Operator Spaces, Quantum Probability and Applications

Wuhan University, Wuhan, China

June 4-10, 2012

Operator Spaces, Quantum Probability and Applications (Wuhan 4-9 June 2012)

Tuesday	Wednesday	Thursday	Friday	Saturday
8:30 – 8:45				Free day
Welcome by Hua Chen, the Dean				
8:45 – 9:35	9:00 – 9:45	9:00 – 9:45	9:00 – 9:45	
Pisier	Junge	Le Merdy	Sukochev	
9:35 – 10:20 Photo and Tea	9:45 – 10:20 Tea break			
10:20 – 11:05	10:20 – 11:05	10:20 – 11:05	10:20 – 11:05	
Ruan	Parcet	Gong	Labuschagne	
11:15 – 12:00	11:15 – 12:00	11:15 – 12:00	11:15 – 12:00	
Jiang	Randrianantoanina	Kerr	Nechita	
12：30		LUNCH		
14:30 – 15:00	14:30 – 15:00	Free afternoon	14:30 – 15:00	
Yao / Potapov	Perrin / Ng		Palazuelos / Majewski	
15:00 – 15:30	15:05 – 15:35		15:05 – 15:35	
Wiggins / Dirksen	Hong / Fima		Duan / Kaneda	
15:05 – 16:05	15:40 – 16:10		15:40 – 16:10	
Wang / Qiu	Bekjan / Lee		Kye / Zhang	
16:10 – 16:35 Tea break	16:15 – 16:35 Tea break		16:15 – 16:35 Tea break	
16:35 – 17:15	16:35 – 17:15		16:35 – 17:15	
Franz	Mei		Lindsay	
17-20 – 18:00	17-20 – 18:00		17-20 – 18:00	
Li	de la Salle		Yan	
18：30		DINNER		

Operator Spaces, Quantum Probability and Applications

Wuhan University, 4-10 June 2012

SCHEDULE

Monday

- **Registration in Jun Yi Dynasty Hotel during the whole day**
- **18:30: Dinner (buffet) Jun Yi Dynasty Hotel (5th Floor)**

Notice:

- Bus transfer between Hotel and University is arranged twice in both directions every day:
  - **Hotel → University** at 8:40 except Tuesday at 8:10
  - **Mei Yuan → Hotel** at 13:20 after lunch for those who wish to have a brief rest in their room
  - **Hotel → University** at 14:10
  - **Mei Yuan → Hotel** after dinner at 19:30 except Wednesday at 18:30 to Banquet

  Please be strictly **PUNCTUAL** !
- The hotel is located on the southern border of the campus. The walking distance from the hotel to the School of Mathematics is about 20 minutes.

Tuesday

8:10 **Departure from Hotel by bus**

8:30 - 8:45 **Welcome by Hua CHEN**, Dean of the School of Mathematics & Statistics

8:45 - 9:35 **Gilles Pisier** (Paris 6 and Texas A&M University):
Operator space structures on L_p-spaces

9:35 - 10:20 **Photo and Tea break**

10:20 - 11:05 **Zhong-Jin Ruan** (University of Illinois at Urbana-Champaign):
Noncommutative Poisson boundaries over locally compact quantum groups

11:15 - 12:00 **Chunlan Jiang** (Hebei Normal University):
On the operator $U + V$ and C*-subalgebras of the universal irrational rotation algebra

12:30 **Lunch in Mei Yuan**

13:20 **Return back to Hotel by bus**

14:10 **Departure from Hotel by bus**

14:30 - 15:05 Parallel session (Talk 1: Auditorium; Talk 2: Lecture Room on the third Floor)

- **Yi-Jun Yao** (Fudan University):
  On K-theory of some noncommutative orbifolds
- **Denis Potapov** (University of NSW, Sydney) :
  Spectral shift function for normal operators

15:05 - 15:35 Parallel session

- **Alan D Wiggins** (University of Michigan-Dearborn):
  Close II_1 Factors and the isomorphism problem
- **Sjoerd Dirksen** (University of Bonn):
  Noncommutative Boyd interpolation theorems

15:40 - 16:10 Parallel session

- **Qin Wang** (Donghua University):
  Fibred coarse embedding into Hilbert space and its applications
- **Yanqi Qiu** (University of Paris 6):
  The UMD constants for a class of itereted $L_p(L_q)$ spaces

16:10 - 16:35 **Tea break**

16:35 - 17:15 **Uwe Franz** (University of Franche-Comté):
ad-invariant Lévy processes on free quantum groups and their Markov semigroups

