Titles and Abstracts

BAGHERI Ali

Algebraic tools of von Neumann algebras

Irvin Kaplansky introduced Baer $*$-rings as an algebraic counterpart to von Neumann algebras, incorporating axioms associated with annihilators of various sets. This approach highlights the foundational importance of both ring theory and lattice theory in the context of von Neumann algebras. *Question:* Can any fundamental result in von Neumann algebras be extended to Baer $*$-rings? In Baer $*$-rings, it is proved that shifts and unitaries remain sufficient for constructing any contraction, isometry, and power partial isometry.

BHAT Rajarama

Peripheral Poisson boundary

It is shown that the operator space generated by peripheral eigenvectors of a unital completely positive map on a von Neumann algebra has a C^*-algebra structure through Choi-Effros type product. This extends the notion of non-commutative Poisson boundary by including the point spectrum of the map contained in the unit circle. The main ingredient utilized is dilation theory. This theory provides a simple formula for the new product. The notion has implications to our understanding of quantum dynamics. For instance, it is shown that the peripheral Poisson boundary remains invariant in discrete quantum dynamics. This talk is based on a joint work with Samir Kar and Bharat Talwar.

CASPERS Martjin

A noncommutative Calderón-Torchinsky theorem

In this talk I will explain how to prove the following version of a theorem that was obtained by Calderón and Torchinsky allowing sharp estimates for Fourier multipliers acting on L^p-spaces when p approximates 2. Let $G = \mathrm{SL}(n, \mathbb{R})$ and let $K = \mathrm{SO}(n)$ be its maximal compact subgroup. Let Ω be minus the radial Casimir operator. Let $\dim(G/K) < 2S_G < 2\dim(G/K), s \in (0, S_G]$ and $p \in (1, \infty)$ be such that $|\frac{1}{p} - \frac{1}{2}| < \frac{s}{2S_G}$. Then, there exists a constant $C_{G,s,p} > 0$ such that for every $m \in L^\infty(G) \cap L^2(G)$ bi-K-invariant with $m \in \mathrm{Dom}(\Omega^s)$ and $\Omega^s(m) \in L^{2S_G/s}(G)$ we have,

$$\|T_m : L^p(\widehat{G}) \to L^p(\widehat{G})\| \leq C_{G,s,p} \|\Omega^s(m)\|_{L^{2S_G/s}(G)},$$

where T_m is the Fourier multiplier with symbol m acting on the non-commutative L^p-space of the group von Neumann algebra of G. This gives new examples of L^p-Fourier multipliers with decay rates becoming slower when p approximates 2. The theorem holds more generally for a wide class of semi-simple Lie groups. A crucial element of the proof is a new connection with Heat kernel estimates of the Casimir operator as obtained by Sawyer, for $\mathrm{SL}(n,\mathbb{R})$, and Anker and Ji, for the general case.

CADILHAC Léonard

Non-commutative covering lemmas

In classical harmonic analysis, the most standard proof of Hardy-Littlewood maximal inequality makes use of Vitali's covering lemma. This lemma tells us that, given a family of balls in $\mathbb{R}^d$, one can extract a subfamily that covers the same volume, up to a constant, and whose elements do not intersect much. It is not clear how to generalize such a lemma in order to be able to conduct a similar proof for operator-valued functions. As a consequence, in the noncommutative setting, this approach was left aside and maximal inequalities are often reduced, through various techniques, to the martingale case. In this talk, I will present another possible direction to prove Hardy-Littlewood maximal inequality, in the spirit of covering lemmas.

COLLINS Benoit

Extensions of quantum de Finetti theorems and operator valued Martin Boundaries

The Quantum de Finetti theorem is a fundamental tool in quantum information theory because it allows to characterize separable states. We generalize the Quantum de Finetti theorem and propose a new proof based on an operator-valued version of Biane's quantum Choquet-Deny theory. We then consider the problem of operator-valued Martin boundaries and show that this is a separable extension of the classical Martin Boundary.

