GPOTS 2007

Abstracts

Talk times and locations are subject to change.

10:30 Sa, Rm 115 **Abdelkader, Dehici** (dehicikader@yahoo.fr), University of Guelma, Algeria. Some Remarks on Semi-Fredholm Perturbations of Linear Operators.

In this work, we give some remarks on classes of Fredholm perturbations in Banach spaces. Moreover, we discuss the relation between the left maximality and right maximality of the ideal of Fredholm perturbations and the geometric properties of some Banach spaces.

10:30 W, Rm 106 **Acharya, Lipi Rani** (lipi@iitk.ac.in), Indian Institute of Technology, Kanpur, India. Representation Theorems for Operators of type $\ell_{p,q}^{\omega,\psi}$ and $s_{\omega,\psi}$.

Let $\psi : [0\ \infty) \to [0\ \infty)$ be a continuous, strictly increasing, subadditive function which satisfies $\psi(0) = 0$; and $\omega = \{\omega_n\}$ be a fixed sequence of positive numbers. Denoting by $\{s_n(x)\}$, the sequence of decreasing rearrangement of $x = \{x_n\} \in \ell^\infty$ defined by

$$s_n(x) = \inf\{c \geq 0 : \text{card}\{i \in \mathbb{N} : |x_i| \geq c\} \leq n\};$$

we introduce

$$\ell_{p,q}^{\omega,\psi} = \{\{x_n\} \in \ell^\infty : \{\textstyle\sum_{k=1}^{\infty}[k^{1/p-1/q}\ \psi(\omega_k\ s_k(x))]^q\}^{1/q} < \infty\},\ 0 < p \leq \infty,\ 0 < q < \infty;$$

and

$$\ell_{p,\infty}^{\omega,\psi} = \{\{x_n\} \in \ell^\infty : \sup_{k\in\mathbb{N}} k^{1/p}\psi(\omega_k\ s_k(x)) < \infty\};\ 0 < p \leq \infty,\ q = \infty.$$

We also consider

$$s_{\omega,\psi} = \{\{x_n\} \in \Omega : \sup_{n\in\mathbb{N}}(n+1)^k\psi(\omega_n|x_n|) \leq M_k, \text{ for some } M_k > 0,\ k \in \mathbb{N}\};$$

where Ω represents the space of all scalar sequences. The above sequence classes coincide with the well known Lorentz sequence spaces and the space of rapidly decreasing sequences for particular choice of ω and ψ. We characterize a bounded linear operator T of the type $\ell_{p,q}^{\omega,\psi}$ and $s_{\omega,\psi}$ in terms of its series representation, where by an operator of type λ, we mean that the sequence of $\{a_n(T)\}$ of its approximation numbers is a member of λ, λ being a scalar sequence class.

5:00 W, Rm 106 **Argerami, Martin** (argerami@math.uregina.ca), University of Regina. On Kadison's Carpenter's Theorem.

Let $\mathcal{M}$ be a II_1 factor and let $\mathcal{A}$ be a maximal abelian subalgebra of $\mathcal{M}$. If $t \in [0, 1]$ then let $\mathcal{P}_t$ denote the set of all projections p in $\mathcal{M}$ with $\tau(p) = t$, where τ denotes the trace of $\mathcal{M}$. Kadison (PNAS 99, 2002) conjectured the equality of sets

$$E_{\mathcal{A}}(\mathcal{P}_t) = \{a \in \mathcal{A} :\ 0 \leq a \leq 1,\ \tau(a) = t\}$$

where $E_{\mathcal{A}}$ denotes the trace preserving conditional expectation of $\mathcal{M}$ onto $\mathcal{A}$. Although we have previously obtained some weak versions of this equality, this problem is still open. In this talk we propose a setting (that essentially deals with the Cartan subalgebras of the hyperfinite II_1 factor $\mathcal{R}$) within which we prove that the set on the left-hand side of the equality above is $\|\cdot\|_1$-dense in the set on the right-hand side. This is achieved by constructing an explicit family of non-discrete operators in $E_{\mathcal{A}}(\mathcal{P}_t)$. This is joint work with P. Massey.

3:00 W, Rm 115 **Baker, Richard** (baker@math.uiowa.edu), The University of Iowa. ON THE CLASSIFICATION OF P-ADIC UHF BANACH ALGEBRAS.

We define the class of p-adic UHF Banach algebras. We then use a certain p-adic spectral theorem to show that the supernatural number associated to a p-adic UHF Banach algebra is an isomorphism invariant of the algebra.

10:30 Th, Rm 115 **Ball, Joseph** (ball@math.vt.edu), Virginia Tech. MULTIVARIABLE GENERALIZATIONS OF THE SCHUR CLASS: POSITIVE KERNEL CHARACTERIZATION AND TRANSFER FUNCTION REALIZATION.

The operator-valued Schur-class is now defined to be the set of holomorphic functions S mapping the unit disk into the space of contraction operators between two Hilbert spaces. There are a number of alternate characterizations: the operator of multiplication by S defined a contraction operator between two Hardy Hilbert spaces, S satisfies a von Neumann inequality, a certain operator-valued kernel associated with S is positive- definite, and S can be realized as the transfer function of a dissipative (or even conservative) discrete-time linear input/state/output linear system. Various multivariable generalizations of this class have appeared recently, one of the most encompassing being that of Muhly and Solel where the unit disk is replaced by the strict unit ball of the elements of a dual correspondence E^σ associated with a W^*-correspondence E over a W^*-algebra $\mathcal{A}$ together with a $*$- representation σ of $\mathcal{A}$. The main new point which we add here is the introduction of the notion of reproducing kernel Hilbert correspondence and identification of the Muhly-Solel Hardy spaces as reproducing kernel Hilbert correspondences associated with a completely positive analogue of the classical Szegö kernel. In this way we make the analogy between the Muhly-Solel Schur class and the classical Schur class more complete. We illustrate the general theory by specializing it to some well-known special cases; in some instances there result new kinds of realization theorems. This talk reports on joint work with Animikh Biswas (University of North Carolina at Charlotte), Quanlei Fang (Virginia Tech) and Sanne ter Horst (Vrije Universiteit, Amsterdam).

8:30 Sa, Rm 115 **Blecher, David** (dblecher@math.uh.edu), University of Houston. C^*-ALGEBRAS AND NONCOMMUTATIVE FUNCTION THEORY.