17:20 - 18:00 **Xiangdong Li** (Chinese Academy of Science):
Riesz transforms and Hodge decomposition on complete Riemannian manifolds

18:30 **Dinner in Mei Yuan**

19:30 **Return back to Hotel by bus**

Wednesday

8:40 **Departure from Hotel by bus**

9:00 - 9:45 **Marius Junge** (University of Illinois at Urbana-Champaign):
Cocyles and noncommutative harmonic analysis

9:55 - 10:20 **Tea break**

10:20 - 11:05 **Javier Parcet** (Instituto de Ciencias Matematicas, Madrid):
Twisted Hilbert transforms and idempotent Fourier multipliers

11:15 - 12:00 **Narcisse Randrianantoanina** (Miami University, Oxford):
Noncommutative martingale Hardy spaces

12:30 **Lunch in Mei Yuan**

13:20 **Return back to Hotel by bus**

14:10 **Departure from Hotel by bus**

14:30 - 15:00 <u>Parallel session</u> (Talk 1: Auditorium; Talk 2: Lecture Room on the third Floor)

- **Mathilde Perrin** (Instituto de Ciencias Matematicas, Madrid):
  Hypercontractivity of the Ornstein-Uhlenbeck and Poisson semigroups for free products
- **Chi-Keung Ng** (Chern Institute of Mathematics, Nankai):
  A Murray-von Neumann type classification of C*-algebras

15:05 - 15:35 <u>Parallel session</u>

- **Guixiang Hong** (University of Franche-Comté):
  Calderón-Zygmund operators associated to matrix-valued kernels
- **Pierre Fima** (University of Paris 7):
  K-amenability of HNN extensions of amenable discrete quantum groups

15:40 - 16:10 <u>Parallel session</u>

- **Turdebek N. Bekjan** (Xingjiang University):
  Noncommutative integral inequalities for convex functions of maximal functions
- **Hunhee Lee** (Chungbuk National University):
  Some Beurling-Fourier algebras are operator algebras

16:15 - 16:35 **Tea break**

16:35 - 17:15 **Tao Mei** (Wayne State University):
An H_1-BMO duality for semigroups of operators on von Neumann algebras

17:20 - 18:00 **Mikael de la Salle** (University of Franche-Comté):
Noncommutative L_p spaces without the completely bounded approximation property

18:30 **Departure for Banquet by bus** with a very brief stop in the hotel just for dropping things

19:00 **Banquet in Tai Zi Long**

Thursday

8:40	**Departure from Hotel by bus**
9:00 - 9:45	**Christian Le Merdy** (University of Franche-Comté): Square function estimates and dilation properties of operators on noncommutative L^p-spaces
9:55 - 10:20	**Tea break**
10:20 - 11:05	**Guihua Gong** (University of Puerto Ricco): Classification of noncommutative spaces and dynamical systems.
11:15 - 12:00	**David Kerr** (Texas A&M University): Sofic entropy via finite partitions
12:30	**Lunch in Mei Yuan**
13:30	**Departure for excursion**

Afternoon and evening

- Visit to Hubei Museum
- Walk on the northern shore of Yangtze River
- Sightseeing of Yangtze by night on boat with dinner served aboard

Friday

8:40 **Departure from Hotel by bus**

9:00 - 9:45 **Fyodor Sukochev** (University of NSW, Sydney):
Johnson-Schechtman inequalities in the free probability theory

9:55 - 10:20 **Tea break**

10:20 - 11:05 **Louis E. Labuschagne** (North-West University, South Africa):
The invertibility of Toeplitz operators with noncommuting symbols

11:15 - 12:00 **Ion Nechita** (University of Toulouse):
Random subspaces of a tensor product and the additivity problem

12:30 **Lunch in Mei Yuan**

13:20 **Return back to Hotel by bus**

14:10 **Departure from Hotel by bus**

14:30 - 15:00 **Parallel session** (Talk 1: Auditorium; Talk 2: Lecture Room on the third Floor)

- **Carlos Palazuelos** (Instituto de Ciencias Matematicas, Madrid):
  How much non-local can a quantum state be?
- **Wladyslaw A. Majewski** (University of Gdansk):
  On applications of Orlicz spaces to Statistical Physics

15:05 - 15:35 **Parallel session**

- **Runyao Duan** (University of Technology, Sydney):
  Quantum effects in zero-error communication and non-commutative graphs
- **Masayoshi Kaneda** (Nazarbayev University):
  All AW^*-algebras are monotone complete

