups by Rossmann.
  In this talk I explain how a positivity property of Kirillov's character formula can be used in constructing group representations.

- **Craig Kleski** (kleskic@miamioh.edu) Miami University
  Title: *A noncommutative Bishop-de Leeuw theorem*

  Abstract. The Bishop-de Leeuw theorem asserts the equivalence of various sort of peaking phenomena for function spaces in $C(X)$. We discuss a noncommutative version of this theorem for an operator system S in $B(H)$ in terms of either the representations of $C^*(S)$ or of $C_e^*(S)$. Under certain conditions on S, $C^*(S)$, or $C_e^*(S)$, we exhibit connections between Choquet points and noncommutative peak points.

- **Alex Kumjian** (alex@unr.edu) University of Nevada, Reno
  Title: *Twisted topological graph C^*-algebras*

  Abstract. Hui Li showed in his thesis that Katsuras construction of the C^*-algebra of a topological graph could be twisted by a complex line bundle over the edge space. In joint work with Li we prove that the resulting C^*-algebra is isomorphic to a twisted groupoid C^*-algebra.

- **Scott LaLonde** (slalonde@uttyler.edu) University of Texas at Tyler
  Title: *Amenability and uniqueness for groupoids associated to inverse semigroups*

  Abstract. In this talk we will discuss applications of a recent uniqueness theorem for the reduced C^*-algebra of a Hausdorff étale groupoid to the C^*-algebras associated to an inverse semigroup. In particular, we will investigate the isotropy bundles of such groupoids, and we will show that under certain reasonable hypotheses the isotropy is closely related to the structure of the inverse semigroup. This yields a uniqueness theorem for inverse semigroup C^*-algebras in which the distinguished subalgebra is a very natural one. We may also discuss some results on amenability for the universal groupoid of an inverse semigroup.

- **Nicholas LaRacuente** (laracue2@illinois.edu) University of Illinois at Urbana-Champaign
  Title: *Superadditivity bounds for heralded channels*

  Abstract. Given a pair of quantum channels Φ and Ψ, we define a heralded channel as one that applies Φ to the input with probability λ or Ψ with probability $(1-\lambda)$, and also provides an extra classical output allowing the receiver to distinguish which channel was applied. Using the monogamy and faithfulness of squashed entanglement, we show that the Holevo capacity of the heralded channel is close to the one-shot Holevo information of Φ when Ψ is nearly additive and λ sufficiently small. Heralded channels are extremely common in quantum information experiments, as they may describe loss or state preparation failure. Furthermore, we obtain these results directly from the monogamy of entanglement, not relying on the form of Φ or Ψ. We briefly discuss possible extensions of this technique, including a quantum capacity analog to the heralded channel and how other entanglement-dependent quantities may show monogamy by comparison with squashed entanglement.

  (*) Joint work with Li Gao and Marius Junge. This research is supported by the NSF Graduate Research Fellowship Program under Grant Number DGE-1144245 and the Graduate College Distinguished Fellowship from the University of Illinois.

- **Hung-Chang Liao** (hxl255@psu.edu) Pennsylvania State University
  Title: *Rokhlin dimension of $\mathbb{Z}^m$-actions on simple C^*-algebras*

  Abstract. We study Rokhlin dimension of $\mathbb{Z}^m$-actions on simple separable stably finite C^*-algebras with finite nuclear dimension. We prove that under suitable assumptions, a strongly outer $\mathbb{Z}^m$-action has finite Rokhlin dimension, which extends the known result for $\mathbb{Z}$-actions. Thanks to the recent breakthrough in the classification program, this implies that the crossed product formed by such an action is classifiable (under the UCT assumption). As an application, we show that for a large class of C^*-algebras, the $\mathbb{Z}^m$-Bernoulli action has finite Rokhlin dimension.