The main theme of our talk is how classical function theory goes noncommutative, using C^*-algebra (and von Neumann algebra) tools. Probably most of the talk will be on recent joint work with Labuschagne, in which we completely generalize the theory of generalized H^p spaces (in an abstract function algebra setting) from the 1960s to a von Neumann algebraic context introduced by Arveson and studied by many authors. In particular, one has to take the classical arguments, which feature hundreds of tricks with functions which fail for operators, and replace them with noncommutative tools coming from the theory of von Neumann algebras and unbounded operators. We also hope to discuss the role of C^*-algebras generated by 'noncommutative function algebras' and operator spaces; in particular the noncommutative Shilov boundary.

11:30 W, Rm 106 **Cameron, Jan** (jcameron@math.tamu.edu), Texas A&M University. HOCHSCHILD COHOMOLOGY OF FACTORS WITH CARTAN MASAS.

It has been shown by Sinclair and Smith that the Hochschild cohomology groups $H^n(N, N), n \geq 2$ vanish for all type II_1 factors N which have a Cartan maximal abelian subalgebra (masa) and separable predual. We extend this result to the case of the general type II_1 factor, using some recently developed tools which address masas in nonseparable factors.

10:30 Th, Rm 106 **Castro, Luis** (lcastro@mat.ua.pt), University of Aveiro. Invertibility of Wiener-Hopf plus Hankel operators with numerical ranges bounded away from zero.

We will present a criterion for left, right and both-sided invertibility of matrix Wiener-Hopf plus Hankel operators with Fourier symbols in the Wiener subclass of the almost periodic algebra. The criterion is based on the value of a certain mean motion constructed from a particular numerical range which needs to be bounded away from zero. Such numerical range is dependent on the Fourier symbols of the initial Wiener-Hopf and Hankel operators. AMS Subject Classification: 47B35, 47A68, 47A05, 42A75.

4:30 W, Rm 106 **Cho, Ilwoo** (chowoo@sau.edu), St. Ambrose University. Graph Groupoids and Corresponding von Neumann Algebras.

We will consider the connection between directed graphs and Hilbert space operators. In fact, we already know they have a close relations. e.g., Cuntz- Krieger Algebras, Quiver Algebras, etc. In this talk, we will observe the so- called graph von Neumann algebras which are groupoid crossed product algebras having certain amalgamated reduced free probabilistic structures. Also, we will discuss about the *-isomorphic graph von Neumann algebras and the difficulties to deal with this isomorphism problems.

3:00 Th, Rm 106 **Curto, Raul** (rcurto@math.uiowa.edu), University of Iowa. The Lifting Problem for hyponormal pairs of commuting subnormals.

The Lifting Problem for Commuting Subnormals (LPCS) asks for necessary and sufficient conditions for a pair of subnormal operators on Hilbert space to admit commuting normal extensions. It is well known that the commutativity of the pair is necessary but not sufficient, and it has recently been shown that the joint hyponormality of the pair is necessary but not sufficient. Moreover, while abstract solutions of LPCS exist, concrete solutions are only known in very specific situations. Our previous research (joint with J. Yoon and S.H. Lee) has shown that many of the nontrivial aspects of LPCS are best detected within the class $\mathfrak{H}_1$ of commuting hyponormal pairs of subnormal operators, so we focus our attention on this class. A large subclass of $\mathfrak{H}_1$, the 2-variable weighted shifts with tensor core (denoted by $\mathcal{TC}$), has proved quite valuable in a related context. In this talk, I will present recent joint work with S.H. Lee and J. Yoon, in which we provide a complete solution of LPCS within the class $\mathcal{TC}$.

11:00 Th, Rm 106 **Dadarlat, Marius** (mdd@math.purdue.edu), Purdue University. Trivialization of continuous fields with strongly self-absorbing fibres.

Suppose A is a separable unital C(X)-algebra each fibre of which is isomorphic to the same strongly self-absorbing and K_1-injective C*- algebra D. We show that A and C(X,D) are isomorphic as C(X)-algebras provided the compact Hausdorff space X is finite-dimensional. This statement is known not to extend to the infinite-dimensional case. (joint work with W. Winter.)

11:00 Sa, Rm 106 **Dai, Xingde** (xingdedai@yahoo.com), UNC-Charlotte. The paths between two wavelet sets.

We present an equivalent condition for two wavelet sets to have a direct path.

11:00 W, Rm 106 **Das, Paramita** (pnt2@unh.edu), University of New Hampshire and Vanderbilt University. The planar algebra of the group-type subfactors.

We describe the planar algebra, or equivalently, the standard invariant, of a family of subfactors introduced by Bisch and Haagerup. These subfactors play an important role in the theory, since

they provide a very simple mechanism to construct subfactors whose standard invariant has infinite depth and various other interesting properties. This is joint work with Dietmar Bisch and Shamindra Ghosh.

1:30 Th, Rm 115 **Davidson, Kenneth** (krdavids@uwaterloo.ca), University of Waterloo.
*-Representations of rank 2 graphs, dilation and periodicity.

In this talk, we will survey recent joint work with Stephen Power and Dilian Yang on the operator algebras of rank 2 graphs on a single vertex. We show that every defect free row contractive representation of the graph has a unique dilation to a *-representation. This leads to the conclusion that the C*-envelope of the nonself-adjoint operator algebra of the graph is the Kumjian-Pask C*-algebra. We completely classify the atomic *-representations of the graph. Also we characterize when these graphs are aperiodic. When the graph is periodic, we show that the C*-algebra decomposes as a tensor product of $C(\mathbb{T})$ with a simple C*-algebra.

4:00 Sa, Rm 106 **Dean, Andrew** (andrew.dean@lakeheadu.ca), Lakehead University.
Classification of C*-dynamical systems.

We shall discuss several results in which C*-dynamical systems arising as inductive limits are classified using K-theoretic and spectral data.

4:30 Th, Rm 115 **Duncan, Benton** (benton.duncan@ndsu.edu), North Dakota State University.
C^*-envelopes of free products.

We say that an operator algebra has the *unique extension property* if, given a faithful $*$-representation π of $C_e^*(A)$, any completely contractive extension of $\pi|_A$ is equal to π. Given two unital operator algebras A and B with the unique extenson property we show that the C^*-envelope of the universal free product $A * B$ is given by $C_e^*(A) * C_e^*(B)$. We will discuss some classes of operator algebras with the unique extension property and present some examples to illustrate the result.

11:30 Sa, Rm 106 **Dutkay, Dorin** (ddutkay@mail.ucf.edu), University of Central Florida.
Wavelet representations of Baumslag-Solitar groups.

