ABSTRACTS OF 16th WORKSHOP: NON-COMMUTATIVE HARMONIC ANALYSIS,
6-12.07.2014, Będlewo, Poland

1. **Octavio Arizmendi (Centro de Investigación en Matemáticas)**

   Classical and Free Infinite Divisibility of Scale Mixtures of Boolean Stable Laws

   Abstract: Let $b_{\alpha,\rho}$ be a Boolean stable law, with stability index α and asymmetry parameter ρ. We prove that any scale mixture of $b_{\alpha,\rho}$ is both classically and freely infinitely divisible for $\alpha \leq \frac{1}{2}$ and also for some $\alpha > \frac{1}{2}$. Furthermore, we show the multiplicative infinite divisibility of $b_{\alpha,1}$ with respect classical, free and monotone convolutions.

   Scale mixtures of Boolean stable laws include some generalized beta distributions of second kind, which turn out to be both classically and freely infinitely divisible. One of them appears as a limit distribution in multiplicative free laws of large numbers studied by Tucci, Haagerup and Möler.

   We use a representation of $b_{\alpha,1}$ as the free multiplicative convolution of a free Bessel law and a free stable law to prove a conjecture of Hinz and Młotkowski regarding the existence of the free Bessel laws as probability measures. The proof depends on the fact that $b_{\alpha,1}$ has free divisibility indicator 0 for $\frac{1}{2} < \alpha$.

2. **Nobuhiro Asai (Aichi University of Education)**

   The q-deformed Bargmann measures related to Class I and III of Brenke-Chihara polynomials for $0 < q < 1$

   Abstract: The q-orthogonal polynomials having the Brenke type generating functions have been revived and a classification of them has been presented in a recent paper by Asai-Kubo-Kuo (IDAQP, 2013). It is known as particular examples that Class I contains little q-Laguerre polynomials and Class III does Al-Salam-Carltitz polynomials. As a sequel of the paper by Asai et al., we have been considering to find explicit forms of Bargmann measures associated with these q-polynomials.

   In this talk, we will show explicit forms, in terms of q-hypergeometric series, of q-deformed Bargmann measures associated with Class I and III of Brenke-Chihara polynomials for $0 < q < 1$. For Class II, the explicit form has not been obtained yet.

   (1) A form of the q-Bargmann measure for Class III is slightly different from the q-deformed Gaussian measure of van-Leeuwen-Maassen (J. Math. Phys, 1995), so that we will mention both of similarities and dissimilarities among these measures, too.

   (2) The q-Bargmann measure associated with Class I can be also written explicitly, but is essentially different from that of van-Leeuwen-Maassen. One of interesting and unexpected features is that our measure in the q-series representation contains the Rogers-Szegö's polynomials, which have been appeared in the paper on q-Gaussian processes on the q-Fock space by Bożejko-Kümmerer-Speicher (CMP, 1997).

   (3) If time is allowed, other related things will be mentioned.

3. **Monika Bhattacharjee (Indian Statistical Institute, Kolkata)**

   Limiting Spectral Distribution of Symmetrized Autocovariance Matrices under Infinite Dimensional Vector Linear Process and Its Application to Diagnosis the Time Series Model

   Abstract: We consider the sequence of autocovariance matrices for Infinite Dimensional Vector Linear Process. Except one, all the autocovariance matrices are asymmetric. We consider two symmetrized version of these matrices – the symmetric sum and the symmetric product and show that the Limiting Spectral Distribution exists in each case. We provide the moment formulae of these limits in terms of moments of some freely independent variables. In particular when the observations are i.i.d. explicit description of the limit is given for the symmetric product. Also, we provide a diagnosis method to choose appropriate order of the Moving Average process in high-dimensional cases.

4. **Ayan Bhattacharya (Indian Statistical Institute, Kolkata)**

   Heavy-tailed random fields indexed by trees

   Abstract: We consider a family of heavy-tailed random fields indexed by trees. Using techniques from extreme value theory, we discuss various asymptotic properties of these random fields. This talk is based on a joint work with Rajat Subhra Hazra and Parthanil Roy.

