Titles and Abstracts

- **Stephen Curran**: *A characterization of freeness by invariance under quantum spreading*

  Abstract: De Finetti's famous theorem characterizes sequences of random variables whose joint distribution is invariant under permutations as conditionally i.i.d. It was later shown by Ryll-Nardzewski that this in fact holds under the seemingly weaker assumption that the distribution is invariant under "spreading", i.e. taking subsequences. Beginning with the breakthrough work of Claus Koestler and Roland Speicher, there have been a number of recent results in free probability around de Finetti type theorems where the class of symmetries comes from a quantum group. In this talk we will introduce quantum objects which play the role of increasing sequences taking values in the set 1,...,n. Using these objects, we introduce a notion of "quantum spreadability" for a sequence of noncommutative random variables, and establish a free analogue of the Ryll-Nardzewski theorem.

- **Alice Guionnet**: *Planar algebras and the Potts model on random graphs*

  (based on joint work with Jones, Shlyakhtenko, Zinn Justin)

  Abstract: In this talk, we discuss the construction of states on planar algebras coming from physics, such as the potts model on random graphs, by the use of matrix models.

- **Ken Dykema** : *Amalgamated free products of embeddable von Neumann algebras and sofic groups*

  (based on joint work with N. Brown and K. Jung).

  Abstract: Using random matrix techniques, we investigate microstates free entropy dimension in amalgamated free products of von Neumann algebras. Using other random permutation techniques, we prove that free products of sofic groups with amalgamation over amenable subgroups are sofic, (with B. Collins).

- **Roland Speicher** : *Quantum Symmetries in Free Probability*

  Abstract: In recent years it has become increasingly apparent that quantum symmetries (i.e., the invariance under the action of some quantum group) play an important role in free probability. The starting point of this was my joint work with Claus Koestler on a free de Finetti Theorem, where we showed that invariance under the action of quantum permutations characterizes freeness with amalgamation, for an infinite sequence of random variables. More general results in this direction for a recently introduced class of quantum groups (called "easy") were obtained in joint work with Teo Banica and Stephen Curran. I will survey some of these developments.

- **Florin Radulescu** : *Operator Algebras and Number Theory*

  Abstract: Using techniques from operator algebras we find an operator system structure on the space of cosets in the Hecke algebra. Various properties of Hecke operators are then analyzed, including essential spectrum.

- **Éric Ricard** : *Some multipliers in free probabilities*

  Abstract: We introduce a notion of multipliers on Toeplitz algebras. As an application, we prove that the free quasi free C^*-algebras have the completely contractive approximation property.

- **Javier Parcet** : *Completely bounded Fourier multipliers on group von Neumann algebras*

  ((Joint work with M. Junge and T. Mei)

  Abstract: Given a discrete group G, consider a Fourier multiplier

  $$T_m : \sum_{g\in \mathrm{G}} \widehat{f}(g)\lambda(g) \mapsto \sum_{g\in \mathrm{G}} m(g)\widehat{f}(g)\lambda(g).$$

  If $L_p(\widehat{\mathbb{G}})$ denotes the standard L_p space over its group von Neumann algebra, it is a classical problem to determine sufficient conditions for the boundedness and complete boundedness of T_m on $L_p(\widehat{\mathbb{G}})$. Hörmander smoothness condition

  $$\big|\partial_\xi^\beta \widetilde{m}(\xi)\big| \lesssim |\xi|^{-|\beta|} \quad \text{for all multi-indices} \quad |\beta| \leq \left[\frac{n}{2}\right] + 1$$

  applies when $\mathrm{G} = \mathbb{Z}^n$ and $\widetilde{m} : \mathbb{R}^n \to \mathbb{C}$ is a *lifting multiplier* for m, a smooth function whose restriction to $\mathbb{Z}^n$ coincides

with m. In the general case there is no canonical differential structure to work with and no sufficient differentiability conditions are known. Our main result will be a generalization of Hörmander's theorem for discrete groups. The proof is based on an abstract formulation of Calderón-Zygmund theory for von Neumann algebras which we will briefly introduce if time permits.

- **Cyril Houdayer**: *Approximation properties and absence of Cartan subalgebra for free Araki-Woods factors*

  (based on joint work with Eric Ricard)

  Abstract: In this talk we will discuss some recent results we obtained on Shlyakhtenko's free Araki-Woods factors. We first show that they have the complete metric approximation property (cmap). We then use this result together with Ozawa-Popa's techniques to prove that any (conditioned) non-amenable subfactor has no Cartan subalgebra. We finally apply these results to the classification problem of factors of type III.

- **Narutaka Ozawa** : *Quasi-homomorphism rigidity with noncommutative targets*

  Abstract: As a strengthening of Kazhdan's property (T), property (TT) was introduced by Burger and Monod. In this talk, I will add more rigidity to (TT) and introduce property (TTT). This property is suited for the study of rigidity phenomena for quasi-homomorphisms with noncommutative targets and ϵ-representations.