- **Wenjing Liu** (wbs4@wildcats.unh.edu) University of New Hampshire
  Title: *An extension of the Beurling-Chen-Hadwin-Shen theorem for noncommutative Hardy spaces associated with finite von Neumann algebras*

  Abstract. In 2015, Yanni Chen, Don Hadwin and Junhao Shen proved a noncommutative version of Beurling's theorem for a continuous unitarily invariant norm α on a tracial von Neumann algebra $(\mathcal{M},\tau)$ such that $\alpha \geq \| \ \|_{1,\tau}$. The role of H^∞ is played by a maximal subdiagonal algebra $\mathcal{A}$. In the talk, we first will show that if α is a continuous normalized unitarily invariant norm on $(\mathcal{M},\tau)$, then there exists a faithful normal tracial state ρ on $\mathcal{M}$ and a constant $c>0$ such that α is a $c\| \ \|_{1,\rho}$-dominating norm on $(\mathcal{M},\rho)$. Moreover, $\rho(x)=\tau(xg)$, where $x\in\mathcal{M}, g\in L^1(\mathcal{Z}(\mathcal{M}))$, where $\mathcal{Z}(\mathcal{M})$ is the center of $\mathcal{M}$. The c and ρ are not unique. However, if there is a c and ρ so that the Fuglede-Kadison determinant of g is positive, then Beurling-Chen-Hadwin-Shen theorem holds for $L^\alpha(\mathcal{M},\tau)$. The key ingredients in the proof of our result include a factorization theorem and a density theorem for $L^\alpha(\mathcal{M},\rho)$.

• **Preeti Luthra** (maths.preeti@gmail.com) University of Delhi, India
Title: *Embeddings and C^*-envelopes of exact operator systems*

Abstract. Kirchberg proved that a separable C^*-algebra embeds into $\mathcal{O}_2$ if and only if it is exact. Very recently, Paulsen and Zheng introduced Cuntz operator systems $\mathcal{S}_n$, and using the simplicity of $\mathcal{O}_n$, it turned out that $\mathcal{O}_n$ is actually the C^*-envelope of $\mathcal{S}_n$ for all $1 \leq n \leq \infty$. Motivated by this, we prove a necessary and sufficient condition for embedding an operator system into $\mathcal{O}_2$, in terms of the exactness of their C^*-envelopes.

Using Kirchberg's theorems on tensor product of $\mathcal{O}_2$, we establish results regarding embedding of operator systems of the form $\mathcal{S} \otimes_{min=c} \mathcal{S}_2$ into $\mathcal{O}_2$. Further, we obtain some equivalent conditions for their C^*-envelopes to be $*$-isomorphic either to $\mathcal{O}_2$ or to a C^*-subalgebra of $\mathcal{O}_2$. Some analogous results on operator systems of the form $\mathcal{S} \otimes_{min=c} \mathcal{S}_\infty$ are also proved, making use of the Kirchberg's theorem on $\mathcal{O}_\infty$.

Applications of the results proved, including a description of the C^*-envelopes of some operator systems with tensor product factor $\mathcal{S}_2$ or $\mathcal{S}_\infty$, are also discussed.

(*) Joint work with Ajay Kumar.

• **Daniel Markiewicz** (danielm@math.bgu.ac.il) Ben-Gurion University of the Negev, Israel
Title: *Classification of C^*-envelopes of tensor algebras arising from stochastic matrices*

Abstract. In this talk we discuss the C^*-envelope of the (non-self-adjoint) tensor algebra associated via subproduct systems to a finite irreducible stochastic matrix P.

We showed previously that there are examples of such C^*-envelopes that are not *-isomorphic to either the Toeplitz algebra or the Cuntz-Pimsner algebra, which was somewhat unexpected. In this talk we provide a detailed identification of the boundary representations of the tensor algebra inside the Toeplitz algebra, also known as its non-commutative Choquet boundary. We apply this characterization to clarify matters by describing the various C^*-envelopes that can land between the Toeplitz and the Cuntz-Pimsner algebras. More precisely, we classify the C^*-envelopes of tensor algebras up to *-isomorphism and stable isomorphism, in terms of the underlying matrices.

(*) This talk is based on joint work with Adam Dor-On.