CONDE ALONSO José

Pseudodifferential operators over Schatten classes and group algebras

Pseudodifferential operators are generalizations of Fourier multipliers. Given a *symbol* $a : \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{C}$, the associated pseudodifferential operator ψ_a has the form

$$\psi_a(f)(x) = \int_{\mathbb{R}^n} a(x,\xi)\widehat{f}(\xi)e^{2\pi i x\cdot\xi}d\xi.$$

In this talk, we study extensions of pseudodifferential operators to (unimodular) groups G with differential structures given by adequate cocycles. Our symbols are now functions $a : G \to \mathcal{L}(G)$, and we get column and row objects

$$\psi_a^c(f) = \int_G a(g)\widehat{f}(g)\lambda_g d\mu_G(g), \text{ and } \psi_a^r(f) = \int_G \widehat{f}(g)\lambda_g a(g) d\mu_G(g).$$

We study $L_p(\mathcal{L}G)$-boundedness results of ψ_a^c and ψ_a^r via transference to natural objects that act on $S_p(G)$, under smoothness assumptions on the cocycle derivatives of a. The column/row nature of the objects leads naturally to Hardy-type estimates when $p \neq 2$. Based on work in progress with Adrián González Pérez, Javier Parcet and Eduardo Tablate.

DAWS Matthew

Approximation properties and averaging for Drinfeld doubles

I will describe an averaging procedure for locally compact quantum groups with respect to a compact subgroup, and how this procedure interacts with multipliers. When applied to the Drinfeld Double of a discrete quantum group (averaging over the compact dual, which appears naturally as a quantum subgroup) this gives a bijection between central multipliers of the discrete quantum group, and invariant multipliers of the double. This allows us to link central approximation properties of the discrete quantum group with approximation properties of the double, outside of the unimodular case. This is joint work with Jacek Krajczok and Christian Voigt.

DUMAS Guillaume

Regularity of matrix coefficients of symmetric Gelfand pairs of Lie groups

In his proof that $SL(3,\mathbb{R})$ has strong property (T), Vincent Lafforgue used the fact that $SO(2)$-bi-invariant matrix coefficients of unitary representations of $SO(3)$ are $\frac{1}{2}$-Hölder continuous outside of some singular points. Similar regularity results are also at the core of the study of the approximation property for simple Lie groups by Lafforgue, de la Salle and then Haagerup and de Laat. In this talk, I will extend this continuity result and show how to find the optimal regularity of K-finite matrix coefficients of G for many pairs (G, K) associated to both compact and non-compact symmetric spaces.

HASEBE Takahiro

Generators of monotone convolution hemigroups on the unit circle

There is a general theory of additive processes (processes with independent increments, not necessarily stationary) on a locally compact abelian group, see the book of Herbert Heyer. In this case, the natural convolution for probability measures is commutative, and the marginal laws of additive processes are all infinitely divisible. For nonabelian groups, however, such a general theory is unknown to my best knowledge. A difficulty is that the convolution operation is also noncommutative. Monotone convolution on the unit circle, introduced by Hari Bercovici, is a noncommutative binary operation for probability measures on the unit circle that appeared from monotone independence of Muraki. Recently, with a help of Loewner theory, I gave a complete description of generators of the corresponding additive processes in a joint work with Ikkei Hotta. This work is a continuation of the previous joint work with Uwe Franz and Sebastian Schleissinger.

HONG Guixiang

From the spherical maximal inequalities to a local smoothing estimate on quantum Euclidean spaces

In this talk, we will firstly review briefly the spherical maximal inequalities and the local smoothing estimates in the classical setting; and then present the progresses we have made in this research direction, in particular a local smoothing estimate for the wave equation (or operator) on two-dimensional quantum Euclidean space. Several new ingredients will be discussed to overcome the difficulties caused by the noncommutativity.

JIAO Yong

Noncommutative weak-L^∞ and BMO martingales

Bennett, DeVore and Sharpley (Ann of Math., 1981) introduced the weak analogue of the space L^∞ and studied its relationship to the space of functions of bounded mean oscillation. This talk will present some recent progress in the context of functions on $\mathbb{R}^d$ with values in a semi-finite von Neumann algebra. This allows for the comparison of the BMO norms of an operator-valued function and its decreasing rearrangement. The argument rests on a new distributional estimate for noncommutative martingales, which is of independent interest. The applications include related $BMO \to wL^\infty$ inequalities for square functions and conditional square functions, as well as corresponding versions of Stein and dual Doob estimates, which are new even for classical martingales.