15:40 - 16:10 **Parallel session**

- **Seung-Hyeok Kye** (Seoul National University):
  On the optimality of entanglement witnesses
- **Chao Zhang** (Wuhan University):
  Regularity estimates in Hölder spaces for Schrödinger operators via a $T1$ theorem

16:15 - 16:35 **Tea break**

16:35 - 17:15 **Martin Lindsay** (University of Lancaster):
Quantum Brownian motion on a noncommutative manifold

17:20 - 18:00 **Lixin Yan** (Sun Yat-Sen University):
Spectral multipliers for operators with generalized Gaussian estimates

18:30 **Dinner in Mei Yuan**

19:30 **Return back to Hotel by bus**

Saturday

Excursion to Mu Lan Shanzai

List of abstracts

1) **Turdebek N. Bekjan:** Noncommutative integral inequalities for convex functions of maximal functions

Abstract: We establish a Marcinkiewicz type interpolation theorem for convex functions of maximal functions in the noncommutative setting. As applications, we prove the noncommutative analogue of the Doob inequality for convex functions of maximal functions on martingales, the analogue of the classical Dunford-Schwartz maximal ergodic inequality for convex functions of positive contractions, and that of Stein's maximal inequality for convex functions of symmetric positive contractions. As a consequence, we obtain the moment Burkholder-Davis-Gundy inequality for noncommutative martingales.

2) **Mikael de la Salle:** Non-commutative L_p spaces without the completely bounded approximation property

Abstract: For p different from 2, I will present examples of discrete groups such that the associated non-commutative L_p spaces fail the completely bounded approximation property. Depending on the value of p, these groups are the lattices in $SL(n,\mathbb{R})$ or $SL(n,F)$ for a p-adic field F and $n \geq 3$. As a consequence, these groups are the first examples of exact groups without the AP, and their reduced C*-algebras are exact C*-algebras without the OAP. This is a joint work with Vincent Lafforgue.

3) **Joerd Dirksen:** Noncommutative Boyd interpolation theorems

Abstract: In 1969, D.W. Boyd introduced two indices p_E and q_E, nowadays called Boyd's indices, for every rearrangement invariant Banach function space E on $\mathbb{R}_+$. Based on earlier work by Calderón, Boyd showed that every sublinear map of weak types (p,p) and (q,q) is bounded on E if and only if $p < p_E \leq q_E < q$. The 'if' part of this statement is Boyd's interpolation theorem.

In my talk I will present a new approach to this theorem, which leads to Boyd-type interpolation results for certain operators on noncommutative vector-valued Banach function spaces. As particular cases, one can interpolate the noncommutative dual Doob and Doob maximal inequality, as well as the 'upper' noncommutative Khintchine inequalities for both Rademacher and free semicircular variables. As a result, we find a characterization of the noncommutative Banach function spaces in which the upper Khintchine inequalities hold.

If time permits, I will discuss applications of these results to Burkholder-Davis-Gundy and Burkholder-Rosenthal inequalities for martingales in noncommutative Banach function spaces.

Parts of the talk are based on joint work with B. de Pagter, D. Potapov and F. Sukochev and on joint work with É. Ricard.

4) **Runyao Duan:** Quantum effects in zero-error communication and non-commutative graphs

Abstract: In 1956 Shannon introduced the notion of zero-error capacity to characterise the ability of noisy channels to transmit classical information with zero probability of error. The study of this notion and related topics has since then grown into a vast field called zero-error information theory. Very recently a quantum generalization of the zero-error information theory has become an active research topic. In this talk we will review the recent progress in quantum zero-error information theory by focusing on various quantum effects in zero-error communication. In particular, we will show that there are quantum channels of which a single use is not able to transmit classical information perfectly yet two uses can. This is achieved by employing entangled input states between different uses of the given channel and thus cannot

happen for classical channels. This striking finding indicates that the zero-error capacity of quantum channels satisfy a strong super-additivity and is fundamentally different from any classical channels.

We will also introduce a notion of non-commutative graphs as a generalization of classical graphs, to characterise the zero-error communication ability of quantum channels. This new insight enables us to introduce a quantum generalisation of the classic Lovasz theta function over classical graphs that was introduced by Lovasz in 1979. Interestingly, the notion of non-commutative graphs has been extensively studied in operator algebras under the name of operator systems.