We construct representations of the Baumslag-Solitar groups $BS(1,N) =< u,t|ut = t^N u >$ which admit wavelets. The commutant of these representations is in one-to-one correspondence with certain harmonic functions for a transfer operator. Connections to wavelets, fractals and random walks are presented. The wavelet theory of these representations exhibits some rigidity properties.

3:30 Sa, Rm 106 **Fang, Junsheng** (jfang@cisunix.unh.edu), University of New Hampshire.
On maximal injective subalgebras of tensor products of von Neumann algebras.

Let M_i be a von Neumann algebra, and B_i be a maximal injective von Neumann subalgebra of M_i, $i = 1, 2$. If M_1 has separable predual and the center of B_1 is atomic, e.g., B_1 is a factor, then $B_1 \otimes B_2$ is a maximal injective von Neumann subalgebra of $M_1 \otimes M_2$. This partly answers an old question of Popa.

4:00 W, Rm 106 **Farthing, Cynthia** (cfarthing2@math.unl.edu), University of Nebraska-Lincoln.
Viewing Crossed Products by $\mathbb{Z}^l$ as Higher-rank Graph Algebras.

We show that if α is an action of $\mathbb{Z}^l$ on a finitely-aligned k-graph, Λ, by automorphisms, then

there is an induced action, $\widetilde{\alpha}$, of $\mathbb{Z}^l$ on the higher-rank graph C^*-algebra of Λ. Furthermore, the crossed-product $C^*(\Lambda) \times_{\widetilde{\alpha}} \mathbb{Z}^l$ can be realized as the C^*-algebra of a $k+l$-graph. We will use this fact to give conditions for when the crossed-product C^*-algebra is simple and to calculate the K-theory for a particular class of 2-graphs.

4:00 Th, Rm 106 **Fialkow, Lawrence** (fialkowl@newpaltz.edu), SUNY New Paltz. SOLUTION OF THE QUADRATIC MOMENT PROBLEM IN 3 REAL VARIABLES.

We show that a real multisequence of degree 2 in 3 real variables has a representing measure if and only if the corresponding moment matrix $M(1)$ is positive semidefinite.

3:30 W, Rm 106 **Giol, Julien** (giol@math.tamu.edu), Texas A&M University. GEOMETRY OF PROJECTIONS AND FINITENESS.

The classical notion of finiteness for C*-algebras arises naturally from the Comparison Theory for projections. It is therefore deeply rooted in set theory. Nevertheless, finite von Neumann are characterized among von Neumann algebras by the existence of a center-valued trace, or by the fact that they have Stable Rank one, or again by the fact that they satisfy the strong Dixmier Property. Thus the title of this talk could be: yet another characterization of finiteness for von Neumann algebras? To a C*-algebra A we assign a number d(A) which can a priori be either a nonnegative integer or infinite. Roughly speaking, this number tells us how big the homotopy classes of projections are. For a von Neumann algebra M, we find that d(M)=0 iff M is commutative ; d(M)=2 iff M is finite and noncommutative ; d(M)=3 otherwise. We will explain in particular why, when M is taken to be concrete in B(H), these results provide us with a quantitative version of the following characterization: M is finite iff the homotopy of any two projections is equivalent to the existence of a common complement in H for their ranges.

3:30 W, Rm 115 **Gupta, Manjul** (manjul@iitk.ac.in), Indian Institute of Technology, Kanpur. APPROXIMATION NUMBERS OF MATRIX TRANSFORMATIONS AND INCLUSION MAPS.

For $n \in \mathbb{N}$ and $T \in \mathcal{L}(X, Y)$, where X and Y are Banach spaces, its n^{th} approximation number is defined as

$$a_n(T) = \inf\{\|T - A\| : A \in \mathcal{L}(X, Y), \text{ rank } A < n\}.$$

We establish here the relationships of the approximation numbers of matrix transfor-mations acting between spaces of the type $\lambda(X)$ where λ is a scalar-valued sequence space and $(X, \|.\|_X)$ is a Banach space defined as

$$\lambda(X) = \{\overline{x} = \{x_i\} : x_i \in X, \forall\ i \in \mathbb{N} \text{ and } \{\|x_i\|_X\} \in \lambda\};$$

with the corresponding numbers of their component operators. This study leads to a characterization of a diagonal operator to be approximable(operators for which $a_n(T) \to 0$ as $n \to \infty$). Further, we compute the approximation numbers of inclusion maps acting between $\ell^p(X)$ spaces for $1 \leq p \leq \infty$.

3:00 Sa, Rm 115 **Han, Deguang** (dhan@pegasus.cc.ucf.edu), University of Central Florida. SOME DUALITY RESULTS FOR PROJECTIVE UNITARY REPRESENTATIONS.

We will discuss a few results involving the duality of π-orthogonal and π-simliar vectors for projective unitary representations π of countable groups. This work is partially motivated by the duality principle in time-frequency analysis, and it is a joint work with David Larson.

4:30 Sa, Rm 106 **Ionescu, Marius** (marius.ionescu@dartmouth.edu), Dartmouth College.
INDUCING WAVELET AND FRACTAL REPRESENTATIONS.

This talk is based on joint work with Paul Muhly. Given a locally compact Hausdorff groupoid G and a right G-space X one can build the so called "imprimitivity groupoid". This new groupoid is Morita equivalent to the original groupoid, as shown by Muhly, Renault, and Williams. Then one can induce a representation of $C^*(G)$ to the C^*-algebra of the imprimitivity groupoid. We present an explicit formula for the induced representations. We apply our results to the Deaconu-Renault groupoid associated with a local homeomorphism and we make the connection with recent work of Jorgensen and Bratelli, Jorgensen and Dutkay, and work of Larsen and Raeburn.

11:00 F, Rm 115 **Helton, Bill** (helton@math.ucsd.edu), UC San Diego. CONVEX MATRIX INEQUALITIES.

We consider noncommutative polynomials and rational functions, $r(x, x^T)$, in noncommutative variables $x = \{x_1, \cdots x_g\}$ etc. which respect an involution denoted ^{T}. The positivity domain of a symmetric noncommutative function r is the set D_r of matrix tuples X (of all sizes) making r take a positive semi definite value $r(X)$. $\{X : \ r(X)PosDef \ \}$. A conjecture of McCullough and Helton is that positivity domains have a very nice representation (called a linear matrix inequality representation). Another issue is: which sets transform to convex ones. The talk will describe some recent work with collaborators on such topics. Matrix inequalities, especially convex ones, play a substantial role in systems engineering.

3:00 W, Rm 106 **Ivanov, Nikolay** (nivanov@math.tamu.edu), Texas A&M University. ON THE STUCTURE OF SOME REDUCED AMALGAMATED FREE PRODUCT C^*-ALGEBRAS.

