Vanderbilt University, Department of Mathematics, Nashville, Tennessee, USA

THE THIRD ANNUAL SPRING INSTITUTE ON

NONCOMMUTATIVE GEOMETRY AND OPERATOR ALGEBRAS

in conjunction with the

20th ANNUAL SHANKS LECTURE

May 9 to May 20, 2005

Abstracts

Teodor Banica, Universite Paul Sabatier (Toulouse III)

Random walks on discrete quantum groups

Abstract: We consider random walks on various quantum algebraic objects - quantum permutation groups, discrete quantum groups, subfactor graphs - with a few explicit calculations of associated probability measures.

Dietmar Bisch, Vanderbilt University

A Notion of Free Product for Planar Algebras

Abstract: The Fuss-Catalan algebras, discovered by Jones and myself, are the fundamental symmetries associated to a subfactor whenever an intermediate subfactor is present. These algebras arise as certain ``free products'' of Temperley-Lieb algebras when viewed as planar algebras. In general, the dimension generating function of a free product planar algebra can be computed via Voiculescu's free multiplicative convolution.

Florin Boca, University of Illinois at Urbana-Champaign

Some Statistical Problems Related to the Equation ad-bc=1

Abstract: We will present some results concerning the spacing statistics of the Farey sequence and the limiting distribution of the linear flow on the punctured 2-torus (joint work with Zaharescu), and on the distribution of reduced quadratic irrational numbers. The last topic is related to the continued fractionalgorithm and to certain number-theoretic spin chain models in thermodynamics. In this framework we will introduce a certainC*-algebra that is related to irrational rotation algebras.

Ken Dykema, Texas A&M University

Multilinear function series and transforms in free probability theory

Abstract: We consider the algebra of formal multilinear function series, analogous to formal power series over an algebra, and we show that the R- an S-transforms in free probability theory have unsymmetrized versions inthis setting.

Alex Furman, University of Illinois at Chicago

Measure Equivalence and rigidity of higher rank lattices

Abstract: Measure Equivalence of groups can be viewed as either measurable analogue of quasi-isometries or as a convenient framework for the study of Orbit Equivalence of free, probability measure-preserving group actions. In this

context we shall focus on rigidity phenomena of higher rank lattices.

Shamindra Ghosh, University of New Hampshire

Representations of a Planar Algebra

Abstract: This talk will describe `representations of a planar algebra' in the sense of Vaughan Jones and classification of the irreducible ones according to their weights.
To every representation of a planar algebra, one can associate a power series called `dimension'. We will show that the radius of convergence of the dimension of any irreducible representation of a finite depth planar algebra is at least as big as the inverse-square of the modulus of the planar algebra.

Pinhas Grossman, UC Berkeley

Intermediate Subfactors with No Extra Structure

Abstract: This talk will present joint work with Vaughan Jones on classifying quadrilaterals of II_1 factors which have "no extra structure", in the sense that the standard invariants of the elementary inclusions are Temperley-Lieb algebras. It turns out that there are only two possibilities for the planar algebra of a noncommuting quadrilateral with no extra structure.

Adrian Ioana, UCLA

Amalgamated Free Products of w-rigid Factors and Calculation of their Symmetry Groups, part II

Abstract: We present several unique decomposition results (\'a la Bass-Serre) for amalgamated free products of w-rigid factors. We apply this to prove rigidity results for isomorphisms between such factors and to explicitly calculate their symmetry groups, i.e. their fundamental groups and automorphism groups. This is joint work with Jesse Peterson and Sorin Popa.

Kenley Jung, UCLA

Some free entropy dimension inequalities for subfactors of finite index

Abstract: Given an inclusion of II_1-factors $N \subset M$ and a finite generating set F for N we construct finite generating sets X for N and Y for M such that $\delta_0(X) geq \delta_0(Y)$ where δ_0 denotes Voiculescu's microstates free entropy dimension. Applying this result to the basic construction yields a lower bound for $\delta_0(Y)$ in terms of $\delta_0(X)$ and $[M:N]$. We apply these results to obtain certain nonisomorphism theorems.

Yasuyuki Kawahigashi, University of Tokyo

Classification of extensions in algebraic quantum field theory and vertex operator algebras

Abstract: We will explain how to study local and non-local extensions of local nets of factors on the circle. Relations of this problem to classification of diffeomorphism covariant nets with c < 1, boundary conformal field theory, the Goodman-de la Harpe-Jones subfactors, and vertex operator algebras such as the moonshine VOA are presented. This is joint work with Roberto Longo.

Wolfgang Lück, Universität Münster

Middle algebraic K-theory of von Neumann algebras, group C^*-algebras and group rings

Abstract: We compute the lower and middle algebraic K-groups of von Neumann algebras. Since K-groups commute with finite products, it suffices to treat the various types separately. The middle K-groups vanish if the type is different from I_f or II_1. The groups can be computed in this cases via center valued traces and certain determinants. We use this to study the corresponding K-groups for group C^*-algebras and group rings. In particular it is interesting to study the passage from the integral group ring to the complex group ring, to the reduced group C^*-algebra and finally to the group von Neumann algebra.

