WABASH
EXTRAMURAL MODERN ANALYSIS
MINICONFERENCE

September 24 and 25, 2011

Abstracts

Invited Talks

9:50–10:40, Saturday, Room: 252

Topological orbit equivalence of free, minimal actions of $\mathbb{Z}^d$ on the Cantor set

Thierry Giordano, *Ottawa University*

In 1959, H. Dye introduced the notion of orbit equivalence and proved that any two ergodic finite measure-preserving transformations on a Lebesgue space are orbit equivalent. He also conjectured that an arbitrary action of a discrete amenable group is orbit equivalent to a $\mathbb{Z}$-action. This conjecture was proved by Ornstein and Weiss and its most general case by Connes, Feldman and Weiss by establishing that an amenable non-singular countable equivalence relation $\mathcal{R}$ can be generated by a single transformation, or equivalently is hyperfinite, i.e., $\mathcal{R}$ is up to a null set, a countable increasing union of finite equivalence relations. In the Borel case, Weiss proved that actions of $\mathbb{Z}^d$ are (orbit equivalent to) hyperfinite Borel equivalence relations, whose classification was obtained by Dougherty, Jackson and Kechris. In 1995, Giordano, Putnam and Skau proved that minimal $\mathbb{Z}$-actions on the Cantor set were orbit equivalent to approximately finite (AF) relations and their classification was given. In this talk I will indicate the main steps of the proof of the general result obtained in a joint effort with H. Matui, I. Putnam and C. Skau and whose statement is the following: Theorem Any minimal, free $\mathbb{Z}^d$-action on the Cantor set is affable (i.e., orbit equivalent to AF-relations).

10:50–11:40, Saturday, Room: 252

The relation between Tsirelson's problem and Connes' embedding problem

Marius Junge, *University of Illinois at Urbana-Champaign*

During his seminal work on Bell inequalities B. Tsirelson formulated a problem concerning two possible meaning of independent quantum states, one using tensor products and one using commuting projections. We show that that Connes' embeding problem implies a positive solution of Tsirelson's problem, and that a matrix valued version of Tsirelson's problem is indeed equivalent to Connes' embedding problem. We will also discuss the operator systems which are the heart of the argument, and further related interesting operator systems in quantum information theory.

2:00–2:50, Saturday, Room: 252

Classifying subfactors up to index 5

Emily Peters, *Massachusetts Institute of Technology*

Subfactors of von Neumann algebras have a famous real number invariant, the Jones Index. Subfactors with index less than or equal to four are known to be 'classical' (classified by Dynkin diagrams). In 1991 Haagerup began the project of studying subfactors with index "just a little higher" than four. The classification of subfactors with index up to 5 has recently been completed. I'll talk about recent work with Scott Morrison, Noah Snyder and Dave Penneys in this direction.

3:00–3:50, Saturday, Room 252

New Bounds on the Cap Set Problem

Nets Katz, *Indiana University*

A set $A \subset F_3^N$ (where F_3 is the finite field with 3 elements) is called a cap set if it contains no lines. In joint work with Michael Bateman, we show that there is are constants $C, \epsilon > 0$ so that any cap set satisfies

$$|A| \leq \frac{C3^N}{N^{1+\epsilon}}.$$

9:30–10:20, Sunday, Room: 252

Central limits in operator-valued non-commutative probability

Serban Belinschi, *University of Saskatchewan*

Besides classical independence, three types of independences specific to non-commutative probability are best known: Voiculescu's free independence, Boolean independence introduced by Speicher and Woroudi and Muraki's monotone independence. For each of them, the central limits (the corresponding non-commutative analogues of the classical normal distribution) are known: the Wigner law (for free independence), the Bernoulli distribution (for Boolean independence) and the arcsine law (for monotone independence).

In this talk we shall discuss properties of the operator-valued analogues of these three distributions, found by Voiculescu (the free central limit) and Popa (the monotone and Boolean central limits). We shall show that they satisfy certain arithmetic relations involving free, Boolean and monotonic convolutions and show connections to free convolution semigroups. The talk will be based on joint work with M. Popa and V. Vinnikov.

10:30–11:20, Sunday, Room 252

Addition of free nonselfadjoint variables

Hari Bercovici, *Indiana University*

he addition of free selfadjoint variables leads to a free convolution and a whole chapter of noncommutative harmonic analysis. The nonselfadjoint case seems to be more difficult. We will consider a relatively simple situation in which one still obtains an interesting convolution, along with its own harmonic analysis and limit theorems. This is joint work with A. Nica.

Contributed Talks

11:50–12:10, Saturday, Room: 252

Quasi-homomorphisms and Surface Groups

José Carrión, *Purdue University*

By a quasi-homomorphism of a group G we mean an approximately multiplicative map of G to the unitary group of a unital C^*-algebra. A quasi-homomorphism induces partially defined map at the level K-theory. Studying the action of these maps at the K-theoretic level yields cohomological invariants related to almost-flat bundles over the classifying space of G.

In the early 90s Exel and Loring associated two invariants to pairs of almost-commuting scalar unitary matrices u and v: one a K-theoretic invariant, which may be regarded as the image of the Bott element in $K_0(C(\mathbb{T}^2))$ by a quasi-homomorphism of $\mathbb{Z}^2$ to $U(n)$; the other a winding number invariant, which is the winding number in $\mathbb{C} \setminus \{0\}$ of the path $t \mapsto \det(tvu + (1-t)tuv)$. The so-called Exel-Loring formula states that these two invariants coincide if $\|uv - vu\|$ is sufficiently small.