5. **Arup Bose (Indian Statistical Institute, Kolkata)**

Convergence of a class of Toeplitz type matrices

Abstract: We use the method of moments to study the spectral properties in the bulk for symmetric finite diagonal large dimensional random and non-random Toeplitz type matrices via the joint convergence of matrices in an appropriate sense. As a consequence, we revisit the famous limit theorem of Szegö for non-random symmetric Toeplitz matrices. This is joint work with Sreela Gangopadhyay and Koushik Saha. It seems rather hard to deal with the non-symmetric counterparts of these matrices.

6. **Jacek Brodzki (University of Southampton)**

The local spectrum of the Dirac operator for the universal cover of $SL(2, \mathbb{R})$

Abstract: In this talk we present a very intricate interaction between representation theory and the structure of Dirac operator for the universal cover of the group $SL(2, \mathbb{R})$. We will show how to use representation theory of the group to compute the spectrum of the Dirac operator operator. As one of the implications of this result, we shall explain how to exhibit the Dirac operator as the generator of the Kasparov group $KK(C, A)$, where A is the reduced C^*-algebra of the group. By considering an appropriate Fourier transform of this operator, we obtain a new and direct computation of the K-theory for the algebra A, without the need to employ the Connes-Kasparov conjecture. Our approach relies on a detailed analysis of the representation theory of the group, and in particular, we identify an interesting representation, which we call the limit-of-discrete-series, which is the frontier between the discrete and the principal series of the group. Furthermore, we identify the localised spectra of the Dirac operator which allows us to compute the Dirac cohomology for the universal cover of $SL(2, \mathbb{R})$, providing a new explicit example of this theory. This talk describes joint work with Niblo, Plymen, and Wright.

7. **Marie Choda (Osaka Kyoiku University)**

Operator Algebraic Shannon's Interpretation for Entropy-preserving Stochastic Averages

Abstract: We study various relations of ρ and Φ from the view point of the von Neumann entropy. Here ρ and Φ are a state and a unital positive Tr-preserving linear map on the algebra $M_n(\mathbb{C})$ of $n \times n$ complex matrices respectively. A new state $\rho \circ \Phi$ is arising from ρ via Φ. We give some characterizations for these two states to have the same value of the von Neumann entropy. Among others, it is characterized by that Φ behaves for ρ as a *-automorphism of M.

8. **Jan Czajkowski (University of Wrocław)**

Poster – Non-uniqueness phase of percolation on reflection groups in $\mathbb{H}^3$

Abstract: In the present paper I consider Cayley graphs of reflection groups of finite-sided Coxeter polyhedra in 3-dimensional hyperbolic space $\mathbb{H}^3$, with standard sets of generators. As the main result, I prove the existence of non-degenerate non-uniqueness phase of Bernoulli bond and site percolation on such graphs, i.e. that $p_c < p\mathrm{u}$, for two classes of such polyhedra:

- for any polyhedra as above with $k \geq 13$ faces;
- for any compact right-angled polyhedra as above.

I also establish a natural lower bound for the growth rate of such Cayley graphs (when the number of faces of the polyhedron is ≥ 6, used to prove the main result.

9. **Biswarup Das (Polish Academy of Sciences, Warsaw)**

Eberlein compactification of quantum groups

Abstract: We will propose a notion of Eberlein compactification of Universal Locally compact quantum groups. We will also discuss a generalisation of the well-known decomposition theorem namely almost periodic functions form a complemented Banach space within the algebra of Eberlein compact functions, in the context of quantum groups. This is an attempt to study the notion of weakly periodic functions on quantum groups.

Joint work with Matthew Daws.