- **Fred Goodman** : *Cellularity and Jones' Basic Construction*

  Abstract: We establish a framework for cellularity of algebras related to the Jones basic construction. Our framework allows a uniform proof of cellularity of Brauer algebras, ordinary and cyclotomic BMW algebras, walled Brauer algebras, partition algebras, and others. Our cellular bases are labeled by paths on certain branching diagrams rather than by tangles. Moreover, for the class of algebras that we study, we show that the cellular structures are compatible with restriction and induction of modules.

- **Claus Koestler**: *Symmetries and invariance principles in noncommutative probability*

  (based on joint work with Rolf Gohm and Roland Speicher)

  Abstract: The famous de Finetti theorem is foundational for the subject of symmetries and invariance principles in classical probability. It states that an exchangeable infinite sequence of random variables is conditionally i.i.d. Here exchangeability means that the distribution of this sequence is invariant under finite permutations of the random variables. Ryll-Nardzweski's extended version of this result shows that the apparently weaker symmetry of spreadability (a.k.a. contractability) is actually equivalent to exchangeability.

  Recently we have proved an operator algebraic version of this extended de Finetti theorem in noncommutative probability. Now the above symmetries imply conditional independence in terms of commuting squares of von Neumann algebras. We will discuss exchangeability, spreadability, braidability and quantum exchangeability, where the latter two emerged from our new approach. Braidability is applicable to Jones subfactor theory with small index and further applications are discussed in the lecture by Gohm. Quantum exchangeability is connected to Wang's quantum permutation group and gives a new characterization of Voiculescu's freeness with amalgamation.

- **Rolf Gohm**: *Noncommutative Independence from the infinite Braid Group and Symmetric Group*

  (based on joint work with Claus Koestler)

  Abstract: In this lecture we discuss the main developments where we have been able to apply Koestler's noncommutative de Finetti theorem (as presented in the previous lecture) to establish noncommutative conditional independence.

  First we show how representations of the infinite braid group in the automorphisms of a noncommutative probability space lead to the new concept of braidability. This implies spreadability and hence conditional independence, in this way providing new tools for the study of braid group representations. We discuss the role of the socalled "square roots of free generators presentation" and work out the case of the left regular representation.

  Second we explain how in the special case of representations of the infinite symmetric group we arrive at a new operator

algebraic proof of Thoma's theorem (which parametrizes the extremal characters). We emphasize the role of socalled limit cycles in the determination of fixed point algebras and present an interesting argument which derives discrete spectra from commuting squares. There are open questions how to apply such an analysis beyond the symmetric group setting.

- **Siegfried Echterhoff** : *The classification of non-commutative 2-Spheres*

  (based on joint work with Wolfgang Lück, Chris Phillips and Samuel Walters, which appeared very recentlty in Crelle's Journal.)

  Abstract: By a non-commutative two-sphere we understand a crossed product of a rotation algebra (i.e., a non-commutative 2-torus) by a nontrivial finite subgroup of $SL(2,\mathbb{Z})$ via the cannonical action. In case of the commutative torus, the orbit space of such action is always homeomorphic to the 2-sphere S^2, so the fixed-point algebras for the corresponding actions on the noncommutative tori serve as noncommutative analogues (in the orbifold sense) of the 2-sphere S^2. In case of irrational tori, the fixed-point algebras are Morita equivalent to the corresponding crossed products, so it makes sense to study those. In the past many authors have studied these algebras and presented partial results for their classification. Here we give a complete classification of all of them and we show in particular that all irrational 2-spheres are AF-algebras.

- **S. Sundar** : *The weak heat kernel expansion and the quantum double suspension*

  (based on joint work with Partha Sarathi Chakraborty)

  Abstract: In this talk, we consider a property of spectral triples called the weak heat kernel asymptotic expansion property (WHKAT). A spectral triple having WHKAT satisfies the hypothesis of the local index formula and has finite simple dimension spectrum. We also show that WHKAT is preserved under the quantum double suspension of spectral triples. We will explain that some of the known examples of spectral triples constructed for the odd dimensional quantum spheres have the weak heat kernel expansion.

- **Niranjan Ramachandran** : *The Weil-etale topology and zeta functions*

  Abstract: The talk will explore some recent ideas about the geometric foundations of algebraic number theory. Particular emphasis will be put on the Weil group, whose very existence encapsulates much of class field theory.

- **Debashish Goswami** : *Quantum Isometry Groups: a brief overview*

  (based on joint works with J. Bhowmick, A. Skalski and T. Banica.)

  Abstract: In this talk, a sketch of the recent and fast-growing theory of quantum isometry groups will be given.We shall discuss the formulation of quantum isometry groups in various frameworks and discuss some interesting examples.

- **V P Belavkin** : *A New Banach *-Algebra and Noncommutative Stochastic Integration*

  Abstract: We review the basic concepts of stochastic integration and reformulate them in terms of a Banach four-normed *-algebra with the associative product given by the stochastic covariation. We show that this nonunital algebra having two nilpotent first and second order *-ideals is a generalization of the C*-algebra corresponding to only one nontrivial norm - the operator norm. The noncommutative generalization of this algebra which we call Ito B*-algebra leads to the *-algebraic theory of quantum stochastic integration developed in [1-4]. The main notions and results of classical and quantum stochastic analysis are reformulated in this unifying approach. The general Levy process is defined in terms of the modular B*-Ito algebra. If time will allow, we shall show the corresponding quantum stochastic filtering equation [5] on the predual space of a W*-algebra as a noncommutative version of the Zakai equation driven by the process. This is derived by a noncommutative analog of the Girsanov transformation, which we introduced in full generality in [6].