This talk is mainly based on the following two papers:

- Runyao Duan, Super-Activation of Zero-Error Capacity of Noisy Quantum Channels, availabel on arXiv: http://arxiv.org/abs/0906.2527.
- Runyao Duan, Simone Severini, Andreas Winter, Zero-error communication via quantum channels, non-commutative graphs and a quantum Lovasz theta function, available on arXiv: http://arxiv.org/abs/1002.2514.

5) **Pierre Fima:** K-amenability of HNN extensions of amenable discrete quantum groups

Abstract: We construct the HNN extension of discrete quantum groups, we study their representation theory and we show that an HNN extension of amenable discrete quantum groups is K-amenable.

6) **Uwe Franz:** ad-invariant Lévy processes on free quantum groups and their Markov semigroups

Abstract: We classify Lévy processes on the free orthogonal quantum group O_N^+ and the free permutation quantum group S_N^+ introduced by Wang, whose distributions and Markov semigroups are invariant under the adjoint action. Then we study potential theory of these processes, i.e. their Markov semigroups and Dirichlet forms and the derivations associated to them by Cipriani and Sauvageot's construction. We also use these derivations to construct spectral triples. Joint work with Anna Kula and Fabio Cipriani.

7) **Guihua Gong:** Classification of noncommutative spaces and dynamical systems

Abstract: In this talk, I will discuss the classification of simple stably finite C*-algebras and its implication in the C*-dynamical systems.

8) **Guixiang Hong:** Calderón-Zygmund operators associated to matrix-valued kernels

Abstract: Calderón-Zygmund operators with noncommuting kernels may fail to be L_p-bounded for $p \neq 2$, even for kernels with good size and smoothness properties. Matrix-valued paraproducts, Fourier multipliers on group von Neumann algebras or noncommutative martingale transforms are frameworks where we find such difficulties. We obtain weak type estimates for perfect dyadic CZO's and cancellative Haar shifts associated to noncommuting kernels in terms of a row/column decomposition of the function. Arbitrary CZO's satisfy $\mathrm{H}_1 \to L_1$ type estimates. In conjunction with $L_\infty \to$ BMO, we get certain row/column L_p estimates. Our approach also applies to noncommutative paraproducts or martingale transforms with noncommuting symbols/coefficients. Our results complement recent results of Junge, Mei, Parcet and Randrianantoanina.

9) **Chunlan Jiang:** On the operator $U+V$ and C*-subalgebras of the universal irrational rotation algebra

Abstract: In the talk, we characterize the spectrum and the Brown spectrum of the operator $U+V$. We also introduce a class of generalized universal irrational rotation C*-algebras and characterize simplicity, tracial linear functionals, and K-groups of the algebras.

10) **Marius Junge:** Cocyles and noncommutative harmonic analysis

Abstract: Our aim is to get some results in harmonic analysis for (smooth) duals of discrete groups, meaning for singular integrals on the corresponding noncommutative L_p of the group von Neumann algebra. We describe how such results can be obtained from a simple transference principle. Unfortunately, that means that the classical Calderon-Zygmund theory takes place somewhat outside the noncommutative function space in consideration. We also provide infinite dimensional results in form of Riesz transforms.

This is joint work with Parcet and Mei.

11) **Masayoshi Kaneda:** All AW^*-algebras are monotone complete

Abstract: We affirmatively settle the long standing open problem "Are all AW^*-algebras monotone complete?" dating back to I. Kaplansky's paper published in Annals of Mathematics in 1951. We also give a complete characterization of AW^*-algebras, and as a corollary, we obtain the spectral theorem for normal elements in general AW^*-algebras.

12) **David Kerr:** Sofic entropy via finite partitions

Abstract: A few years ago Lewis Bowen introduced a notion of entropy for measure-preserving actions of sofic groups and used it to obtain a far-reaching extension of the Ornstein-Weiss classification of Bernoulli actions over amenable groups. Subsequently Hanfeng Li and I developed a more general operator-algebraic approach to sofic entropy and established a variational principle in this context. I will show that these two perspectives can be reconciled to produce a definition with the novelty that it does not depend on generators, like the standard formulation of classical measure entropy due to Sinai. This leads to a streamlined analysis of the entropy of Bernoulli actions over sofic groups, and in particular enables one to show that such actions have completely positive entropy.