10. **Maciej Dołęga (University of Wrocław)**

Gaussian fluctuations of anisotropic Young diagrams

Abstract: In 1977 Vershik and Kerov and independently Logan and Shepp discovered that large random Young diagrams with respect to Plancherel measure concentrate around some explicit limit shape. In 1993 Kerov showed that the fluctuations around that limit shape are Gaussian. Biane, using free probability, noticed that the concentration of the shape of large Young diagrams around some limit shape is satisfied by a much larger class of measures with, so-called, approximate factorization property, while Śniady proved that a similar phenomena holds for the second order asymptotics. We will discuss a continuous deformation of these measures and a typical behaviour of large anisotropic Young diagrams. In particular, we will show that law of large numbers and central limit theorem is observed for this much bigger class which plays a similar role as Gaussian Beta Ensembles as a generalization of Gaussian Unitary Ensembles.

11. **Nadieżda Dołmatowa (University of Wrocław)**

Poster – A special modulus of continuity and the K-functional

Abstract: We consider the questions connected with the approximation of real continuous 1-periodic functions and give a new proof of the equivalence of the special Boman-Shapiro modulus of continuity with Peetre's K-functional. We also prove Jackson's inequality for the approximation by trigonometric polynomials.

12. **Gérard Duchamp (Université Paris-Nord)**

Noncommutative symmetric functions, bases in duality and representations

Abstract: We review how the theory of noncommutative symmetric functions starts and the first Hopf algebras in duality. Doing this, one can express Schützenberger's factorization through two spaces in duality. We provide also faithful representations of noncommutative Heisenberg-Weyl algebra.

13. **Wiktor Ejsmont (University of Wrocław)**

New characterization of two-state normal distribution

Abstract: I will speak about a purely noncommutative criterion for the characterization of two-state normal distribution. I prove that families of two-state normal distribution can be described by a relation which is similar to the conditional expectation in free probability, but has no classical analogue. I also show a generalization of Bożejko, Leinert and Speicher's formula (relating moments and noncommutative cumulants).

14. **Rachid El Harti (University Hassan I, Settat)**

The Banach-Stone theorem for some Banach $*$-algebras and Applications

Abstract: The main objective of this work is to extend the classical Banach Stone theorem to reduced Banach $*$-algebras, (in particular to group-algebras). As application, we give classification of some preserving linear maps.

15. **Gero Fendler (Universität Wien)**

On the weak*-fixed point properties of Fourier-Stieltjes algebras and of the Banach space duals of separable C^*-Algebras.

Abstract: We shall relate the weak*-fixed point property of the Fourier-Stieltjes algebra of a locally compact group to the compactness of the group. Furthermore we show that the dual $\widehat{A}$ of a separable C^*-algebra A is discrete if and only if its Banach space dual has the weak*-fixed point property. We discuss further the equivalence of these properties to the uniform weak* Kadec-Klee property of A^* and to the coincidence of the weak* topology with the norm topology on the pure states of A. The lecture is based on joint work with Prof. Anthony To-Ming Lau and Prof. Michael Leinert.

16. **Uwe Franz (Université de Franche-Comté, Besançon)**

Hunt's formula for the compact quantum groups $SU_q(N)$ and $U_q(N)$.

Abstract: Hunt's formula gives a classification of convolution semigroups of probability measures, or equivalently, of Lévy processes on Lie groups in terms of their genererator. It shows how such processes are combinations of a continuous (or Gaussian) part and a jump part. We present an analog of Hunt's formula for the compact quantum groups $SU_q(N)$ and $U_q(N)$. It turns out that the generators of convolutions semigroups of states on $C(SU_q(N))$

and $C(U_q(N))$ can again be decomposed into a Gaussian part and a "jump"part. Joint work with Anna Kula, Martin Lindsay, and Michael Skeide.