We study some reduced free products of C^*-algebras with amalgamations. We give necessary conditions for the positive cone of the K_0 group to be the largest possible. We also give necessary conditions for simplicity and uniqueness of trace.

8:30 Su, Rm 115 BURNETT HALL **Junge, Marius** (junge@math.uiuc.edu), University of Illinois at Urbana-Champaign. NONCOMMUTATIVE RIESZ TRANSFORMS.

For a Riemanian manifold the distance between two points is given by

$$d(p,q) = \sup_{\|\nabla f\|_\infty \le 1} |f(p) - f(q)|.$$

This concept has been generalized in the theory of semigroups of positive maps $T_t = e^{-tA}$ to

$$d_A(p,q) = \sup_{\|\Gamma_A(f,f)\|_\infty \le 1} |f(p) - f(q)|.$$

Here

$$2\Gamma_A(f,g) = A(\bar{f}g) - A(\bar{f})g - \bar{f}A(g)$$

is the positive form associated to the generator A considered by Sauvageot and many others. For a Riemanian manifold with $A = -\Delta$, the Laplace-Beltrami operator we have $d = d_A$ and

$$\Gamma_A(f,f) = (\nabla f, \nabla f).$$

For many semigroups in the commutative setting one can show Paul Andre Meyer's inequality

$$c_p^{-1}\|A^{1/2}f\|_p \le \|\Gamma_A(f,f)^{1/2}\|_p \le c_p\|A^{1/2}f\|_p.$$

The main intention of this talk is to show the upper estimate for $p > 2$ and certain semigroups of completely positive maps on noncommutative L_p spaces. Here free products and free groups are particularly interesting. We also discuss applications of the lower estimate for quantum

metric spaces (in the sense of Rieffel) for hyperbolic groups with the Haagerup property.

9:30 Su, Rm 115 Burnett Hall **Kaftal, Victor** (kaftal@math.uc.edu), University of Cincinnati. Infinite Schur-Horn theorems.

I will discuss recent Schur-Horn type theorems by Neumann; Arveson and Kadison; and Antesana, Massey, Ruiz, and Stojanoff. Our main contribution is: **Theorem** Let ξ, η be two monotone sequences decreasing to 0 and assume that ξ is not summable. Then the following are equivalent:

(i) There is an operator $A \in K(H)^+$ with $s(A) = \eta$ and $s(E(A)) = \xi$ where $s(A)$ denotes the s-sequence (eigenvalue list) of A and $E(A)$ denotes the diagonal of A for a fixed basis.
(ii) $\operatorname{diag} \xi = E(U \operatorname{diag} \eta\, U^*)$ for some unitary operator U.
(iii) $\xi = Q\eta$ for some orthostochastic matrix Q ($Q_{ij} = (U_{ij})^2$ for an orthogonal matrix U.)
(iv) $\sum_{j=1}^n \xi_n \leq \sum_{j=1}^n \eta_n$ for all $n \in \mathbb{N}$.

If ξ is summable, in lieu of condition (iv) we have

(iv′) $\sum_{j=1}^n \xi_n \leq \sum_{j=1}^n \eta_n$ for all $n \in \mathbb{N}$ and $\sum_{j=1}^\infty \xi_n = \sum_{j=1}^\infty \eta_n$.

The proof is in part based on an analysis of a construction by Markus in 1964 which extends to the infinite case the original T-transform construction of a stochastic matrix by Hardy, Littlewood and Polya. This is joint work with Gary Weiss.

11:30 Sa, Rm 115 **Kantun Montiel, Gabriel** (pos00580@alumnos.fcfm.buap.mx), Benemerita Universidad Autonoma de Puebla. Generalized T-Fredholm elements in Banach Algebras.

Let A and B be algebras with unit e and $T : A \to B$ a homomorphism. R. Harte defined the T-Fredholm elements in A as those $a \in A$ such that $T(a) \in B^{-1}$. We now say that a is a generalized T- Fredholm element if $T(a)$ is relatively regular in B and there is a generalized inverse b of a such that $T(e - ab - ba) \in A^{-1}$. We investigate generalized T-Fredholm elements and show that if $T(A) = B$ and T is finitely regular then if a is T-Fredholm then a is relatively regular, so a have a pseudo-inverse $b \in A$, and for each pseudo-inverse of a we have $e - ab - ba \in \Phi_T(A)$. Thus the generalized T-Fredholm elements are a in fact a generalization of T-Fredholm elements. We show that some properties of the generalized Fredholm operators remain true for generalized T-Fredholm elements, like a half spectral mapping theorem and some algebraic properties.

3:00 Sa, Rm 106 **Kaliszewski, Steve** (kaliszewski@asu.edu), Arizona State University. Hecke Algebras and Imprimitivity for Crossed Products by Homogeneous Spaces.

For discrete Hecke pairs (G, H), we introduce a notion of covariant representation which reduces in the case where H is normal to the usual definition of covariance for the action of G/H on $c_0(G/H)$ by right translation. We use this covariance to characterise the representations of $c_0(G/H)$ which are multiples of the multiplication representation on $l^2(G/H)$, and more generally, we prove an imprimitivity theorem for regular representations of certain crossed products by coactions of homogeneous spaces.

8:30 F, Rm 115 **Katsoulis, Elias** (katsoulise@ecu.edu), East Carolina University. Operator algebras for multivariable dynamics.

(Joint work with Ken Davidson.) Let X be a locally compact Hausdorff space with n proper continuous self maps $\tau_i : X \to X$ for $1 \leq i \leq n$. To this we associate various topological conjugacy algebras; and two emerge as the natural candidates for the universal algebra of the

system, the tensor algebra $A(X,\tau)$ and the semicrossed product $C_0(X)\times_\tau F_n$. The C*-envelope of $A(X,\tau)$ is the Cuntz- Pimsner algebra $C^*(X,\tau)$ as defined by Katsura. We introduce a new concept of conjugacy for multidimensional systems, which we coin piecewise conjugacy. We prove that the piecewise conjugacy class of the system can be recovered from either the algebraic structure of $A(X,\tau)$ or $C_0(X)\times_\tau F_n$. Various classification results follow as a consequence. For example, for $n=2,3$, the tensor algebras are (algebraically or even completely isometrically) isomorphic if and only if the systems are piecewise topologically conjugate. We define a generalized notion of wandering sets and recurrence. Using this, it is shown that $A(X,\tau)$ or $C_0(X)\times_\tau F_n$ is semisimple if and only if there are no generalized wandering sets. In the metrizable case, this is equivalent to each τ_i being surjective and v-recurrent points being dense for each $v\in F_n$.