• **Mircea Martin** (mircea.martin@bakeru.edu) Baker University
Title: *Clifford environments in operator theory*

Abstract. Clifford environments of a unital involutive algebra $\mathfrak{A}$ are collections of algebras obtained as augmentations of $\mathfrak{A}$ through processes that employ the universal real or complex Clifford algebras $\mathfrak{C}_n(\mathbb{R})$ or $\mathfrak{C}_n(\mathbb{C})$, $n \geq 1$. When $\mathfrak{A}$ is a C^*-algebra, the associated Clifford environments have intrinsic algebraic and geometric structures inherited from $\mathfrak{A}$ that enables one to study systems of elements of $\mathfrak{A}$ or other related objects by means of some standard algebraic geometry and differential geometry techniques. The talk will point out several specific uses of two types of Clifford environments, with a particular emphasis on the geometry of spaces of Clifford structures in a C^*-algebra.

- **Robert Martin** (rtwmartin@gmail.com) University of Cape Town, South Africa
  Title: *A Gleason solution model for row contractions*

  Abstract. We construct a deBranges-Rovnyak functional model for a large class of contractions from several copies of a Hilbert space into itself. Namely, we consider row contractions which generalize completely non-coisometric contractions with equal defect indices, and we show that any such contraction is unitarily equivalent to the Gleason solution in a deBranges-Rovynak space contractively contained in vector-valued Drury-Arveson space. Drury-Arveson space is a natural several variable generalization of the Hardy space of analytic functions in the unit disk, a Gleason solution is the appropriate several-variable analogue of the restricted backward shift, and it is unique in our case. We further demonstrate that any such d-contraction is (equivalent to) an extension of a partial isometric Gleason solution which acts as multiplication by the independent variables $z = (z_1, ..., z_d)$ on its initial space.

- **Kathryn McCormick** (kathryn-mccormick@uiowa.edu) University of Iowa
  Title: *Riemann surfaces, matrix bundles, and C^*-envelopes*

  Abstract. Let R be a precompact, smoothly bordered Riemann surface, and let α be a representation of the fundamental group of R in $PU_n(\mathbb{C})$ for some n. Then α determines a flat matrix bundle $\mathfrak{E}(\alpha)$ over the closure of R, $\overline{R}$. The continuous cross sections of $\mathfrak{E}(\alpha)$, $\Gamma_c(\overline{R}, \mathfrak{E}(\alpha))$, forms an n-homogeneous C^*-algebra. The continuous cross sections which are holomorphic on R is a subalgebra of $\Gamma_c(\overline{R}, \mathfrak{E}(\alpha)$ that we denote by $\Gamma_h(\overline{R}, \mathfrak{E}(\alpha))$. We determine the boundary representations of $\Gamma_c(\overline{R}, \mathfrak{E}(\alpha))$ for $\Gamma_h(\overline{R}, \mathfrak{E}(\alpha))$ in the sense of Arveson and we describe the C^* envelope of $\Gamma_h(\overline{R}, \mathfrak{E}(\alpha))$. The dependence of $\Gamma_c(\overline{R}, \mathfrak{E}(\alpha))$ and $\Gamma_h(\overline{R}, \mathfrak{E}(\alpha))$ on α is also discussed.

- **Wonhee Na** (wonhee@math.tamu.edu) Texas A&M University
  Title: *Principal functions for bi-free central limit distributions*

  Abstract. The operator $l(v_1)+l(v_1)^*+i(r(v_2)+r(v_2)^*)$ on the full Fock space $\mathcal{F}(\mathcal{H})$ arises from a bi-free central limit distribution. We find the principal function of the completely non-normal operator $l(v_1)+l(v_1)^*+i(r(v_2)+r(v_2)^*)$ on a subspace of $\mathcal{F}(\mathcal{H})$. As an application, we find the essential spectrum of this operator.
  (*) This is joint work with Ken Dykema.

- **Joseph Noles** (jnoles@math.tamu.edu) Texas A&M University
  Title: *Convergence properties and upper-triangular forms in finite von Neumann algebras*

  Abstract. It was shown by Haagerup and Schultz that for any operator T in a finite von Neumann algebra, the sequence $|T^n|^{1/n}$ converges in the strong operator topology. In this talk we will use upper-triangular decompositions first described by Dykema, Sukochev and Zanin to explore when the sequence converges in norm.