17. **Avital Frumkin (Tel Aviv University)**

The diagonal of real symmetric matrices of given spectra as measure space and Zuber Itzycson Harish Chandra integral over the Orthogonal group

Abstract: Let $\lambda = \lambda_1, \lambda_2 ... \lambda_n$ be a positive real vector so that $\sum \lambda_i = 1$. For simplicity we assume λ_i are all rational. Define a diagonal matrix

(1) $$D_\lambda = diag(\lambda_1, \lambda_2 ... \lambda_n)$$

Let O_n be the real orthogonal group of n by n matrices We use the notation $A^o \equiv oAo^t$ By Horn-Schur theorem the set

(2) $$(D^o_{\lambda 11}, D^o_{\lambda 22} ... / o \in O_n)$$

is the permutahedron PH_λ, i.e the convex hall of all the vectors $\lambda_{\sigma(1)}, \lambda_{\sigma(2)} ..., \lambda_{\sigma(n)}$ for $\sigma \in S_n$. PH_λ is endowed with a measure DH^O_λ, given by pulling back to the Haar measure of the real orthogonal group. (Once the unitarian group replaces the real orthogonal group one denotes DH^U_λ). Let N be a large integer number, so that $N\lambda$ is an integer vector, and let

(3) $$Z_{N\lambda} = \sum_{\eta \vdash N} a_\eta x^\eta$$

be the zonal sphere polynomial corresponding to the partition $N\lambda$. Our basic goal is to prove that the coefficients a_η approximate, up to normalization, the density (May be Radon Nicodin derivation) of the measure DH^O_λ at the points $\frac{\eta}{N}$ as well as N goes to infinity. (In the Hermitian case the zonal sphere polynomials are replaced by the Schur polynomials in getting the same type of approximation). This result leads to two corollaries, as follows; Given another rational positive vector $\gamma = (\gamma_1, \gamma_2, ... \gamma_n)$, so that $\sum \gamma_i = 1$. Let $D_\gamma = diag(\gamma_1, \gamma_2 ..)$. Let N be a large integer so that $N\lambda$ and $N\gamma$ are integer vectors . Let

(4) $$Z_{N\lambda} Z_{N\gamma} = \sum_{\eta \vdash 2N} C^{N\lambda, N\gamma}_\eta Z_\eta$$

be the linearization of the product of the two zonal sphere polynomial. The probability's density at point $\frac{\eta}{N}$ of the equations $D^o_\lambda + D^{o'}_\gamma = D_{\frac{\eta}{N}} : o, o' \in O_n$ to hold is approximated,up to normalization, by the coefficients $C^{N\lambda,N\gamma}_\eta$ as well as N tends to infinity. (One use the Haar measure of the orthogonal group as the probability's measure) In the Hermitian case, the Littlewood Richardson coefficients replace those coefficients.

The second corollary concerns with the real symmetric version of the Zuber Itzycson Harish Chandra integral

(5) $$I_\lambda(C) \equiv \int exp(trac(CD^o_\lambda))do$$

integrated over O_n with respect to its Haar measure. λ, D_λ are defined as before.

With no loos of generality, one can assume that C is diagonal matrix so the integral may be taken over PH_λ with respect to DH^o_λ i.e.

(6) $$I_\lambda(C) = \int_{PH_\lambda} \prod exp(C_i (D^o_\lambda)_{ii}) d(DH^O_\lambda)$$

or for given N,

(7) $$I_\lambda(C) = \int_{PH_\lambda} \prod \left(exp \frac{C_i}{N} \right)^{N(D^o_\lambda)_{ii}} d(DH^O)$$

Now in using the Riemann sums process to approximate the integration, by computing the integrand at the points of type $\frac{\gamma}{N} : \gamma \vdash N$ in PH_λ and then approximate the density function of DH^o_λ at those points, by the coefficients of the zonal sphere polynomial $Z_{N\lambda}$ (thanks to the main result), one can evaluate $I_\lambda(C)$ by

(8) $$Z_{N\lambda} \left(exp \frac{C_1}{N}, exp \frac{C_2}{N}, ... exp \frac{C_n}{N} \right)$$

up to normalization, depend on N as well as N tends to infinity.

In the Hermitian version of this process, one may replace the zonal sphere polynomial with the Schur polynomials, with respect to the same parametrization. The very elegant determinant formula of Zuber Itzycson.., is accepted as the asymptotic of the determinant formula for the Schur polynomials. Unfortunately, the zonal sphere polynomial, are not enjoyed such a nice expression for their computations.