13) **Seung-Hyeok Kye:** On the optimality of entanglement witnesses

Abstract: Entanglement is now considered as the main resource for quantum computation and quantum information theory. The basic research topic for the theory of entanglement is, of course, to distinguish entanglement from separable states. By the duality theory between the positivity of linear maps in matrix algebras and the separability of positive semi-definite block matrices, we need nontrivial positive linear maps to detect entanglement. This was formulated as the notion of entanglement witnesses around the turn of the century. An entanglement witness is just a positive linear map which is not completely positive, through the Jamiołkowski-Choi isomorphism.

An entanglement witness is said to be optimal if it detects a maximal set of entanglement. If a decomposable positive map is an optimal entanglement witness then it is known to be a completely copositive linear map supported on a completely entangled subspace, that is, a subspace without product vectors. It is also known that this is also sufficient for optimality for decomposable positive maps in $2 \otimes n$ cases. In the first part of this talk, we give additional necessary conditions for optimality of decomposable maps to show that the complete entangledness of the support is not sufficient for $m \otimes n$ cases whenever $n \geq 3$. These additional conditions will be given in terms of the facial structures of the convex cone consisting of all decomposable positive linear maps.

In the second part of the talk, we will consider the indecomposable cases, for which the notion of optimality is quite subtle. We exhibit examples of indecomposable positive linear maps which give rise to optimal entanglement witnesses, but which are not 'non-decomposable optimal entanglement witnesses' in the sense of the current terminology. We introduce several notions

related with the optimality; *co-optimal, bi-optimal, co-spanning property* and *bi-spanning property* to distinguish the subtleness, and give related examples. We also discuss the relations of these notions with extremeness and exposedness, which guarantee the optimality.

14) **Louis E. Labuschagne:** The invertibility of Toeplitz operators with noncommuting symbols

Abstract: We extend the classical Helson-Szegö theorem to the context of noncommutative H^2 spaces constructed from maximal subdiagonal subalgebras of finite von Neumann algebras. We then briefly survey the existent theory of Toeplitz Operators on these spaces, before going on to show how this noncommutative Helson-Szegö theorem may be used to characterise invertibility of these operators. These results were obtained jointly with Quanhua Xu, and complement and extend classical results of A. Devinatz and H.R. Pousson.

15) **Hun Hee Lee:** Some Beurling-Fourier algebras are operator algebras

Abstract: A result of Varopoulos ('72) says that the Beurling algebra (a weighted convolution algebra) $\ell^1(\mathbb{Z}; w_\alpha)$, where $w_\alpha(n) = (1+n)^\alpha$, $\alpha \geq 0$ is an injective Banach algebra if and only if $\alpha > 1/2$. If we adopt a modern language of operator spaces, then we may reformulate the above as follows. $\ell^1(\mathbb{Z}; w_\alpha)$ with its natural operator space structure is completely isomorphic to an operator algebra if and only if $\alpha > 1/2$.

On the other hand, very recently, a concept of weighted Fourier algebra, namely Beurling-Fourier algebra on compact groups has been introduced and investigated by Ludwig/Spronk/Turowska and by L./Samei. In this talk we will consider Beurling-Fourier algebras on certain compact groups which are completely isomorphic to an operator algebra. Our main examples of compact groups cover connected compact Lie groups including $SU(n)$. For positive directions we will see that the dimension of the group plays an importent role.

16) **Christian Le Merdy:** Square function estimates and dilation properties of operators on noncommutative L^p-spaces

Abstract: Let T be a bounded operator on a classical (=commutative) L^p-space. One can associate the following square function,

$$\|x\|_T := \Big\| \Big(\sum_{k\geq 1} k |T^k(x) - T^{k-1}(x)|^2 \Big)^{\frac{1}{2}} \Big\|_{L^p}, \qquad x \in L^p.$$

The existence of a uniform estimate $\|x\|_T \leq K\|x\|_{L^p}$ is related to various properties of T, such as functional calculus estimates, dilation properties, maximal inequalities... After a brief review of these connections we will turn to the noncommutative context. Given an operator $T: L^p(M) \to L^p(M)$ acting on a noncommutative L^p-space, we introduce associated square functions and discuss their role in various operator theoritical issues, including noncommutative dilation problems. The talk includes concrete examples.

17) **Xiang-Dong Li:** Riesz transforms and Hodge decomposition on complete Riemannian manifolds

Abstract: Riesz transforms are basic examples of the Calderon-Zygmund singular integral operators, and play an important role in various topics in mathematics (elliptic and parabolic PDE, quasi-conformal mapping, and the Navier-Stokes equations, etc) . In 1983, R. Strichartz raised the problem of establishing the L^p-boundedness of Riesz transforms on complete non-compact Riemannian manifolds. In this talk, we will briefly review the study of the Strichartz problem in the last decades, and then present some recent results on a new probabilistic approach to the Riesz transforms on manifolds. As an application, we present some new results in the Hodge decomposition theory on complete non-compact Riemannian manifolds.