9:30 F, Rm 115 **Kerr, David** (kerr@math.tamu.edu), Texas A&M University. ENTROPY, MIXING, AND INDEPENDENCE.

I will discuss how the notion of combinatorial independence can be used to develop a systematic approach to the local theory of entropy and mixing in both topological and measurable dynamics. A crucial point for the success of this viewpoint is to consider locality not only in the neighbourhood sense but also dually at the operator level. This involves fundamental links with the geometric theory of Banach spaces on the one hand and Voiculescu's approximation entropy on the other. I will also demonstrate how the theory can be recast in the language of tensor products and thereby extended to noncommutative dynamics. This is joint work with Hanfeng Li.

4:00 Th, Rm 115 **Kahng, Byung-Jay** (kahngb@canisius.edu), Canisius College. TWISTING OF THE QUANTUM DOUBLE AND WEYL ALGEBRA.

Drinfeld's celebrated "quantum double construction", originally done in the Hopf algebra framework, can be generalized even to the C^*-algebra framework of locally compact quantum groups. A quantum double is naturally associated with a certain "(quasitriangular) R-matrix" $\mathcal{R}$. It turns out that $\mathcal{R}$ determines a (left) twisting of the comultiplication on the quantum double. The result is no longer a quantum group, but it suggests a twisting of the algebra structure on the dual of the quantum double.

In the case of the group C^*-algebra $C^*(G)$ with its natural Hopf structure, this twisting process leads us to the algebra isomorphic to $C_0(G)\times_\tau G$, where τ is the translation. This "Weyl algebra" is no longer a quantum group, while it is well known that it is isomorphic to the algebra of compact operators. I am working on the case of general locally compact quantum groups. The resulting algebra may no longer be isomorphic to $\mathcal{K}(\mathcal{H})$ and could be quite complicated.

11:00 Sa, Rm 115 **Kim, Yun-Su** (kimys@indiana.edu), Indiana University. A GENERALIZATION OF BEURLING'S THEOREM.

We characterize rationally invariant subspaces for a shift operator defined on a vector-valued Hardy space of a bounded multiply connected region in the complex plane.

11:30 Th, Rm 106 **Loring, Terry** (loring@math.unm.edu), University of New Mexico. UNIVERSAL CONSTRUCTIONS, $q\mathbb{C}$ AND SEMIPROJECTIVITY.

The commutative C^*-algebra $C_0(\mathbb{R}^2)$, the C^*-algebra $q\mathbb{C}$ from the Cuntz picture of K-theory, and the noncommutative Grassmanian $G_2^{\rm nc}$, all have similar presentations by generators and relations. We will outline a proof that $q\mathbb{C}$ is semiprojective that takes advantage of this similarity.

Recall $q\mathbb{C}$ consists of the functions in

$$C_0((0,1], \mathbf{M}_2(\mathbb{C}))$$

that are diagonal at the endpoint 1. Its importance in K-theory can be seen in the isomorphism

$$K_0(A) \cong [q\mathbb{C}, A \otimes \mathbb{K}]$$

where $[-,-]$ is to mean homotopy classes of $*$-homomorhpisms. The universal constructions to be considered are relatives of the left-adjoint to the functor

$$A \mapsto \mathbf{M}_n(A)$$

in the category of *not-necessarily unital* C^*-algebras.

1:30 W, Rm 115 **McCullough, Scott** (sam@math.ufl.edu), University of Florida. NON-COMMUTATIVE POLYNOMIALS AND MATRIX CONVEXITY.

Many ideas from convex analysis extend naturally to the non-commutative setting giving rise to the notion of matrix convexity. Certain model engineering problems are expressed as matrix inequalities which do not explicitly depend upon the size of the matrices involved,and a basic question is whether the feasible set is (matrix) convex. This talk will survey results emphasizing the apparent rigidity of matrix convexity for basic non- commutative semi-algebraic sets.

10:30 F, Rm 106 **Massey, Pedro** (massey@math.uregina.ca), University of Regina. THE GAP BETWEEN LOCAL MULTIPLIER ALGEBRAS OF C*-ALGEBRAS.

The local multiplier algebra $M_{\text{loc}}(A)$ of a C*-algebra A was introduced by G. Pedersen as an enveloping C* algebra of A where – if A is separable – every derivation of A can be extended to an inner derivation. It has the property that $M_{\text{loc}}(A) \subseteq M_{\text{loc}}(M_{\text{loc}}(A))$. A long standing question of Pedersen asks whether the above inclusion is an equality. Recently, P. Ara and M. Mathieu unveiled the first examples of separable A where the inclusion is proper. Their examples are AF antiliminal C* algebras. In this talk we will describe a separable liminal C*-algebra A such that the inclusion is also proper. This is joint work with M. Argerami and D. Farenick.

3:30 Th, Rm 115 **Martin, Mircea** (mircea.martin@bakeru.edu), Baker University. AHLFORS-BEURLING CHARACTERISTIC NUMBERS OF ELLIPTIC DIFFERENTIAL OPERATORS.

The Ahlfors-Beurling inequality is related to the standard one-dimensional Cauchy kernel. My main goal is to prove higher-dimensional generalizations of this inequality for fundamental solutions of elliptic differential operators with coefficients in a Banach algebra. The best constants in such inequalities are referred to as Ahlfors-Beurling characteristic numbers. In the Banach algebra setting, I also give generalizations of two inequalities addressing rational approximation in single-variable complex analysis due to Alexander, and Gamelin and Khavinson. The Ahlfors-Beurling characteristic numbers are explicitly determined for Dirac operators with coefficients in Clifford algebras.

5:00 Th, Rm 106 **Matache, Valentin** (vmatache@mail.unomaha.edu), University of Nebraska at Omaha. S–TOEPLITZ COMPOSITION OPERATORS.

Operators on function spaces acting by composition to the right with a fixed selfmap φ of some set are called composition operators of symbol φ. Isometric operators S on a Hilbert space with the property that the sequence $\{S^{*n}\}$ tends to 0 pointwise are called forward unilateral shifts. A Hilbert space operator T is called S–Toeplitz if $S^*TS = T$ and S–uniformly asymptotically Toeplitz, (S–UAT), S–strongly asymptotically Toeplitz, (S–SAT), respectively S–weakly asymptotically Toeplitz, (S–WAT), if the sequence $\{S^{*n}TS^n\}$ is convergent uniformly, strongly,

respectively weakly. We will discuss when composition operators on the Hilbert Hardy space H^2 are M_ϕ– Toeplitz, M_ϕ–UAT, M_ϕ–SAT, or M_ϕ–WAT, where ϕ is a nonconstant inner function and M_ϕ the multiplication operator induced by that function. *Mathematics Subject Classification.* Primary 47B33, Secondary 47B35

4:30 W, Rm 115 **Ng, P. W.** (png@louisiana.edu), University of Louisiana. A measure theoretic uniqueness theorem and the unitary group of an injective type III factor.