- **Rachael Norton** (rachael-norton@uiowa.edu) University of Iowa
  Title: *A comparison of generalized Nevanlinna-Pick theorems*

  Abstract. We show how the so-called displacement equation can be formulated in the context of W^*-correspondences and used to prove a generalization of the Nevanlinna-Pick theorem following the arguments of Constantinescu and Johnson in 2003. We present an outline of our proof and discuss connections between our result and a similar-looking theorem proved by Muhly and Solel in 2004.

- **Judith Packer** (packer@colorado.edu) University of Colorado, Boulder
  Title: *Wavelets and spectral triples for fractal representations of Cuntz algebras*

  Abstract. Here we discuss the wavelet decompositions of certain fractal representations of Cuntz-Krieger C^*-algebras first described by M. Marcolli and A. Paolucci, and relate them to the eigenspaces of Laplacians associated to spectral triples constructed from Cantor fractal sets that are the infinite path spaces of Bratteli diagrams coming from the representations. In particular we make connections between these wavelets and the spectral triple and the Laplace–Beltrami operator on the associated Cantor set first constructed by J. Pearson and J. Bellissard, and A. Julien and J. Savinien. We emphasize particularly the case of Cuntz C^*-algebras $\mathcal{O}_D$ and prove that in this case, the orthogonal wavelet decomposition and the decomposition via orthogonal eigenspaces match up precisely.

  (*) This work is joint with C. Farsi, E. Gillaspy, A. Julien, and S. Kang.

- **Sujan Pant** (sujan-pant@uiowa.edu) The University of Iowa
  Title: *Primeness results for von Neumann algebras associated with Burger-Mozes groups*

  Abstract. We show that the von Neumann algebras associated with Burger-Mozes groups give rise to prime von Neumann algebras. For $\Gamma \in \mathrm{Quot}_n(\mathcal{C}_{rss})$ an i.c.c. group, if there exists $A_1, \ldots, A_k$ commuting diffuse subalgebras of $L\Gamma$ generating a finite index subalgebra, then Γ is commensurable to $\Gamma_1 \times \cdots \times \Gamma_k$ where $\Gamma_i \in \mathrm{Quot}_{n_i}(\mathcal{C}_{rss})$ with $n_1 + \cdots + n_k = n$. In particular, $L\Gamma$ is prime if and only if Γ is virtually indecomposable as a product over groups in $\mathrm{Quot}(\mathcal{C}_{rss})$.

- **Efton Park** (e.park@tcu.edu) Texas Christian University
  Title: *Unitary equivalence of normal matrices over topological spaces*

  Abstract. One of the most striking theorems in linear algebra is the spectral theorem: every normal matrix with complex entries is diagonalizable. An immediate consequence of the spectral theorem is that a normal matrix over the complex numbers is determined up to unitary equivalence by its eigenvalues, counting multiplicities. Suppose we have a normal matrix with entries that are continuous functions on some topological space. Under what circumstances does the spectral theorem still hold? Given two such matrices, when are they unitarily equivalent? These questions and related ones have interesting and nontrivial answers, and it turns out that algebraic topology is a useful tool for studying such questions, as I will (I hope!) demonstrate. Anyone who has taken a first course in algebraic topology should be well-equipped to understand this talk.

- **Benjamin Passer** (bpasser@math.wustl.edu) Washington University in St. Louis
  Title: *Homomorphisms on C^*-algebras with saturated actions*

Abstract. When a finite group acts freely on a compact space, there are significant restrictions on the structure of equivariant self-maps. The first and most famous of these restrictions, the Borsuk-Ulam theorem, indicates that an odd function from a sphere to itself must be homotopically nontrivial, so these classical results are called generalized Borsuk-Ulam theorems. These concepts extend nicely into the noncommutative setting, and examples have surfaced in the literature that partially affirm this sentiment: when an action on a C^*-algebra meets freeness conditions, equivariant self-maps must be nontrivial in some sense. The aim of this study lies in resolving noncommutative Borsuk-Ulam conjectures of Baum, Dabrowski, and Hajac for actions of compact (quantum) groups, which are split into two types due to complications imposed by the noncommutative setting. I will present both positive and negative results regarding these conjectures.