18) **Martin Lindsay:** Quantum Brownian motion on a noncommutative manifold

Abstract: The aim of this talk is to show how quantum Brownian motion may be defined on a spectral triple of finite compact type which is admissible in the sense of Connes. The key ingredients are: a general theory of Lévy processes on compact quantum groups which goes beyond the bounded generator case in the universal setting, developed with my former student Adam Skalski; the quantum isometry group of a noncommutative manifold of the above type, due to Goswami; and the theory of quantum stochastic cocycles and their generation via quantum stochastic differential equations in the sense of Hudson and Parthasarathy.

This is joint work with Biswarup Das.

19) **Wladyslaw A. Majewski :** On applications of Orlicz spaces to Statistical Physics

Abstract: In this talk I will explain the utility of the pair of Orlicz spaces determined by the pair of complementary Young functions $x\ln(x+\sqrt{1+x^2}\,)-\sqrt{1+x^2}+1$ and $\cosh x-1$. I will use Pistone-Sempi arguments (both original and generalized) for commutative as well as noncommutative spaces. The role of the weighted noncommutative Orlicz spaces will be indicated. Applications to Statistical Physics will be presented.

20) **Tao Mei:** An H_1-BMO duality for semigroups of operators on von Neumann algebras

Abstract: Fefferman-Stein's H_1-BMO duality theory has played a central role in the classical analysis since its birth in 1971. The theory of Hardy spaces has been studied in the noncommutative setting from different point of view. This includes the study on subdiagonal von Neumann algebras initiated by Arveson, the study of noncommutative martingale inequalities and H_1-BMO spaces for noncommutative martingales started by Pisier/Xu, and Junge-Le Merdy-Xu's work on noncommutative H_∞-calculus.

In recent joint work with Junge and Parcet, we defined a type of noncommutative BMO spaces by semigroups of (completely) positive operators and successfully used them in the study of fourier multipliers on noncommutative L_p spaces. This talk will report recent progress in seeking corresponding H_1 spaces so that a desired Fefferman-Stein's duality theory holds in the noncommutative setting. A main difficulty in the research is to find "right" noncommutative alternatives to the geometric properties/conditions used in the classical analysis.

21) **Ion Nechita:** Random subspaces of a tensor product and the additivity problem

Abstract: We study singular values (or Schmidt coefficients) of vectors in a random subspace of a tensor product. The set of singular values of unit norm vectors in a random subspace is shown to converge to a deterministic limit that we characterize with the help of a norm arising in free probability. We show how these results are related to the additivity question for the minimum output entropy of random quantum channels.

22) **Chi-Keung Ng:** A Murray-von Neumann type classification of C*-algebras

Abstract: We define type $\mathfrak{A}$, type $\mathfrak{B}$, type $\mathfrak{C}$ as well as C^*-semi-finite C^*-algebras.

It is shown that a von Neumann algebra is a type $\mathfrak{A}$, type $\mathfrak{B}$, type $\mathfrak{C}$ or C^*-semi-finite C^*-algebra if and only if it is, respectively, a type I, type II, type III or semi-finite von Neumann algebra. Any type I C^*-algebra is of type $\mathfrak{A}$ (actually, type $\mathfrak{A}$ coincides with the discreteness as defined by Peligrad and Zsidó), and any type II C^*-algebra (as defined by Cuntz and Pedersen) is of type $\mathfrak{B}$. Moreover, any type $\mathfrak{C}$ C^*-algebra is of type III (in the sense of Cuntz and Pedersen). Conversely, any purely infinite C^*-algebra (in the sense of Kirchberg and Rørdam) with real rank zero is of type $\mathfrak{C}$, and any separable purely infinite C^*-algebra with stable rank one is also of type $\mathfrak{C}$.