JUNGE Marius

From harmonic analysis to Hamiltonian simulation

In this talk we show how Sobolev inequalities in harmonic analysis can be used to prove lower bounds on simulation costs of quantum time evolutions.

KOESTLER Claus

Distributional invariance principles for Jones-Temperley-Lieb algebras

Distributional symmetries and invariance principles provide deep structural results in classical probability. For example, the de Finetti theorem characterizes an infinite sequence of random variables to be conditional independent and identically distributed if and only if its joint distribution is invariant under permuting these random variables. Recently significant progress was made in transferring de Finetti type results to an operator algebraic setting of noncommutative probability. Here commuting squares provide a noncommutative generalization of conditional independence in classical probability. I will briefly overview some of these newer developments, in particular when applied to subfactors. My talk will focus on ongoing research on distributional symmetries in the context of Jones-Temperley-Lieb algebras. It is based on joint work with Ayman Alahmade, Areej Albalawi, Jacob Campbell, Gwion Evans, Rolf Gohm, Arundhathi Krishnan, Alexandru Nica, and Stephen Wills.

KRIEGLER Christoph

The harmonic oscillator on the Moyal-Groenewold plane

Let $A = -\Delta + |x|^2$ be the harmonic oscillator which generates a submarkovian semigroup on $L^p(\mathbb{R}^d)$. It is well-known that its spectral multipliers $m(A)$ are bounded on L^p, $1 < p < \infty$, provided that $m : (0, \infty) \to \mathbb{C}$ is $\lfloor \frac{d}{2} \rfloor + 1$ times differentiable with a certain L^2 type control on its derivatives (Hörmander functional calculus). On the other hand, A can be written as a square sum

$$A = \sum_{k=1}^{d} (i\partial_k)^2 + \sum_{l=1}^{d} x_l^2$$

where the operators $iA_k = -\partial_k$ and $iB_l = ix_l$ generate bounded (translation and modulation) c_0-groups on L^p, that obey simple, so-called canonical, commutation relations (CCR). Recently, van Neerven, Portal and Sharma showed in a series of papers via a transference technique and square function estimates, that square sum operators (as A above) for quite general bounded c_0-groups with CCR inherit the Hörmander functional calculus from A. We show that this also holds for c_0-groups acting on noncommutative L^p-spaces. Along the way of proof, an important step is a new method to generate square function estimates on noncommutative L^p. An application are L^p bounded Hörmander spectral multipliers of the harmonic oscillator on the Moyal plane (also called quantum euclidean space), which are particular noncommutative pseudo-differential operators studied by González-Pérez, Junge and Parcet. This is joint work with Cédric Arhancet (Albi, France), Lukas Hagedorn (Kiel, Germany) and Pierre Portal (Canberra, Australia).

KULA Anna

Lévy–Khintchine decomposition for convolution semigroups of states II

The sum of the generating functionals of two convolution semigroups of states on a compact quantum group is the generating functional of a convolution semigroup of states whose corresponding Lévy process is expressible as a limit of evolution Trotter-products of those of the summands. The following question concerning the reverse of this procedure is of interest. Given a convolution semigroup of states, can its generating functional γ be expressed as the sum of a 'gaussian' generating functional and a 'wholly non-gaussian' one – in short, does γ have a 'Lévy–Khintchine type decomposition'? A key new tool for addressing this is the notion of *approximate innerness* for (ρ, ε)-derivations on the Hopf *-algebra of the quantum group with respect to a *-algebra representation ρ. A satisfactory (and positive) answer is found in the case of certain classes of q-deformed compact Lie groups. Based on joint work with Uwe Franz, Martin Lindsay and Michael Skeide, the talk is the second of two, with the first being given by Martin.