Matilde Marcolli, Max-Planck Institute Bonn

KMS states and complex multiplication

Abstract: In this joint work with A.Connes and N.Ramachandran, we construct a quantum statistical mechanical system that generalizes the Bost-Connes system to imaginary quadratic fields K of arbitrary class number and fully incorporates the explict class field theory for such fields. This system admits the Dedekind zeta function as partition function and the Idele class group as group of symmetries. The extremal KMS states at zero temperature intertwine this symmetry with the Galois action on the values of the states on the arithmetic subalgebra. We also give an interpretation of the original BC system and of the GL(2) system in terms of Shimura varieties, which motivates the construction for imaginary quadratic fields. The geometric notion underlying the construction is that of commensurability of K-lattices.

Remus Nicoara, Vanderbilt University

On II_1 factors arising from 2-cocycles of w-rigid groups

Abstract: (jointly with Sorin Popa and Roman Sasyk) We consider II_1 factors $M_\nu=L_\nu (G)$, where G is a discrete ICC group with a relative property (T) subgroup H, and ν are scalar 2-cocycles of H. We show that for each fixed (G,H) there exists no separable II_1 factor that contains M_ν for uncountably many $\nu\in \text{\rm H}^2(H)$. We consider several classes of examples, such as the irrational rotation HT factors $M_\alpha(\Gamma)=L_{\nu_\alpha}(\mathbb Z^2\rtimes \Gamma)$, where Γ is a non-amenable subgroup of $SL(2,\mathbb Z)$ and ν_α are cocycles of $\mathbb{Z}^2$, $\alpha=e^{2\pi it}$, t \notin \mathbb{Q}$.

Sergey Neshveyev, University of Oslo

Types of von Neumann algebras arising from boundary actions of hyperbolic groups

Abstract: A non-degenerate finitely supported probability measure on a non-elementary hyperbolic group defines a quasi-invariant harmonic measure on the boundary of the group. The corresponding crossed product algebra is well-known to be a factor of type III. In my talk I shall discuss what can be said about the S-invariant of the factor, or in other words, about the ratio set of the orbit equivalence relation on the boundary. This is a joint work with Masaki Izumi and Rui Okayasu.

Narutaka Ozawa, University of Tokyo and UCLA

Hyperbolic Groups and Type II_1 Factors

Abstract: Most of discrete groups admit compact boundaries on which they act amenably, even if groups themselves are not amenable. In particular, groups with a geometric structure, e.g. hyperbolic groups, naturally come with such boundaries. We can read the degree of non-amenability of a group from its amenable boundary. I will explain how to use amenable action to the classification of group von Neumann algebras.

Jesse Peterson, UCLA

Amalgamated Free Products of w-rigid Factors and Calculation of their Symmetry Groups, part I

Abstract: We present several unique decomposition results (\'a la Bass-Serre) for amalgamated free products of w-rigid factors. We apply this to prove rigidity results for isomorphisms between such factors and to explicitly calculate their symmetry groups, i.e. their fundamental groups and automorphism groups. This is joint work with Adrian Ioana and Sorin Popa.

Roman Sauer, Universität Münster

Another approach to Gaboriau's L^2-Betti numbers of equivalence relations

Abstract: We present an alternative approach to Gaboriau's L^2-Betti numbers of equivalence relations using Lueck's dimension theory. Moreover, we explain the relation between L^2 Betti numbers and the minimal volume (based on an idea of Gromov) which shows how useful the viewpoint of equivalence relations can be -- even if one is only interested in L^2 Betti numbers of manifolds.

Hanne Schultz, University of Southern Denmark

Brown measures of sets of commuting operators in a II_1 factor

Abstract: In recent work by U. Haagerup and the speaker it was shown that for any operator T in a II_1 factor M and for any Borel set B in the complex plane there is a maximal T-invariant so-called spectral subspace K_T(B) affiliated with M such that the Brown measure of T|_K_T(B) is concentrated on B. Moreover, K_T(B) is T-hyperinvariant (i.e. S-invariant for every S in {T}'). This enables us to prove the existence of a Brown measure for any finite set T=(T_1,..., T_n) of commuting operators in M. The Brown measure \mu_T is a probability measure on C^n with certain nice properties. We also show that exactly as in the case of a single operator, one can associate to every Borel set in C^n a T_1-,...,T_n-invariant spectral subspace.

Roland Speicher, Queen's University

Free probability and random matrices

Abstract: I will report on recent results around the relation between free probability theory and random matrices.

Yoshimichi Ueda, Kyushu University

HNN extensions of von Neumann algebras

Abstract: I'll present my work on reduced HNN extensions of von Neumann algebras (as well as C^*-algebras). If time permits, I'll talk about my recent attempt of analyzing ascending HNN extensions (i.e., HNN extensions by endomorphisms).

Alain Valette, Universite de Neuchatel

Group II_1-factors with trivial fundamental group and all L^2-Betti numbers zero

Abstract: Popa introduced a class HT of II_1-factors displaying a mixture of rigidity (relative property (T)) and non-rigidity (Haagerup property). Using Gaboriau's work, he defined the L^2-Betti numbers of factors in this class, and showed that, as soon as some L^2-Betti number is non-zero (and finite) then the fundamental group of the factor is zero. This is the case for the factor of $\bbZ^2\rtimes SL(2,\bbZ)$, which was the first example of a factor with trivial fundamental group. We construct new examples of group II_1-factors in HT, with all L^2-Betti numbers zero and with trivial fundamental group. Triviality of the fundamental group follows from recent results of Monod-Shalom.