Norm topology existence and uniqueness theorems play a fundamental role in classification theory as well as extension theory. We believe that measure theoretic versions of these theorems are also interesting. Let M be a type III von Neumann factor with separable predual. Then M is injective if-and- only-if M has a Voiculescu-type theorem. We use this to give another proof that the unitary group of an injective type III factor, given the weak* topology, is extremely amenable. We finally give some results on the Kirchberg property for the unitary group of an injective type III factor. This is joint work with Thierry Giordano.

3:30 Sa, Rm 115 **Packer, Judith** (packer@colorado.edu), University of Colorado, Boulder. Generalized-low pass filters and isometries.

I discuss some recent work, done in collaboration with L. Baggett, N. Larsen, K. Merrill, and I. Raeburn, which, under appropriate conditions, allows us to construct a generalized multiresolution analysis ("GMRA") in the sense of Baggett, H. Medina, and Merrill corresponding to any bounded multiplicity function satisfying the consistency equation that is non-zero in a neighborhood of $1 \in \mathbb{T}$. Using K. Merrill's new definition for generalized-low pass condition for a family of filters, we have been able to construct a family of "low-pass" filter functions. These are then used to construct an isometry, which can in turn used to construct the GMRA using the direct limit methods pioneered by Larsen and Raeburn.

5:00 W, Rm 115 **Paterson, Alan** (m1p1t@yahoo.com). Exactness for the groupoid C*-algebra functor.

In developing his equivariant K-theory on C^*-algebras, N. C. Phillips showed that the functor $A \to C^*(G, A)$ is exact, i.e. takes short exact sequences to short exact sequences. This result is used by Guentner, Higson and Trout in their construction of the equivariant descent functor in E- theory. In noncommutative geometry, the corresponding theory is needed for locally compact groupoids Γ. The talk describes what the functor $A \to C^*(\Gamma, A)$ is in that case, and indicates some of the details of the proof of its exactness.

10:30 Su, Rm 115 Burnett Hall **Peller, Vladimir** (peller@math.msu.edu), Michigan State Uiversity. Differentiability of operator functions.

We consider the problem of the existence of operator derivatives of functions $T \mapsto f(T)$ in the case of self-adjoint operators, unitary operators and contractions. We also consider the problem of the existence of higher operator derivatives. Such problems are closely related to multiple operator integrals. We give an approach to multiple operator integrals that is based on projective tensor products.

8:30 Th, Rm 115 **Phillips, N. Christopher** (ncp@uoregon.edu), University of Oregon. The Tracial Rokhlin Property for Group Actions on C*-Algebras.

Let Γ be a finite group or $\mathbb{Z}$, and let A be an infinite dimensional finite simple separable unital C*-algebra. The tracial Rokhlin property for an action $\alpha\colon \Gamma \to \mathrm{Aut}(A)$ is related to the more usual Rokhlin property in much the same way that Lin's definition of a tracially AF C*-algebra is related to the local approximation characterization of an AF algebra. For finite Γ, the formal definition is as follows: α has the tracial Rokhlin property if for every finite set $F \subset A$, every

$\varepsilon > 0$, and every nonzero positive element $x \in A$, there are mutually orthogonal projections $e_g \in A$ for $g \in \Gamma$ such that:

(1) $\|\alpha_g(e_h) - e_{gh}\| < \varepsilon$ for all $g, h \in \Gamma$.
(2) $\|e_g a - a e_g\| < \varepsilon$ for all $g \in \Gamma$ and all $a \in F$.
(3) With $e = \sum_{g\in\Gamma} e_g$, the projection $1 - e$ is Murray-von Neumann equivalent to a projection in $\overline{xAx}$.

The tracial Rokhlin property is a freeness condition which is weaker than the Rokhlin property and stronger than the requirement that α_g be outer for all $g \in \Gamma \setminus \{1\}$. For finite groups, the Rokhlin property is very rare, while the tracial Rokhlin property is both rather common and, unlike outerness, strong enough to use to prove classification theorems. It plays a key role in the proofs that every higher dimensional noncommutative torus is an AT algebra and that the crossed products of an irrational rotation algebra by the standard actions of $\mathbb{Z}/n\mathbb{Z}$, for $n = 2, 3, 4, 6$, are AF.

This talk will give an overview of the tracial Rokhlin property. Most of the results are for finite groups and C*-algebras with many projections. This is the situation which is best understood. A number of open problems will be stated, particularly for the case $\Gamma = \mathbb{Z}$ and for more general groups; these cases are an important direction for further work.

3:30 Th, Rm 106 **Picioroaga, Gabriel** (gabriel@math.binghamton.edu), Binghamton University. A NEW PRESENTATION OF THOMPSON'S GROUP F AND SOME CONSEQUENCES.

In this joint work with U. Haagerup we give a new (infinite) presentation of the group F (it is known that F has the folowing presentation $\langle x_0, x_1, ... | x_j x_i = x_i x_{j+1} \text{ for } i < j\rangle$). The novelty comes from the fact that our presentation allows one to find generators and relations for the commutator subgroup $[F, F]$, a fact previously unknown. We extract two results out of it:
1) the cost of the group $[F, F]$ is 1 hence the cost cannot decide the (non)amenability question of F;
2) the II_1 factor $L([F, F])$ is asymptotically abelian.

4:30 Sa, Rm 115 **Pogan, Alexandru-Alin** (pogan@math.missouri.edu), University of Missouri. THE DICHOTOMY THEOREM FOR ILL-POSED EQUATIONS.

We prove that the operator G, the closure of the first-order differential operator $-d/dt + D(t)$ on $L_2(\mathbb{R}, X)$, is Fredholm if and only if the ill-posed equation $u'(t) = D(t)u(t)$, $t \in \mathbb{R}$, has exponential dichotomies on $\mathbb{R}_+$ and $\mathbb{R}_-$ and the ranges of the dichotomy projections form a Fredholm pair; moreover, the index of this pair is equal to the Fredholm index of G. Here X is a Hilbert space, $D(t) = A + B(t)$, A is the generator of a bi-semigroup, $B(\cdot)$ is a bounded piecewise strongly continuous operator valued function. Also, we prove some perturbations results and consider various examples of ill-posed problems.