  References:

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6. V. P. Belavkin, "Noncommutative Dynamics and Generalized Master Equations," Mathematical Notes, 2010, Vol. 87, No. 5, pp. 636-653, ISSN 0001-4346. Pleiades Publishing, Ltd., 2010.

- **Thomas Schick** : *Transcendental L^2-Betti numbers: on a question of Atiyah*

  Abstract: L^2-Betti numbers of a closed manifold are defined via the canonical trace of the von Neumann algebra of the fundamental group and the universal covering. These traces assume arbitrary real numbers, but until recently only rational L^2-Betti numbers were known. We provide an explicit construction of nice examples with transcendental L^2-Betti numbers, improving on a method of Tim Austin who gave an existence result for a weaker question.

- **Parta Sarathi Chakraborty** : *A dimensional invariant for compact quantum groups inspired by NCG*

  Abstract: Using the ideas of NCG we will introduce a dimensional invariant for compact quantum groups and illustrate the invariant through some cauculations.

- **Masaki Izumi**: *Toeplitz CAR flows*

  (Joint work with R. Srinivasan)

  Abstract: In this talk, I will report on our joint work about E_0-semigroups, which are continuous 1-parameter semigroups of unital endomorphisms of B(H). In 1987, Powers constructed the first example of type III E_0-semigroups using a quasi-free representation of the CAR algebra. Although his purpose was to construct a single example, his construction is rather general, and could potentially produce many type III examples, which we call Toeplitz CAR flows. By introducing a new invariant using Araki-Woods notion of type I factorizations, we show that there exist uncountably many mutually non cocycle conjugate type III Toeplitz CAR flows.

- **Vijay Kodiyalam**: *Universal skein theory for finite depth subfactor planar algebras*

  (Joint work with T. Srikanth)

  Abstract: We describe an explicit finite presentation for a finite depth subfactor planar algebra. We also show that such planar algebras are singly generated with the generator subject to finitely many relations.

- **Scott Morrison** : *Obstructions for finite-depth subfactors from the embedding theorem*

  Abstract: It is well known (and by now finally proven in the literature!) that the planar algebra of a finite-depth subfactor embeds into the graph planar algebra of the principal graph. I'll sketch one of the proofs of this fact, and then derive a new obstruction for potential principal graphs as an example application.

- **Yasu Kawahigashi**: *Superconformal field theory and operator algebras*

  Abstract: We will present operator algebraic formulation of N=1 and N=2 superconformal field theories. We give basic examples, representation theory and classfication results. We will also discuss connections to noncommutative geometry and mirror symmetry in superstring theory.

- **Shamindra Ghosh**: *Perturbations of planar algebras*

  (Joint work with Paramita Das and Ved Prakash Gupta)

  Abstract: We will introduce the concept of perturbing a planar algebra P by a 'weight' and establish a one-to-one correspondence between weights of P and pivotal structures of the '2-category' associated to P. To every 'bifinite bimodule' ${}_A\mathcal{H}_B$ for II_1-factors A, B, we associate a planar algebra (using construction of planar algebra from a pivotal bicategory) satisfying certain conditions, which we refer to as 'bimodule planar algebra' (BMPA). This helped us in extending Jones' Theorem which associates a planar algebras to an 'extremal' subfactor by removing extremality; such an extension was also proved by Michael Burns in his thesis using different method. Conversely, given a BMPA, we construct a bifinite bimodule whose associated BMPA is isomorphic to the one which we start with (using perturbation of planar algebras and Jones-Shlyakhtenko-Walker-Kodiyalam-Sunder method of construction of subfactors from spherical planar algebras). We will then show that the perturbation class of a BMPA contains a unique 'spherical', 'unimodular' BMPA which can also be characterized as the unimodular one having the minimum index value. As an example, we will start with a particular 'diagonal planar algebra' (which is spherical) and perturb it to get a continuum of non-spherical BMPA's; as pointed out by Jones, we show that these planar algebras are isomorphic to the ones associated to his example of a continuum of non-extremal subfactors with index greater than 4.

- **Richard Burstein**: *Automorphisms of the bipartite graph planar algebra*

  Abstract: A planar algebra may be obtained from any locally finite bipartite graph. Taking fixed points of such a bipartite graph planar algebra under the action of a group of automorphisms produces a planar subalgebra. If this subalgebra is sufficiently small, then it is necessarily of subfactor type, and a corresponding subfactor must then exist.

  In this talk I will describe the automorphism group of an arbitrary bipartite graph planar algebra, and discuss the class of subfactors produced by this planar fixed point construction. I will present several examples of such planar fixed point subfactors, of both finite and infinite depth.