LABUSCHAGNE Louis

Fredholm properties of Toeplitz operators on group algebras

We investigate the Fredholm properties of Toeplitz operators on group algebras of topologically ordered groups. We then demonstrate a connection between Fredholmness of a Toeplitz map and compactness of the corresponding Hankel map. Since not all group algebras admit non-trivial compact Hankel maps, this leaves the challenge of providing criteria for the existence of compact Hankel maps. This is achieved by providing criteria for the existence of a noncommutative Wermer embedding function, the existence of which enables us to precisely describe compact Hankel maps in such algebras.

LINDSAY Martin

Lévy–Khintchine decomposition for convolution semigroups of states I

The sum of the generating functionals of two convolution semigroups of states on a compact quantum group is the generating functional of a convolution semigroup of states whose corresponding Lévy process is expressible as a limit of evolution Trotter-products of those of the summands. The following question concerning the reverse of this procedure is of interest. Given a convolution semigroup of states, can its generating functional γ be expressed as the sum of a 'gaussian' generating functional and a 'wholly non-gaussian' one – in short, does γ have a 'Lévy–Khintchine type decomposition'? A key new tool for addressing this is the notion of *approximate innerness* for (ρ, ε)-derivations on the Hopf *-algebra of the quantum group with respect to a *-algebra representation ρ. A satisfactory (and positive) answer is found in the case of certain classes of q-deformed compact Lie groups. Based on joint work with Uwe Franz, Anna Kula and Michael Skeide, the talk is the first of two, with the second being given by Anna.

McDONALD Edward

Differentiation and Lipschitz estimate in L_p-spaces for $p < 1$

Integration and differentiation do not work as expected for functions valued in quasi-Banach spaces, and elementary results such as the integrability of continuous functions do not hold. I will explain how to overcome some of these difficulties in the context of operator Lipschitz estimates. Based on joint work with F. Sukochev.

MOYART Hugues

Interpolation of non commutative Hardy spaces

I will sketch some ideas and tools from interpolation theory in the setting of Hardy spaces associated with noncommutative martingales.

PARCET Javier

The local geometry of idempotent Schur multipliers

Let Σ be a relatively compact domain in $\mathbf{R}^n \times \mathbf{R}^n$ with smooth boundary $\partial\Sigma$ and let S_Σ denote the idempotent Schur multiplier whose symbol takes the value 1 over Σ and 0 elsewhere. Given $1 < p \neq 2 < \infty$, we characterize the boundedness of S_Σ on Schatten p-classes in terms of the local geometric behavior of the boundary $\partial\Sigma$, up to a mild transversality assumption. We give a geometric criterion in terms of a new zero-curvature condition and an analytic one, which shows that S_Σ is locally modeled on the triangular projection. This is a great nontrigonometric amplification of Fefferman's ball multiplier theorem which includes the Fourier-analytic setting via Toeplitz symbols. Applying a form of our result over differentiable manifolds, we characterize idempotent Fourier multipliers with smooth boundary on arbitrary Lie groups. Given a boundary point, cb-L_p-boundedness holds around it iff the boundary is locally the coset of a codimension 1 Lie subgroup. This implies that only three group/symbol configurations are valid for L_p-boundedness up to local surjective homomorphisms. These are the natural Hilbert transforms on $\mathbf{R}$, the affine group $ax + b$, and the universal cover of $\mathrm{PSL}_2(\mathbf{R})$. This completes, for Lie groups, a longstanding search of Fourier L_p-idempotents. Joint work with M. de la Salle and E. Tablate.

RICARD Éric

Some maps on free products

I will describe the construction of some basic completely bounded maps on the non commutative L_p-spaces associated with free products. This is based on joint works with Tao Mei and Quanhua Xu.

SPEICHER Roland

Universality of free random variables

Consider a tuple of normal operators in a tracial operator algebra setting with prescribed sizes of the eigenspaces for each of the operators. We address the question what one can say about the sizes of the eigenspaces for any non-commutative polynomial in those operators? We show that for each polynomial there are unavoidable eigenspaces. We will describe this minimal situation both in algebraic terms - where it is given by realizations via matrices over the free skew field and via rank calculations - and in analytic terms - where it is given by freely independent random variables with prescribed atoms in their distributions. The fact that the latter situation corresponds to this minimal situation allows us to draw many new conclusions about atoms in polynomials of free variables. The talk is based on arXiv:2107.11507, which is joint work with O. Arizmendi, G. Cebron, and S. Yin.