18. **Jacek Grela (Jagiellonian University, Kraków)**

Diffusion of non-hermitian matrix models

Abstract: We discuss a diffusive picture for general non-hermitian matrix models by presenting an extended case study of different initial conditions. In this approach we are able to obtain both finite and large N results and retreive the so called quaternionic Green's function. Special emphasis is put to the non-normal initial conditions which set up a non-trivial eigenvector correlations. Furthermore, we show an equivalence between the diffusive picture and a non-hermitian matrix model with an external field and we comment on some general results for the subclass of complex normal models.

19. **Takahiro Hasebe (Hokkaido University)**

Unimodality for freely selfdecomposable distributions

Abstract: Selfdecomposable distributions appear as an extension of stable distributions. In 1978 Yamazato proved that all selfdecomposable distributions are unimodal.

In free probability, Biane proved in 1999 that free stable distributions are all unimodal. In this talk, I would like to explain the free analogue of Yamazato's theorem, i.e. all freely selfdecomposable distributions are unimodal. This is joint work with Steen Thorbjørnsen.

20. **Fumio Hiai (Tohoku University)**

Anti-norms and superadditivity inequalities in type II_1 factors

Abstract: Let M be a type II$_1$ factor. A general exposition is given on the new notion of symmetric anti-norms on M^+ as well as symmetric norms on M. We next consider special anti-norms (called derived anti-norms) $\|A\|_! := \|A^{-p}\|^{-1/p}$ for a symmetric norm $\|\cdot\|$ on M and a constant $p > 0$. For such anti-norms and for a certain class of functions $f : [0,\infty) \to [0,\infty)$ we provide a general superadditivity inequality

$$\|\psi(A+B)\|_! \geq \|\psi(A)\|_! + \|\psi(B)\|_!,$$

whose special case is the superadditivity of the Fuglede-Kadison determinant.

21. **Takeshi Hirai (Kyoto)**

Spin representations of twisted central products of double covering finite groups and the case of permutation groups (joint work with Akihito Hora)

Abstract: Let S be a finite group with a character, sgn, of order 2, and S' its central extension by a group $Z = \langle z \rangle$ of order 2. A representation π of S' is called *spin* if $\pi(z\sigma') = -\pi(\sigma')$ $(\sigma' \in S')$, and the set of all equivalence classes of spin irreducible representations (= IRs) of S' is called the *spin dual* of S'. Take a finite number of such triplets $(S'_j, z_j, \mathrm{sgn}_j)$ $(1 \leq j \leq m)$. We define twisted central product $S' = S'_1 \hat{*} S'_2 \hat{*} \cdots \hat{*} S'_m$ as a double covering of $S = S_1 \times \cdots \times S_m$, $S_j = S'_j/\langle z_j \rangle$, and for spin IRs π_j of S'_j, define twisted central product $\pi = \pi_1 \hat{*} \pi_2 \hat{*} \cdots \hat{*} \pi_m$ as a spin IR of S'. We study their characters and prove that the set of spin IRs π of this type gives a complete set of representatives of the spin dual of S'. These results are applied to the case of representation groups S' for $S = \mathfrak{S}_n$ and $\mathfrak{A}_n$, and their (Frobenius-)Young type subgroups. This is a joint work with Akihito HORA.

22. **Vincel Hoang Ngoc Minh (Université Paris-Nord)**

Factorization and Renormalization

Abstract: Calculus with integro-differential operators is often a calculation in an associative algebra with unit and it is essentially a non-commutative computation. But, by adjonction a co-commutative co-product, it operates in a bi-algebra isomorphic to an enveloping algebra. We then obtain an adequate framework for an implementation on computer algebra via monoidal factorization, transcendence bases and PBW bases. In this talk, we give the most general co-commutative deformations of the shuffle co-product and an effective construction of pairs of bases in duality.