These invariants are examples of the ones we consider. A generalization of the Exel-Loring formula for quasi-homomorphisms of a surface group taking values in a unital C^*-algebra (with a trace) is given. (This is joint work with M. Dadarlat).

4:00–4:20, Saturday, Room: 252

Dichotomous Behavior for the Hypercyclicity of Weighted Shifts

Irina Seceleanu, *Bridgewater State University*

We say a continuous linear operator T on a Banach space X is hypercyclic provided there exists a vector x in X whose orbit $Orb(T,x) = x, Tx, T^2x, ...$ is dense in X. Weighted shifts are among the many operators exhibiting this remarkable behavior. We show that for the class of weighted shifts, if an operator has an orbit with a non-zero limit point, it will also possess a dense orbit. Equivalently, either no orbit of T has a non-zero limit point in the space X or some orbit has every vector in X as a limit point.

4:30–4:50, Saturday, Room: 252

Automatic continuity of orthogonality or disjointness preserving maps

Timur Oikhbeg, *University of California at Irvine*

Suppose E and X are Banach spaces, and E is equipped with some kind of order (it may be either a Banach lattice, or a non-commutative L_p space). Suppose furthermore that T is a linear map from E to X, for which $T(e)$ and $T(f)$ satisfy a certain metric condition, resembling disjointness, whenever e and f are disjoint elements of E. We show that, under certain conditions, T is necessarily continuous.

Part of this work was carried out in collaboration with A.M.Peralta and D.Puglisi.

5:00–5:20, Saturday, Room: 274

New examples of von Neumann algebras with unique Cartan subalgebra

Bogdan Theodor Udrea, *University of Iowa*

In this talk we will show that any compact action of direct products of icc hyperbolic groups gives rise to a von Neumann algebra with unique Cartan subalgebra. The method we employ also allows new structural results for maximal abelian subalgebras of II_1 factors associated with products of hyperbolic groups. This is a joint work with I. Chifan and T. Sinclair.

5:30–5:50, Saturday, Room: 274

Fundamental Agler Decompositions

Kelly Bickel, *Washington University, St. Louis*

It is well-known that every holomorphic function $\phi : \mathbb{D}^2 \to \mathbb{D}$ possesses an Agler decomposition; i.e. that there exist positive semi-definite kernels functions K_1 and K_2 such that

$$1 - \phi(\lambda)\overline{\phi(\mu)} = (1 - \lambda_1\bar{\mu_1})K_1(\lambda, \mu) + (1 - \lambda_1\bar{\mu_1})K_2(\lambda, \mu) \qquad \forall \lambda, \mu \in \mathbb{D}^2. \tag{1}$$

In general, such decompositions are difficult to write down explicitly. In this talk, we present a constructive, elementary proof of (1) using fundamental shift-invariant subspaces of the Hardy space on the bidisk. We then use these constructed decompositions to analyze properties about general Agler decompositions.

6:00–6:20, Saturday, Room: 252

On quasi-diagonality of continuous fields

Jose Lugo, *Purdue University*

Quasi-diagonal C*-algebras form a large class of C*-algebras and arise naturally in many contexts. Dan Voiculescu has shown that quasi-diagonality is a homotopy invariant, and consequently, that the cone of a C*-algebra is always quasi-diagonal. In this talk we discuss an extension of this result for exact continuous fields of C*-algebras. As an application, we obtain that the group C*-algebras of certain central group extensions are always quasi-diagonal.

Sunday

11:30–11:50, Sunday, Room: 252

Diverging Aluthge Sequences of Shifts

Kevin Rion, *Bridgewater State University*

Given a bounded linear operator T on a Hilbert space, the Aluthge transform is defined by $\Delta(T) = |T|^{\frac{1}{2}} U |T|^{\frac{1}{2}}$, where $T = U|T|$ is the polar decomposition of T.

The nth Aluthge transform is defined for $n \geq 1$ by $\Delta^n(T) = \Delta(\Delta^{n-1}(T))$, with $\Delta^0(T) = T$.

We show if T is any bilateral forward shift then the Aluthge sequence $T, \Delta(T), \Delta^2(T), ...$ either converges in the strong operator topology (SOT) to a normal shift, or the set of SOT subsequential limit points is an interval of normal shifts. More specifically, this set of subsequential limits points has the form $\{t \cdot S; a \leq t \leq b\}$ where S is the pure forward shift.

Lastly, we show for any $0 < a < b$ there is a bounded forward shift T for which $\{t \cdot S; a \leq t \leq b\}$ is the set of SOT subsequential limit points of the Aluthge sequence of T.

11:55–12:15, Sunday, Room: 252

The q-Gaussian algebras are weakly amenable

Steve Avsec, *University of Illinois at Urbana-Champaign*

Abstact: The q-Gaussian variables were first introduced by Bożejko and Speicher as a generalization of classical Gaussian variables and Voiculescu's free Gaussians. The von Neumann algebras they generate are similar to free group factors in that they are noninjective, non-Γ II_1 factors. We shall give a proof that the q-Gaussian algebras have the weak* completely contractive approximation property and a corollary of this fact following Ozawa and Popa's landmark paper.