TULENOV Kanat

Sobolev projection on quantum torus and its complete boundedness

This is a joint work with F. Sukochev and D. Zanin, where we establish the complete boundedness of Sobolev projection from $L_1(\mathbb{T}_\theta^d)$ into $L_{1,\infty}(\mathbb{T}_\theta^d)$. In the special case $\theta = 0$, our results strengthen the classical results due to Pelczynski and Wojciechowski.

WANG Hua

A revisit of reconstruction of quantum groups

I will describe an alternative approach to the Tannaka-Krein-Woronowicz reconstruction. Instead of producing the underlying Hopf algebra, we will reconstruct directly the corresponding multiplicative unitary. Time permitting, I will say a few more words on some duality clarified by this work, and some possible extensions to more general settings.

WANG Simeng

Proper cocycles, measure equivalence and L_p-Fourier multipliers

We establish a new transference method of completely bounded L_p-Fourier multipliers for proper cocycles for pmp group actions on standard probability spaces. This generalizes the previous results by Haagerup and Jolissaint which only deals with the case $p = \infty$. In particular, this gives a natural transference method of Fourier multipliers between groups with measure equivalence, which directly implies and notably generalizes the main result of Hong-Wang-Wang on the pointwise convergence of noncommutative Fourier series on amenable groups. As a second application, this theory also yields a transference method of L_p-Fourier multipliers from lattices in a linear Lie group to the whole group, which strengthens the previous results for Schur multipliers obtained by Haagerup and Lafforgue-de la Salle. This is ongoing joint work with Gan Yao.

WU Lian

The sharp weighted maximal inequalities for noncommutative martingales

The purpose of the paper is to establish weighted maximal L_p-inequalities in the context of operator-valued martingales on semifinite von Neumann algebras. The main emphasis is put on the optimal dependence of the L_p constants on the characteristic of the weight involved. As applications, we establish weighted estimates for the noncommutative version of Hardy-Littlewood maximal operator and weighted bounds for noncommutative maximal truncations of a wide class of singular integrals.

WYSOCZANSKI Janusz

Weakly-monotone C^*-algebras

In this talk we will discuss properties of a family of C*-algebras generated by creation/annihilation operators on the weakly monotonic Fock space. Some of their properties will be described, including representation theory and maximal abelian subalgebras with their spectra. Their relations to Pusz-Woronowicz q-deformations of the Canonical Commutation Relations (q-CCR), Cuntz-Krieger C*-algebras and general graph C*-algebras will be discussed as well. The talk is based on my collaboration with Vito Crismale, Maria Elena Griseta, Stefano Rossi and Simone del Vecchio (University of Bari, Italy).

XIA Runlian

Amalgamated free products and HNN extensions are the two fundamental objects in the Bass-Serre theory

Amalgamated free products and HNN extensions are the two fundamental objects in the Bass-Serre theory. In this talk, we will introduce some L_p-bounded ($1 < p < \infty$) Fourier multipliers for HNN extensions, with the help of Khinchine type inequalities on these groups. This work is a continuation of a recent work with Adrián González and Javier Parcet. It is related to the results of Mei, Ricard and Xu who proved L_p-boundedness of the same type of Fourier multipliers on amalgamated free products of von Neumann algebras.

ZHANG Haonan

Bohnenblust–Hille inequalities for cyclic groups and applications to learning quantum observables

To learn low-degree quantum observables on high-level qudit systems using a small number of random queries, a dimension-free noncommutative Fourier analysis inequality is needed. Such an inequality is named after Bohnenblust and Hille and its variant on qudit systems can be reduced to its analog on cyclic groups when the order is prime. However, Bohnenblust–Hille inequalities were known only when the order of the cyclic group is either 2 (Hamming cube) or infinity (torus). For general $2 < N < \infty$, some geometric obstacles prevent the standard method from proving Bohnenblust–Hille inequalities on cyclic groups of order N. In this talk, I will present a solution to this problem and discuss learning applications. This is based on joint work with Alexander Volberg (Michigan State University) and Joseph Slote (Caltech).