Von Neumann Algebras and their Applications
Algèbres de Von Neumann et leurs applications

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IONUT CHIFAN, University of Iowa
Rigidity in group von Neumann algebra

In the mid thirties F. J. Murray and J. von Neumann found a natural way to associate a von Neumann algebra L(G) to every countable discrete group G. Classifying L(G) in terms of G emerged from the beginning as a natural yet quite challenging problem as these algebras tend to have very limited "memory" of the underlying group. This is perhaps best illustrated by Connes' famous result asserting that all icc amenable groups give rise to isomorphic von Neumann algebras; thus in this case, besides amenability, the algebra has no recollection of the usual group invariants like torsion, rank, or generators and relations. In the non-amenable case the situation is radically different; many examples where the von Neumann algebraic structure is sensitive to various algebraic group properties have been discovered via Popa's deformation/rigidity theory. In this talk I will present several new instances where the von Neumann algebra completely retains canonical algebraic constructions in group group theory such us direct product, amalgamated free product, or wreath product.

ROLANDO DE SANTIAGO, The University of Iowa
Product Rigidity for Non-Prime Group von Neumann Algebras

Since their inception, the classification problem of group von Neumann algebras has been endeavor to determine which, if any, canonical properties of the group Γ are detectable in $L(\Gamma)$, the resulting algebra. We show if Γ is a k-fold product of of non-elementary hyperbolic groups and Λ is an arbitrary group such that $L(\Gamma) \cong L(\Lambda)$, then Λ is necessarily a non-trivial k-fold product of non-amenable groups $\Lambda_1, \ldots, \Lambda_k$. In this case, the group von Neumann algebra retains the direct product structure of the underlying group.

Refining these techniques, we are able to show the class of the so-called poly-hyperbolic groups exhibit similar phenomena. Namely, if Γ is a group in this in this class whose group von Neumann algebra decomposes into a tensor product of II_1 factors $L(\Gamma) \cong P_1 \bar{\otimes} P_2$, then Γ must necessarily be commensurable to non-trivial direct product of poly-hyperbolic groups.

CESAR GALINDO, Universidad de los Andes
Coideal subalgebras of some Kac algebras

Kac algebras play an important role in the theory of inclusions of hyperfinite factors of type II_1; indeed, any irreducible finite index depth 2 subfactor is obtained as fixed point set under the action of some finite dimensional Kac algebra on the factor. There furthermore is a Galois-like correspondence between the lattice of intermediate subfactors and the lattice of coideal subalgebras of the Kac algebra.

We describe the lattice of coideal subalgebra of the Kac algebras obtained by 2-cocycle deformation of the algebra of function $\mathbb{C}^G$ of a finite group G. As an example we describe the lattice of coideal subalgebras of some Kac algebras of Kac-Paljutkin type.

ISAAC GOLDBRING, University of California, Irvine
Explicit sentences distinguishing McDuff's II_1 factors

McDuff was the first to give a family of continuum many pairwise nonisomorphic separable II_1 factors. In a recent paper by Boutonnet, Chifan, and Ioana, it was shown that the elements of this family also have pairwise nonisomorphic ultrapowers. As a result, none of these factors are *elementarily equivalent*, meaning that for every pair of distinct elements M_α and M_β of this

family, there is some sentence σ such that the value of σ in M_α differs from the value of σ in M_β. However, at first glance, it was not clear how to extract such sentences from their proof. In joint work with Bradd Hart, we used *Ehrenfeucht-Fraisse games* to give an upper bound on the complexity of sentences distinguishing the McDuff factors. In this talk, I will discuss recent joint work with Hart and Henry Towsner, where we show how a finer analysis of the Boutonnet-Chifan-Ioana result can be used to write down explicit sentences distinguishing the McDuff factors.

BRADD HART, McMaster University
Theories of II_1 factors

I will give an update on the state of the art regarding theories of II_1 factors. Theory here means the first order continuous theory of the factor. I will include comments about the theory of the hyperfinite II_1 factor, theories of free group factors and their ultraproducts as well as ultraproducts of matrix algebras.