23. **Robin Hudson (Loughborough University)**

A causal quantum stochastic double product integral related to Lévy area

Abstract: We consider the causal product integral

$$\bigotimes_{a<x<y<b}\left(1+\frac{i\lambda}{2}\left(dP\left(x\right)dQ\left(y\right)-dQ\left(x\right)dP\left(y\right)\right)\right)$$

where λ is a real parameter and P and Q are the "momentumąnd "position"Brownian motions of quantum stochastic calculus, which satisfy the commutation relation

$$\left[P\left(s\right),Q\left(t\right)\right]=-2is\wedge t.$$

We approximate it by the discrete double product

$$\bigotimes_{1\leq j<k\leq n}\left(1+\frac{i\lambda\left(b-a\right)}{2n}\left(p_jq_k-q_jp_k\right)\right)$$

where the (p_j,q_j) are mutually commuting standard canonical pairs formed by the normalized increments of P and Q over the subintervals of an partitioning of $[a,b[$ into n equal subintervals. By identifying each $p_jq_k-q_jp_k$ as an angular momentum and hence as the infinitesimal generator of rotations, this is approximated in turn by the second quantization $\Gamma\left(W_n\right)$ of a discrete double product W_n of rotations in different planes in the Hilbert space $L^2\left([a,b[\right).$ W_n and its limit W as $n\to\infty$ can be evaluated as explicit unitary operators by counting generalized Dyck paths using Catalan numbers and the Catalan triangle.

This is joint work with Yuchen Pei.

24. **Anna Jencova (Slovak Academy of Sciences, Bratislava)**

Quantum versions of the classical randomization criterion

Abstract: The randomization criterion is an important result of classical statistical decision theory. It relates deficiency of two statistical experiments, given by comparing the risks (or payoffs) of decision procedures, to existence of a stochastic mapping transforming one experiment close to the other. In the quantum setting, statistical experiments are defined as (finite) parametrized sets of quantum states and stochastic mappings are replaced by quantum channels, that is, trace preserving completely positive maps. We show that the randomization criterion is a consequence of duality of so-called base section norms, which contain also the diamond norm (cb-norm) and its dual. Using this duality, this result can be extended to the case when experiments are replaced by quantum channels and their randomization is obtained either by post- or pre-processing by another channel. Moreover, the channels are not necessarily completely positive, but more general positivity properties are allowed, e.g. positive or k-positive.

25. **Un Cig Ji (Chungbuk National University)**

Quantum White Noise Differential Equations and Applications

Abstract: Based on quantum white noise theory, we introduce the notion of quantum white noise derivatives acting on the space of operators on Boson Fock space. Motivated by the implementation problem of canonical commutation relations and normal-ordered (Wick ordered) form of exponentials of higher powers of quantum white noise, we suggest a systematic study of quantum white noise differential equations associated with Wick derivations. As applications we discuss the implementation problems of CCRs and normal ordered forms of some operators on Boson Fock space. This talk is based on several joint works with Nobuaki Obata:

[1] U. C. Ji and N. Obata: *Generalized white noise operators fields and quantum white noise derivatives*, Seminaires et Congrés **16** (2007), 17–33

[2] U. C. Ji and N. Obata: *Annihilation-derivative, creation-derivative and representation of quantum martingales*, Commun. Math. Phys. **286** (2009), 751–775

[3] U. C. Ji and N. Obata: *Implementation problem for the canonical commutation relation in terms of quantum white noise derivatives*, J. Math. Phys. **51** (2010), 123507

[4] U. C. Ji and N. Obata: *Calculating normal-ordered forms in Fock space by quantum white noise derivatives*, Interdiscip. Inform. Sci. **19** (2013), 201–211.

26. **Marius Junge (Illinois at Urbana Champaign)**

Riesz transforms and harmonic analysis

Abstract: We will show that boundedness of Riesz transforms for group von Neumann algebras can be reduced to a very good understanding of the underlying derivation and, of course, Khintchine inequalities. We will illustrate results

for groups and q-gaussian variables with applications to concentration inequalities. This is joint work with Mei ,Parcet, and Zeng.