We also prove that type $\mathfrak{A}$, type $\mathfrak{B}$, type $\mathfrak{C}$ and C^*-semi-finiteness are stable under taking hereditary C^*-subalgebras, multiplier algebras and strong Morita equivalence. Furthermore, any C^*-algebra A contains a largest type $\mathfrak{A}$ closed ideal $J_{\mathfrak{A}}$, a largest type $\mathfrak{B}$ closed ideal $J_{\mathfrak{B}}$, a largest type $\mathfrak{C}$ closed ideal $J_{\mathfrak{C}}$ as well as a largest C^*-semi-finite closed ideal $J_{\mathfrak{sf}}$. Among them, we have $J_{\mathfrak{A}} + J_{\mathfrak{B}}$ being an essential ideal of $J_{\mathfrak{sf}}$, and $J_{\mathfrak{A}} + J_{\mathfrak{B}} + J_{\mathfrak{C}}$ being an essential ideal of A. On the other hand, $A/J_{\mathfrak{C}}$ is always C^*-semi-finite, and if A is C^*-semi-finite, then $A/J_{\mathfrak{B}}$ is of type $\mathfrak{A}$.

Finally, we show that these results hold if type $\mathfrak{A}$, type $\mathfrak{B}$, type $\mathfrak{C}$ and C^*-semi-finiteness are replaced by discreteness, type II, type III and semi-finiteness (as defined by Cuntz and Pedersen), respectively.

It is a joint work with Ngai-Ching Wong.

23) **Carlos Palazuelos:** How much non-local can a quantum state be?

Abstract: In this talk we will introduce a natural measure of non-locality for bipartite quantum states and we will study the connection of this measure with the projective tensor norm. We will also explain a relaxation of the problem which will allow us to obtain some upper/lower bounds for this measure as well as some non-multiplicativity results.

24) **Javier Parcet:** Twisted Hilbert transforms and idempotent Fourier multipliers

Abstract: Directional Hilbert transforms are basic objects for the convergence of Fourier series. Given a discrete group G, a orthogonal representation $\gamma : \mathrm{G} \to O(n)$ and a unit vector $u \in \mathbb{R}^n$ we study the cross product extension of the u-directional Hilbert transform $H_u \rtimes_\gamma id_{\mathrm{G}}$ in the group algebra $\mathcal{L}(\mathbb{R}^n \rtimes_\gamma \mathrm{G})$. Our main result is a geometric characterization of L_p-boundedness for γ-twisted Hilbert transforms and $1 < p \neq 2 < \infty$. Given $\Lambda \subset \mathrm{G}$, we will also provide sufficient geometric conditions on (Λ, γ, u) for the L_p-boundedness of $H_u \rtimes_\gamma id_{\mathrm{G}}$ restricted to elements with Fourier spectrum in Λ. Finally, we will relate our results above with cocycle extensions of directional Hilbert transforms on arbitrary group von Neumann algebras $\mathcal{L}(\mathrm{G})$ and idempotent Fourier multipliers in $\mathbb{R}$.

25) **Mathilde Perrin:** Hypercontractivity of the Ornstein-Uhlenbeck and Poisson semigroups for free products

Abstract: After a brief historical introduction to the wide subject of Hypercontractivity and its closed relation with the Logarithmic Sobolev inequalities, this talk will focus on hypercontractivity for free products. We will first consider the noncommutative analogue of Nelson's inequalities in the Gaussian case, and following Biane's probabilistic approach we study the hypercontractivity of the free product of Ornstein-Uhlenbeck semigroups on Spin algebras. The second part of the talk will deal with a free product version of the Bonami-Beckner Theorem. We will discuss the hypercontractivity of the Poisson semigroup on the group von Neumann algebras generated by $\mathbb{Z}_2 * \cdots * \mathbb{Z}_2$ and $\mathbb{F}_n = \mathbb{Z} * \cdots * \mathbb{Z}$ respectively, by using two complementary methods:a probabilistic approach and a combinatorial one.

26) **Gilles Pisier:** Operator space structures on L_p-spaces

Abstract: We will describe a new operator space structure on L_p $(1 < p < \infty)$ for p an even integer, and compare it with the one introduced in our previous work using complex interpolation. For the new structure, the Khintchine inequalities and Burkholder's martingale inequalities have a very natural form: the span of the Rademacher functions is completely isomorphic to the operator Hilbert space OH, and the square function of a martingale difference sequence d_n is $\Sigma\, d_n \otimes \bar{d}_n$.

27) **Denis Potapov:** Spectral shift function for normal operators

Abstract: The talk establishes existence of the Koplienko spectral shift function for normal operators, an open problem by F. Gesztesy, A. Pushnitski, and B. Simon. It also extends the result to the setting of higher order spectral shift.

28) **Zhong-Jin Ruan:** Noncommutative Poisson boundaries over locally compact quantum groups

Abstract: Poisson boundaries associated with groups and probability measures have played a very important role in the study of random walks (on discrete groups) and harmonic analysis and ergodic theory (on locally compact groups). In this talk, we study noncommutative Poisson boundaries over locally compact quantum groups. We show that many classical results are still true in the quantum group setting.