(*) Joint with Alexandru Chirvasitu.

- **Gelu Popescu** (gelu.popescu@utsa.edu) University of Texas at San Antonio
  Title: *Free pluriharmonic functions on noncommutative polyballs* (to appear in Analysis & PDE)

Abstract. We study free k-pluriharmonic functions on noncommutative regular polyballs. The regular polyballs have universal operator models consisting of left creation operators acting on tensor products of full Fock spaces. Extending a result of Halmos, we determine the class of k-multi-Toeplitz operators and show that the bounded free k-pluriharmonic functions on regular polyballs are precisely the noncommutative Berezin transforms of k-multi-Toeplitz operators. The Dirichlet extension problem on regular polyballs is also solved. We provide a Naimark type dilation theorem for direct products of unital free semigroups, and use it to obtain a structure theorem which characterizes the positive free k-pluriharmonic functions on the regular polyball. We give necessary and sufficient conditions for a function to be the Poisson transform of a completely bounded (resp. completely positive) map on the C^*-algebra generated by the universal operator model of the regular polyball. We obtain Herglotz-Riesz representation theorems for free holomorphic functions on regular polyballs with positive real parts, extending the classical result as well as Koranyi-Pukanszky version in scalar polydisks.

- **John Quigg** (quigg@asu.edu) Arizona State University
  Title: *Exotic crossed products and coaction functors — a problem*

Abstract. Inspired by work of Brown and Guentner on exotic group C^*-algebras, we devised an approach to the exotic crossed products of Baum, Guentner, and Willett that goes through coaction functors. It transpires that our approach to exotic group C^*-algebras differs significantly from that of Brown and Guentner, and our attempt to reconcile them leads to a an amazingly basic question concerning positive definite functions.

(*) This is joint work with Steve Kaliszewski and Magnus Landstad.

• **Mizanur Rahaman** (mizanur1@gmail.com) University of Regina, Canada
Title: *Fidelity preservation in C^*-algebras*

Abstract. Fidelity provides a measure of distance between quantum states, where a quantum state is defined to be a density operator acting on a finite-dimensional Hilbert space. In quantum information theory, one is interested in the structure of positive trace-preserving linear maps that preserve fidelity for all pairs of states. In this talk I will consider the concept of fidelity in a C^*-algebra $\mathcal{A}$ and characterize the structure of positive trace-preserving linear maps on $\mathcal{A}$ that preserve fidelity.

• **Travis Russell** (trussell8@huskers.unl.edu) University of Nebraska-Lincoln
Title: *Characterizations of ordered operator spaces*

Abstract. Let $Z \subset B(H)$ be an operator space. Ruan's theorem shows that Z is characterized up to complete isometry by the sequence of norms inherited by regarding $M_n(Z)$ as a subspace of $B(H^n)$. However, Z may possess additional structures of interest - for example, a real subspace of self-adjoint operators, a sequence of positive cones, etc. In this talk, we will consider an abstract characterization for operator spaces from which one can derive not only the sequence of norms, but also a sequence of positive cones, a real subspace of self-adjoint operators, and more generally, a sequence of cones of accretive operators, i.e., operators whose real part is positive. Time permitting, we will discuss extension problems and other applications.

• **Bernard Russo** (brusso@uci.edu) University of California, Irvine
Title: *2-local triple derivations on von Neumann algebras*

Abstract. Everywhere defined derivations on von Neumann algebras are well understood thanks to the pioneering work of Kaplansky, Kadison, and Sakai in the 1950s and 60s. Local derivations on von Neumann algebras were introduced by Kadison in 1990 and 2-local derivations (which are not assumed to be linear maps) were introduced in the context of $B(H)$ in 1997 by Semrl. Both are now well understood in the context of von Neumann algebras due to the work of these authors and Ayupov & Kudaybergenov in 2015. Nonassociative structures (Jordan, Lie, and triple) on von Neumann algebras provide insight into their metric geometry and are relevant to their connection to quantum mechanics and particle physics. Algebraically, triple derivations on von Neumann algebras correspond to Lie derivations on the associated Tits-Kantor-Koecher Lie algebras. I shall review the basic facts about triple derivations on von Neumann algebras and then present some recent work, obtained jointly with Kudaybergenov, Oikhberg, and Peralta, on 2-local triple derivations on von Neumann algebras .