10:30 F, Rm 115 **Poon, Yiu** (ytpoon@iastate.edu), Iowa State University. EIGENVALUES OF THE SUM OF MATRICES FROM DIFFERENT UNITARY ORBITS.

Let A and B be $n \times n$ complex matrices. Characterization is given for the set $\mathcal{E}(A, B)$ of complex numbers μ such that μ is an eigenvalue of a matrix of the form $U^*AU + V^*BV$ for some unitary matrices U and V. Consequences of the results are discussed and computer algorithms and programs are designed to generate the set $\mathcal{E}(A, B)$. The results refine those of Wielandt on normal matrices. Extensions of the results to linear operators on Hilbert space are also considered.

9:30 Th, Rm 115 **Popescu, Gelu** (gelu.popescu@utsa.edu), University of Texas at San Antonio. NONCOMMUTATIVE TRANSFORMS AND FREE PLURIHARMONIC FUNCTIONS.

We develop a theory of free pluriharmonic functions on noncommutative balls and their boundary behavior. This provides a framework for the study of arbitrary n-tuples of operators on Hilbert spaces. The main tools used in this study are certain noncommutative transforms which generalize the classical transforms of Berezin, Poisson, Fantappie, Herglotz, and Cayley. Several classical results from complex analysis have free analogues in our noncommutative multivariable setting.

10:30 W, Rm 115 **Power, Stephen** (s.power@lancaster.ac.uk), Lancaster University. OPERATOR ALGEBRAS ASSOCIATED WITH UNITARY COMMUTATION RELATIONS.

We define nonselfadjoint operator algebras with generators $L_{e_1}, \ldots, L_{e_n}, L_{f_1}, \ldots, L_{f_m}$ subject to the unitary commutation relations of the form

$$L_{e_i} L_{f_j} = \sum_{k,l} u_{i,j,k,l} L_{f_l} L_{e_k}$$

where $u = (u_{i,j,k,l})$ is an $nm \times nm$ unitary matrix. These algebras, which generalise the analytic Toeplitz algebras of rank 2 graphs with a single vertex, are classified up to isometric isomorphism in terms of the matrix u. This is joint work with Baruch Solel, 2006: arXiv:0704.0079

4:00 W, Rm 115 **Quigg, John** (quigg@asu.edu), Arizona State University. CATEGORICAL LANDSTAD DUALITY.

Crossed-product duality for actions and coactions of locally compact groups on C*-algebras allows the recovery of the original action or coaction up to Morita-Rieffel equivalence. Landstad duality, on the other hand, allows the recovery up to isomorphism. Moreover, this duality holds in a strong form: it is completely categorical. This is joint work with Steve Kaliszewski and Iain Raeburn.

5:00 Th, Rm 115 **Rojas, Edixon** (edixonr@ula.ve), University of Aveiro, Portugal. SIMILARITY TRANSFORMATION METHODS FOR SINGULAR INTEGRAL OPERATORS WITH REFLECTION ON WEIGHTED LEBESGUE SPACES.

It will be explicitly constructed a similarity relation between singular integral operators with reflection and singular integral operators without reflection (acting between weighted Lebesgue spaces). This will be done as a particular case of an equivalence relation between those two kinds of operators. As a consequence, the Fredholm property is characterized for the operators in consideration, and a Fredholm index formula is provided.

9:30 Sa, Rm 115 **Sherman, David** (dsherman@math.ucsb.edu), University of California, Santa Barbara. ASPECTS OF OPERATOR THEORY IN VON NEUMANN ALGEBRAS.

Many statements from operator theory still make sense when $B(H)$ is replaced with a different von Neumann algebra. In the first part of this talk I will survey some translations which originate in work from the 1970s on approximate equivalence. Some parts of the theory go through cleanly or even better than in $B(H)$, but there are also setbacks, notably the lack of a good analogue for Voiculescu's theorem.

One of the motivations for Voiculescu's theorem was to show that the reducible operators are norm- dense in $B(\ell^2)$. In the second part of the talk I will discuss a related class of operators: for n a cardinal greater than 1, an element x of a von Neumann algebra is said to be *n-divisible*

if the relative commutant of $W^*(x)$ unitally contains a type I_n factor. (Basically, x is the direct sum of n unitarily conjugate operators.) I will answer several – not all – questions about the density of the n-divisible operators, including norm density in $B(\ell^2)$ and strong density in a II_1 factor. The answer to the second, for finite n, is "sometimes."

8:45 W, Rm 115 **Shlyakhtenko, Dimitri** (shlyakht@math.ucla.edu), UCLA. FREE STOCHASTIC CALCULUS, L^2 DERIVATIONS AND FREE ENTROPY DIMENSION.

Certain L^2 derivations can be "exponentiated" to a obtain a one- parameter family of embeddings of an algebra into its free product with a free group factor. This construction is related to the subject of free stochastic differential equations. Using this construction, we prove some lower estimates on the microstate free entropy dimension, and compute its exact value for a class of groups.

4:00 Sa, Rm 115 **Shulman, Tatiana** (tatiana_shulman@yahoo.com), New Hampshire University. ON SOME C*-ALGEBRAS GENERATED BY PROJECTIONS.

We consider the universal C*-algebras $P_{n,\lambda}$ on generators $p_1, ..., p_n$ subject to the relations $p_i^* = p_i = p_i^2, p_1 + ... + p_n = \lambda 1$, where $\lambda \in \mathbb{R}$. We consider the question: under which n, λ the algebra $P_{n,\lambda}$ is of type I, nuclear, or exact. We prove that among these algebras there are continuum of non-isomorphic ones. We also discuss some results about the closure of the set of all operators that are the sum of n projections.

11:30 Th, Rm 115 **Skripka, Anna** (skripkaa@math.missouri.edu), University of Missouri-Columbia. ON A PERTURBATION DETERMINANT IN FINITE VON NEUMANN ALGEBRAS.

In the finite von Neumann algebra setting, we introduce the concept of a perturbation determinant associated with a pair of self-adjoint elements and relate it to the existing concepts of the Fuglede-Kadison and the de la Harpe- Skandalis determinants. An analog of Krein's representation for the spectral shift function in terms of the perturbation determinant is obtained and then applied in the proof of the Birman-Solomyak spectral averaging formula for a general non-linear perturbation. Some consequences of the spectral averaging formula will also be discussed. This is a preliminary report of joint work with K. A. Makarov.