This is a joint work with Mehrdad Kalantar and Matthias Neufang.

29) **Narcisse Randrianantoanina:** Noncommutative martingale Hardy spaces

Abstract: We will discuss recent developments on noncommutative martingale inequalities. In the first part, we will focus mainly on aspects of atomic decompositions for noncommutative martingales belonging to Hardy spaces for the case $0 < p \leq 1$. We will briefly review the classical case and report on some recent results in this line.

In the second part of the talk, we will explore variants of the classical Davis decomposition. In 2009, Perrin obtained a noncommutative analogue of the Davis decomposition. We will discuss a constructive approach to this decomposition that also led to extensions of Perrin's result to the case $0 < p < 1$. This talk is based on recent joint works with Quanhua Xu.

30) **Yanqi Qiu:** The UMD constants for a class of itereted $L_p(L_q)$ spaces

Abstract: Let $1 < p \neq q < \infty$ and $(D, \mu) = (\{\pm 1\}, \frac{1}{2}\delta_{-1} + \frac{1}{2}\delta_1)$. Define by recursion: $X_0 = \mathbb{C}$ and $X_{n+1} = L_p(\mu; L_q(\mu; X_n))$. We show that there exist $c_1 = c_1(p, q) > 1$ and $c_2 = c_2(p, q, s) > 1$, such that the UMD$_s$ constants of X_n's satisfy $c_1^n \leq C_s(X_n) \leq c_2^n$ for all $1 < s < \infty$. Our results yield an elementary construction of super-reflexive non-UMD Banach lattices.

31) **Fyodor Sukochev:** Johnson-Schechtman inequalities in the free probability theory

Abstract: In this joint work with D. Zanin, we introduce and study a "free Kruglov operator". As an application of this study, we prove an analogue of the Johnson-Schechtman inequalities in the setting of free probability theory and an arbitrary symmetric operator space. This extends and complements earlier L_p–results due to Voiculescu and to Junge, Parcet and Xu.

32) **Qin Wang:** Fibred coarse embedding into Hilbert space and its applications

Abstract: We introduce a concept of fibred coarse embedding into Hilbert space for metric spaces, which is a generalization of Gromov's notion of coarse embedding into Hilbert space and has applications in higher index problems. This is based on joint work with Xiaoman Chen and Guoliang Yu.

33) **Alan D Wiggins:** Close II_1 Factors and the isomorphism problem

Abstract: Let A and B be von Neumann algebras represented on the same Hilbert space H and let

$$d(A, B) = \max\{\sup_{x \in A} \inf_{y \in B} \|x - y\|, \sup_{x \in B} \inf_{y \in A} \|x - y\|\}.$$

We present new examples of families $\mathcal{F}$ of separable II_1 factors and a universal constant $c > 0$ such that if $M \in \mathcal{F}$ and N is any II_1 factor with $d(M, N) < c$, then N is $*$-isomorphic to M.

Time permitting, we discuss spatial isomorphisms and applications to strong solidity and unique Cartan masas. This is joint work with Jan Cameron, Erik Christensen, Allan Sinclair, Roger Smith, and Stuart White.

34) **Yi-Jun Yao:** On K-theory of some noncommutative orbifolds

Abstract: In this talk (based on our joint work with Xiang Tang), we plan to discuss the computation of K-theory groups of some crossed-product C*-algebras, by using an equivariant version of Rieffel's strict deformation.

35) **Lixin Yan:** Spectral multipliers for operators with generalized Gaussian estimates

Abstract: In this talk I will describe some recent results obtained jointly with P. Chen, E.L. Ouhabaz, and A. Sikora on spectral multipliers for abstract self-adjoint operators with generalized Gaussian estimates.

36) **Chao Zhang:** Regularity estimates in Hölder spaces for Schrödinger operators via a $T1$ theorem

Abstract: We derive Hölder regularity estimates for operators associated with a time independent Schrödinger operator of the form $-\Delta + V$.

The results are obtained by checking a certain condition to the function $T1$. Our general method applies to get regularity estimates for maximal operators and square functions of the heat and Poisson semigroups, for Laplace transform type multipliers and also for Riesz transforms and negative powers $(-\Delta + V)^{-\gamma/2}$, all of them in an unified way.

This is a joint work with Tao Ma, Pablo Stinga and Jose Luis Torrea.