• **Lauren Sager** (lbq32@wildcats.unh.edu) University of New Hampshire
Title: *A Beurling-Blecher-Labuschagne theorem for noncommutative Hardy spaces associated with semifinite von Neumann algebras*

Abstract. In this talk, we seek to characterize the lower triangular subalgebra-invariant subspaces of the Schatten p-class on an infinite dimensional Hilbert space $\mathcal{H}$. In order to do so, we prove a Beurling-Blecher-Labuschagne theorem for H^∞-invariant subspaces of $L^p(\mathcal{M},\tau)$ where $\mathcal{M}$ is a von Neumann algebra with semifinite, faithful, normal tracial weight τ, $0 < p \leq \infty$, and H^∞ is an non-commutative Hardy space as defined by Arveson. The proof of this main result relies on density theorems for the $L^p(\mathcal{M},\tau)$ spaces, and factorization results. As an application of the main result, we can completely characterize all H^∞ invariant subspaces of $L^p(\mathcal{M} \rtimes_\alpha \mathbb{Z},\tau)$ where $\mathcal{M} \rtimes_\alpha \mathbb{Z}$ is the non-self-adjoint crossed product of a von Neumann algebra $\mathcal{M}$ by an action α on $\mathcal{M}$. Then, we are able to completely characterize all lower triangular subalgebra-invariant subspaces of the Schatten p-class for $0 < p \leq \infty$.

• **Guy Salomon** (guy.salomon@tx.technion.ac.il) Department of Mathematics, Technion — Israel Institute of Technology, Haifa 3200003, Israel
Title: *The noncommutative Choquet boundary of graph tensor-algebras*

Abstract. The fundamental nonselfadjoint operator-algebra associated with a countable directed graph is its tensor-algebra. Ten years ago, Katsoulis and Kribs showed that its C^*-envelope — the noncommutative counterpart of the Shilov boundary — is the Cuntz-Krieger algebra of the graph.

My aim in this talk is to describe the noncommutative counterpart of points in the *Choquet boundary* of the tensor-algebra and to provide a full characterization of them. This leads both to a new proof of Katsoulis-Kribs theorem mentioned above and to a characterization — in terms of the graph itself — of the tensor-algebra hyperrigidity inside the Cuntz-Krieger algebra.

(*) The talk is based on joint work with Adam Dor-On.

• **Christopher Schafhauser** (cschafha@uwaterloo.ca) University of Waterloo, Canada
Title: *MF Actions of Free Groups on Nuclear C^*-algebras*

• **Albert Sheu** (asheu@ku.edu) University of Kansas
Title: *Noncommutative Gauss-Bonnet Theorem by Rosenberg's approach*

Abstract. Following Jonathan Rosenberg's approach to Levi-Civita connections on noncommutative tori, we show that the Gauss-Bonnet theorem holds for two classes of non-conformal deformations of the flat metric on the noncommutative two-tori, including the case of non-commuting scalings along the principal directions of a two-torus. We also analyze how the curvature form and the uniqueness of torsion-free metric-compatible connection are affected when the connection operator for the inner *-derivations is not limited to the prominent one considered by Rosenberg, and find a complete answer.

(*) Joint work with Mira A. Peterka.

• **Yanli Song** (ylsong@me.com) University of Toronto, Canada
Title: *Discrete groups and equivariant index*

Abstract. Consider a manifold M together with a free action of a discrete group. The famous Atiyahs L^2-index theorem gives a formula to calculate its higher index for the discrete group. In this talk, we assume there is an action of a compact Lie group K in addition to the discrete group action. We show that if the discrete group action and compact Lie group action are admissible in a suitable sense, then any elliptic dierential operator on M is Fredholm after restricting to isotypic K-components. In this case, the dierential operator has an equivariant index, which is an innite sum of irreducible K-representations. In this talk, I will explain some properties of the equivariant index.