27. **Marius Junge (Illinois at Urbana Champaign)**

Baby Talk – Stochastic integration for martingales

Abstract: We will start with some classical concepts from probability about martingales with continuous path, and see what can be done in the noncommutative situation.

28. **Yasuyuki Kawahigashi (University of Tokyo)**

Subfactors, tensor categories and boundary conformal field theory

Abstract: Subfactors, tensor categories and boundary conformal field theory Abstract: We present an operator algebraic approach to boundary conformal field theory. By proving a conjecture of Kong and Runkel, we clarify correspondence between boundary and full conformal field theories. We also study defects in the setting of operator algebras. These are joint work with Bischoff, Longo and Rehren.

29. **Søren Knudby (University of Copenhagen)**

When do Fourier and Rajchman agree?

Abstract: The Fourier algebra $A(G)$ and the Fourier-Stieltjes algebra $B(G)$ are function algebras that occur naturally in harmonic analysis of a locally compact group G. Unless G is compact, $A(G)$ is a proper subalgebra of $B(G)$, since functions in $A(G)$ vanish at infinity while $B(G)$ contains the constant functions. Consider the following question: Does the Fourier algebra $A(G)$ coincide with the subalgebra of $B(G)$ consisting of functions vanishing at infinity? This last algebra is sometimes called the Rajchman algebra.

The talk will cover known results concerning this question. It will also include a theorem giving sufficient conditions for the question to have an affirmative answer.

As an application of the theorem we are able to give new examples of groups G such that $A(G)$ coincides with the subalgebra of $B(G)$ consisting of functions vanishing at infinity.

30. **Jurij Kryakin (University of Wrocław)**

On the exact constant in the Jackson–Stechkin inequality for the uniform metric. The talk is based on the joint works with A.Babenko, A. Shadrin, S.Foucart and P.Staszak

Abstract: The classical Jackson-Stechkin inequality estimates the value of the best uniform approximation of a periodic function f by trigonometric polynomials of degree $\leq n-1$ in terms of its r-th modulus of smoothness $\omega_r(f,\delta)$. It reads

$$E_{n-1}(f) \leq c_r\, \omega_r\Big(f, \frac{2\pi}{n}\Big)\,,$$

where c_r is *some* constant that depends only on r. It was known that c_r admits the estimate $c_r < r^{ar}$ and, basically, nothing else could be said about it.

The main new result is the following inequlity

$$(1-\frac{1}{r+1})\,\gamma_r^* \leq c_r < \sqrt{2}\,\gamma_r^*, \qquad \gamma_r^* = \frac{1}{\binom{r}{\lfloor \frac{r}{2} \rfloor}} \asymp \frac{r^{1/2}}{2^r}\,,$$

i.e., that the Stechkin constant c_r, far from increasing with r, does in fact decay exponentially fast.

31. **Anna Krystek (University of Wrocław)**

Poster – TBA

Abstract:

32. **Bartosz Kuśmierz (University of Wrocław)**

Poster – Jack symmetric polynomials and Jack fermionic polynomials - recursion formulas and applications in solid state physics

Abstract: The Jack polynomials (Jacks) - J_λ^α are remarkable family of symmetric polynomials, they are indexed by the partition λ and the real number α. Jacks are generalization of many types of symmetric polynomials, including Schur polynomials ($\alpha = 1$), zonal polynomials ($\alpha = 2$), quaternion zonal polynomial ($\alpha = \frac{1}{2}$) and monomial symmetric functions ($\alpha = \infty$).

Jacks are the eigenvectors of the differential operator - Hamiltonian of the Calogero-Sutherland-Moser model. Since action of CMS Hamiltonian on the monomial symmetric functions is triangular, one can calculate Jacks using simple recursion formula [1-5].