MARCELO LACA, University of Victoria
KMS states of the C-algebras of quasi-lattice ordered semigroups*

Homomorphisms of the quasi-lattice ordered semigroups introduced by Nica into the positive real numbers give rise to quasi-periodic time evolutions on the associated C*-algebras, and we study the equilibrium states of the resulting C*-dynamical systems. We show that equilibrium is unique at each inverse temperature but there is a critical inverse temperature at which the von Neumann type of the equilibrium states changes. We also establish a connection with current work on monoid growth, and offer an operator-algebraic motivation for recent inversion formulas, due to Albenque-Nadeu, Saito and McMullen, for the growth function of a monoid in terms of its clique polynomial. This is joint work with C. Bruce (Victoria), J. Ramagge (Sydney) and A. Sims (Wollongong).

BRENT NELSON, University of California, Berkeley
Derivations on non-tracial von Neumann algebras

Given a non-tracial von Neumann algebra M with a fixed faithful normal state φ, one can study derivations on M as densely defined operators on the corresponding L^2-space. In the study of tracial von Neumann algebras, analyzing such derivations has proven to be a very successful strategy. This is in part because it allows one to bring to bear two very powerful theories: deformation/ rigidity and free probability. When a derivation on M is closable and interacts nicely with the modular automorphism group (i.e. is "μ-modular" for some $\mu > 0$), one is able to replicate much of the analysis from the tracial context. In this talk, I will discuss results in this direction along with some examples.

ALEXANDRU NICA, University of Waterloo
A theorem of the central limit type, in the framework of the infinite symmetric group

I will present a "central limit" type theorem, obtained in joint work with Claus Koestler, which arises in the framework of the infinite symmetric group S_∞. The motivation for this theorem comes from ideas around the concept of exchangeability for non-commutative random variables. Somewhat unexpectedly, the resulting limit law turns out to be directly related to the distribution of a GUE random matrix.

EMILY REDELMEIER, Isara Corporation
Diagrammatic techniques for real and quaternionic matrices: finite case and asymptotics

The diagrammatic approaches to the computation of matrix integrals, in particular matrix cumulants, provide a useful tool for the multi-matrix case which appears in contexts such as free probability. I will discuss how this approach may be applied in the real and quaternionic case. I will look at matrices of finite size as well as asymptotics, and how these are related to cumulants in freeness and higher-order freeness.

LAUREN RUTH, University of California, Riverside
von Neumann dimension for lattices in PGL(2,F), F a local non-archimedean field

The von Neumann dimension of a II_1 factor associated to a lattice in a connected semisimple real Lie group without center — $PSL(2,\mathbb{Z})$ in $PSL(2,\mathbb{R})$, for example — is equal to the product of the formal dimension of a discrete series representation and the covolume of the lattice — in the previous example, the product of $\frac{m}{4\pi}$, m odd, and $\frac{\pi}{3}$. A proof of this result, due to Atiyah, is given in Goodman–de la Harpe–Jones (1989). We show that the proof carries over to lattices in $PGL(2,F)$, where F is a local non-archimedean field, and we compute examples using the Jacquet-Langlands correspondence and results of Ihara.

ROMAN SASYK, University of Buenos Aires and IAM-CONICET
On the Classification of Free Araki Woods Factors

Free Araki-Woods factors (FAWF) were introduced by Shlyakhtenko in 1996. In some sense they are free probability analogs of the hyperfinite factors. Among many amazing properties, Shlyakhtenko showed that they are typically von Neumann algebras of type III_1, and moreover he constructed a one parameter family of non isomorphic type III_1 FAWF. In this talk I will discuss about the complexity of the classification problem of FAWF from the descriptive set theory point of view.

THOMAS SINCLAIR, Purdue University
Robinson forcing in C-algebras*

Several long-standing open problems in the theory of C*-algebras reduce to whether for a given class of C*-algebras there is a locally universal one among them with certain nice properties. I will discuss how techniques from model theory, in particular model-theoretical forcing, can be used to shed light on these problems. This is joint work with Isaac Goldbring.

PAUL SKOUFRANIS, York University
Majorization in Von Neumann Algebras

A classical result in matrix theory characterizes the convex hull of the unitary orbit of a self-adjoint matrix using spectral data. The description of these convex hulls has many applications such as characterizing the possible diagonal n-tuples of a self-adjoint matrix based on its eigenvalues. As all of these problems have natural analogues in an arbitrary unital C*-algebra, it is natural to ask whether we can generalize these results.

In this talk, we discuss extensions of these results to von Neumann algebras. This includes characterizations of diagonal of operators onto maximal abelian self-adjoint algebras (joint work with M. Kennedy). In addition, using von Neumann algebras, we characterize the norm-closed convex hulls of the unitary orbits of self-adjoint operators in any unital C*-algebra (joint work with P. Ng and L. Robert).