• **Jack Spielberg** (jack.spielberg@asu.edu) Arizona State University
Title: *C^*-algebras associated to graphs of groups*

Abstract. There are many interesting examples of groups acting on trees, arising in various fields (e.g. combinatorial group theory, number theory, geometry). When a group acts on a tree, it necessarily also acts on the boundary of the tree, a (totally disconnected) compact Hausdorff space. The C^*-algebras obtained from the crossed product construction include many fundamental examples. I will describe methods for analyzing such crossed products, developed in joint work with Nathan Brownlowe, Alex Mundey, David Pask and Anne Thomas.

• **Nishant Suri** (nsuri@math.uh.edu) University of Houston
Title: *Naimark's problem for AF graph C^*-algebras*

Abstract. Naimark's problem asks whether a C^*-algebra that has only one irreducible $*$-representation up to unitary equivalence is isomorphic to the C^*-algebra of compact operators on some (not necessarily separable) Hilbert space. This problem has been solved in special cases, including that of separable C^*-algebras and of Type I C^*-algebras. However, in 2004 Akemann and Weaver used the diamond principle to construct a C^*-algebra with $\aleph_1$ generators that is a counterexample to Naimark's problem. More precisely, they showed that the statement "There exists a counterexample to Naimark's problem that is generated by $\aleph_1$ elements." is independent of the axioms of ZFC. Whether Naimark's problem itself is independent of ZFC remains unknown. In this talk we examine Naimark's problem in the setting of graph C^*-algebras and show that it has an affirmative answer for (not necessarily separable) AF graph C^*-algebras.
(*) This is joint work with Mark Tomforde.

• **Adi Tcaciuc** (tcaciuca@macewan.ca) MacEwan University, Canada
Title: *Title: On almost-invariant subspaces*

Abstract. We show that any bounded operator T on a separable, reflexive, infinite-dimensional Banach space X admits a rank one perturbation which has an invariant subspace of infinite dimension and codimension. We also prove that many such perturbations can be found when the spectrum of T is countable.

• **Edward Timko** (ejtimko@indiana.edu) Indiana University at Bloomington
Title: *On polynomial n-tuples of commuting isometries*

Abstract. We extend some of the results of Agler, Knese, and McCarthy concerning pairs of shifts to the case of n-tuples of commuting isometries, where $n > 2$. Let $V = (V_1, \ldots, V_n)$ be an n-tuple of commuting isometries on a Hilbert space and let $\mathrm{Ann}(V)$ denote the set of all n-variable polynomials p such that $p(V) = 0$. When $\mathrm{Ann}(V)$ defines an affine algebraic variety of dimension 1 and V is completely non-unitary, we show that V decomposes as a direct of n-tuples $(W_1, \ldots, W_n)$ with the property that, for each i, W_i is either a shift or a scalar multiple of the identity. If V is a cyclic n-tuple of commuting shifts, then we show that V is determined by $\mathrm{Ann}(V)$ up to near unitary equivalence.

• **Fredy Vides** (vides@math.unm.edu) The University of New Mexico
Title: *Local Matrix Homotopies and Soft Tori*

Abstract. In this talk I will present the solution to a local connectivity problem in matrix representations of the form

$$C([-1,1]^N) \longrightarrow M_{2n} \underset{}{\overset{}{\longleftarrow}} M_n \longleftarrow C_\varepsilon(\mathbb{T}^2)\ ,$$

where $C_\varepsilon(\mathbb{T}^2)$ denotes the **Soft Torus**.

The connectivity problem can be stated in the following way: Given $\varepsilon > 0$, is there $\delta > 0$ such that the following conditions hold? For any integer $n \geq 1$, and any two families of N pairwise commuting hermitian contractions $X_1, \ldots, X_N$ and $Y_1, \ldots, Y_N$ in M_n which satisfy the constraints $\|X_j - Y_j\| \leq \delta$, $1 \leq j \leq N$, there are a C*-homomorphism $\Psi : M_n \to M_{2n}$ and N piecewise-analytic paths $\mathbf{X}^1, \ldots, \mathbf{X}^N \in C([0,1], M_{2n})$ such that $\max\{\|\Psi(X_j) - X_j \oplus X_j\|, \|\Psi(X_j) - Y_j \oplus Y_j\|\} \leq \varepsilon$, $\mathbf{X}^j_0 = \Psi(X_j)$, $\mathbf{X}^j_1 = Y_j \oplus Y_j$, $\mathbf{X}^j_t \mathbf{X}^k_t = \mathbf{X}^k_t \mathbf{X}^j_t$ and $\|\mathbf{X}^j_t - Y_j \oplus Y_j\| \leq \varepsilon$ for each $1 \leq j, k \leq N$ and $0 \leq t \leq 1$. Moreover, $\mathrm{Length}(\mathbf{X}^j) \leq \varepsilon$, $1 \leq j \leq N$.