11:00 Th, Rm 115 **Smith, Roger** (rsmith@math.tamu.edu), Texas A&M University. NORMALIZERS OF IRREDUCIBLE SUBFACTORS.

Normalizing unitaries have played a role in von Neumann algebra theory ever since Dixmier used them to classify masas into various types. In this talk we will examine a different situation, an irreducible inclusion $N \subseteq M$ of finite factors. The general problem is to determine the group $\mathcal{N}(N)$ of normalizing unitaries and/or the von Neumann algebra that it generates. We will focus on two situations where it is possible to give complete answers to this. Both arise from discrete groups: the inclusion $L(H) \subseteq L(G)$ for an inclusion of groups $H \subseteq G$, and the inclusion $M^G \subseteq M$ where M^G is the fixed point algebra of a finite group action. In both cases the normalizing unitaries of the subfactor are studied by relating them to certain projections in $N' \cap \langle M, e_N \rangle$ where $\langle M, e_N \rangle$ is the basic construction of subfactor theory. This is joint work with Stuart White and Alan Wiggins.

3:00 Th, Rm 115 **Tomforde, Mark** (tomforde@math.uh.edu), University of Houston. LEAVITT PATH ALGEBRAS.

Given a field K and a directed graph E, one can construct a K- algebra $L_K(E)$ that generalizes the Leavitt algebras introduced in the 1950's. These Leavitt path algebras are defined in a

way similar to that of graph C^*-algebras, and surprisingly it has been found that many similar results hold for the two classes (although the proofs for each class have been different). We will discuss some fundamental structure theorems for the Leavitt path algebras and discuss how these theorems give insight into the relationship between Leavitt path algebras and graph C^*-algebras.

9:45 W, Rm 115 **Weaver, Nik** (nweaver@math.wustl.edu), Washington University. A NEW APPROACH TO QUANTUM METRICS.

We propose a new definition of "quantum metrics" based on algebra filtrations of $B(H)$. In the abelian case our definition reduces to the usual notion of a metric. In general a quantum metric on the von Neumann algebra M can be axiomatically characterized in terms of a distance function on the projections in $M \otimes B(l^2)$. Interesting examples include quantum tori, the quantum plane, and quantum Heisenberg manifolds. This is joint work with Greg Kuperberg.

11:00 F, Rm 106 **White, Stuart** (white@math.tamu.edu), Texas A&M University. VALUES OF THE PUKÁNSZKY INVARIANT IN CERTAIN MCDUFF FACTORS.

The Pukánszky invariant assoicates to a masa A in a II_1 factor a non-empty subset of $\mathbb{N} \cup \{\infty\}$ by examining the multiplicities of the algebra $(A \cup JAJ)'(1 - e_A)$. Every subset of $\mathbb{N} \cup \{\infty\}$ containing 1 or ∞ is known to arise as a Pukánszky invariant of some masa in the hyperfinite II_1 factor, using an ergodic construction of Neshveyev and Størmer in the first case or a group-subgroup inclusion of Dykema, Sinclair and Smith in the second. In this talk we shall show that every non-empty subset arises as a Pukánskzy invariant of a masa in the hyperfinite factor using an approximation argument. We also obtain the same result in any McDuff factor with a Cartan masa.

11:00 W, Rm 115 **Williams, Dana** (dana.williams@dartmouth.edu), Dartmouth College. PROPERTIES PRESERVED UNDER MORITA EQUIVALENCE OF C^*-ALGEBRAS.

Morita equivalence for C^*-algebras was introduced by Rieffel in the 1970s and is now a standard tool in the subject. In this talk, I will discuss some of the important properties of C^*-algebras which are preserved by Morita equivalence. This is joint work with Astrid an Huef and Iain Raeburn.

10:30 Sa, Rm 106 **Wogen, Warren** (wrw@email.unc.edu), University of North Carolina. COMPLEX SYMMETRIC OPERATORS.

(Joint work with S. Garcia.) A conjugation C on Hilbert space is a conjugate linear isometric involution. An operator T is C-symmetric if CTC = T*, and T is complex symmetric if T is C-symmetric for some conjugation C. In recent work of Garcia and Putinar, it is observed that all normal operators, all compressed Toeplitz operators, and many integral operators are complex symmetric. In this talk we describe some new classes of complex symmetric operators. For a fixed conjugation C, we consider some operator algebra questions for the subspace of C-symmetric operators.

4:30 Th, Rm 106 **Yoon, Jasang** (jyoon@iastate.edu), Iowa State University. SCHUR PRODUCT TECHNIQUES FOR COMMUTING MULTIVARIABLE WEIGHTED SHIFTS.

In this paper we study the hyponormality and subnormality of 2-variable weighted shifts using the Schur product techniques in matrices. As applications, we generalize the result in [Theorem 5.2]CuYo1 and give a non-trivial, large class satisying the Curto-Muhly-Xia conjecture CMX for 2-variable weighted shifts. Further, we give a complete characterization of hyponormality and subnormality in the class of flat, contractive, 2- variable weighted shifts (T_1, T_2) with the

condition that the norm of the 0-th horizontal 1-variable weighted shift of (T_1, T_2) is a given constant.

11:30 W, Rm 115 **Zarikian, Vrej** (zarikian@usna.edu), United States Naval Academy.
PAVING SMALL MATRICES AND THE KADISON-SINGER EXTENSION PROBLEM.

An important question concerning the pure states of $B(\ell^2)$, posed in 1959, is the *Kadison-Singer Extension Problem*: Does every pure state on the diagonal of $B(\ell^2)$ extend uniquely to a pure state on all of $B(\ell^2)$. This is equivalent to *Anderson's Paving Problem*, a question about finite matrices: Given $0 < \epsilon < 1$, does there exist an integer k such that every zero-diagonal $n \times n$ matrix "k-paves to ϵ"? In spite of significant progress by Berman-Halpern-Kaftal-Weiss and Bourgain-Tzafriri, the Paving Problem remains open. In this talk, based on joint work with Gary Weiss of the University of Cincinnati, we examine the Paving Problem for small parameter values: $k = 3$ and $n \leq 16$. We show that every 4×4 (resp. 5×5) zero-diagonal matrix 3-paves to $\frac{2}{1+\sqrt{5}} \approx .6180$, that every 6×6 zero-diagonal matrix 3-paves to $\frac{c}{1}\sqrt{2} \approx .7071$, and that these results are sharp. On the other hand, we produce a 7×7 zero-diagonal unitary circulant that 3- paves to approximately .8231. Our techniques blend operator theory, graph theory, and computer experimentation.