The solution to the previously described connectivity problem has been obtained building on some techniques introduced by M.-D. Choi, R. Exel, H. Lin, T. Loring and T. Shulman, and by implementing some methods from matrix geometry introduced by R. Bhatia, L. Elsner, A. McIntosh, A. Pryde and W. Ricker. The relation between the connectivity technique that will be presented in this talk and the solution to some problems in matrix geometry and representation theory of C*-algebras will be outlined.

• **Matthew Wiersma** (mwiersma@uwaterloo.ca) University of Waterloo, Canada
Title: *Weak* tensor products for von Neumann algebras*

Abstract. 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.

- **Chase Worley** (cworley3@vols.utk.edu) University of Tennessee
  Title: *Circulant core Hadamard matrices*

  Abstract. We begin by defining a complex Hadamard matrix and giving examples of size n for each natural number. We will then give some applications of Hadamard matrices in operator algebras. Classification of Hadamard matrices in general is unknown; however, restricting ourselves to size and type, we can begin to answer questions such as finiteness results. Haagerup proved that there are only finitely many circulant Hadamard matrices of size p, for p a prime. Our main result looks at circulant core Hadamard matrices. We will show that there are only finitely many such matrices of size $p+1$ with p a prime number.

- **Abdelrahman Yousef** (abd.yousef@ju.edu.jo) University of Jordan, Amman 11942, Jordan
  Title: *Interpolated Young and Heinz inequalities*

  Abstract. In this talk, we interpolate the well-known Young's inequality for numbers and matrices, when equipped with the Hilbert Schmidt norm, then present the corresponding interpolations of recent refinements in the literature. As an application of these interpolated versions, we study the monotonicity these interpolations obey.

- **Aleksey Zelenberg** (auz114@psu.edu) Pennsylvania State University
  Title: *Rokhlin dimension for C^*-bimodules*

  Abstract. In the classification of C^*-algebras by K-theory, the notion of noncommutative dimension is of central importance. As such, it has been natural to ask for which examples it is finite. For example, when a C^*-algebra arises from a $\mathbb{Z}$-action on compact metric space X (i.e. a crossed product of the form $C(X) \rtimes \mathbb{Z}$), an intricately related notion is the so-called Rokhlin dimension of the action. Specifically, such algebras have finite noncommutative dimension when the space X has finite covering dimension and the action has finite Rokhlin dimension. Currently, generalizations of this result have applied to more general crossed products of form $A \rtimes G$, where A is a (possibly noncommutative) C^*-algebra and G is a (possibly noncommutative) group acting on A. In this talk, we discuss a generalization in a different direction. Specifically, since crossed products of the form $A \rtimes \mathbb{Z}$ can be realized as Pimsner algebras of certain C^*-bimodules, we propose a Rokhlin dimension for arbitrary C^*-bimodules, and discuss results pertaining to the noncommutative dimension of the resulting Pimsner algebras.

- **Mingyu Zhao** (mzhao16@illinois.edu) University of Illinois at Urbana-Champaign
  Title: *Strichartz and resolvent estimates for noncommutative spaces*

  Abstract. In applied mathematics, Strichartz estimates are a family of inequalities for linear dispersive partial differential equations. These inequalities establish size and decay of solutions in mixed norm Lebesgue spaces. We are wondering whether Strichartz estimates still hold if replacing $\mathbb{R}^n$ with n-dimensional noncompact noncommutative spaces. In this talk, we will prove Strichartz estimates and improve the Junge and Mei's resolvent estimate's result for noncommutative Euclidean space.