Jack polynomials turned out to be the convenient functions describing many-electron states in Fractional quantum Hall effect (FQHE) [6-8]. FQHE is remarkable behavior of quasi-two-dimensional electrons in high magnetic field, depending primarily on the Landau level filling factor ν (dimensionless ratio of electron and magnetic flux densities).

Jacks describe several known FQH states: the Laughlin state at $\nu = 1/q$ ($q \in \mathbb{N}_+$), the Moore-Read state at $\nu = 1/2$ and the Read-Rezayi state at $\nu = 3/5$.

Since Jacks are symmetric polynomials, they can describe only the bosonic FQH states. To anti-symmetrize Jacks one can use canonical isomorphism between rings of the symmetric and antisymmetric polynomials - multiplication by Vandermonde determinant. This isomorphism gives the so-called the fermionic Jacks [9-11].

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33. **Seung-Hyeok Kye (Seoul National University)**

Separable states with unique decompositions and applications to construction of PPT entanglement

Abstract: One of the most important problems in quantum information theory is to determine if a given state is separable or entangled. For this purpose, we have to understand the boundary structures of the convex set consisting of all separable states. Note that the boundary consists of faces, and

the first step is to search for faces which are affinely isomorphic to simplices. Any points of such faces are separable states with unique decompositions, which are of independent interest. In this talk, we consider several principles to search for such faces in the multi-partite cases as well as bi-partite case.

As for concrete examples, we will concentrate on low dimensional cases, like 2 x 4, 3 x 3 and 2 x 2 x 2,

and apply the results to construct non-trivial examples of entangled edge states with positive partial transposes.

This talk will be based on co-works with K.-C. Ha :

[1] Separable states with unique decompositions, Commun. Math. Phys. 328 (2014), 131-153, arXiv:1210.1088
[2] Geometry for separable states and construction of entangled states with positive partial transposes, Phys. Rev. A 88 (2013), 024302. arXiv:1307.1362
[3] Multi-partite separable states with unique decompositions and construction of three qubit entanglement with positive partial transpose, arXiv:1402.5813

34. **Franz Lehner (Technische Universität Graz)**

Combinatorics of Cumulants

Abstract: In joint work with O.Arizmendi, T.Hasebe and C.Vargas we present formulas expressing classical, free, boolean and monotone cumulants in terms of each other, using combinatorics of partitions, Tutte polynomials, heaps and permutations.

35. **Andrzej Łuczak (University of Łódź)**

On the commutativity of states in von Neumann algebras

Abstract: Let φ and ω be normal faithful states on a von Neumann algebra. The celebrated Pedersen-Takesaki theorem defines commutativity of φ and ω in terms of their modular automorphism groups. If only ω is faithful then only *commuting of* φ *with* ω is defined. We attempt to define *joint commutativity* of an arbitrary family of normal states which would generalise the one given by the Pedersen-Takesaki theorem. If the algebra in question is the full algebra $\mathbb{B}(\mathcal{H})$ of all bounded operators on a Hilbert space, then this joint commutativity amounts to the natural condition of commutativity of the density matrices of the states. Moreover, equivalence between pairwise commutativity as defined by the Pedersen-Takesaki theorem and the joint commutativity is obtained for a convex family of states.

The notion of *broadcastability* of states has become recently an object of growing interest in the field of Quantum Statistics and Quantum Information Theory. It turns out that it is closely related to commutativity of states. Namely, in general von Neumann algebras broadcastability implies commutativity while in atomic von Neumann algebras the two notions are equivalent.

36. **Marcin Marciniak (University of Gdańsk)**

Quantum symmetries of noncommutative torus

Abstract: We will consider two examples of actions of (quantum) groups on the algebra of noncommutative torus. The first one will be an analogue of free action of a finite group on the classical torus. We will provide necessary conditions for such action in the noncommutative case. Moreover, we will describe the structure of a noncommutative differential manifold on the fixed point algebra of this action. It will be done in the language of real spectral triples. This construction is a noncommutative analogue of the classical construction of flat manifolds. The second part of the lecture will be devoted to description of permutation symmetry of noncommutative torus. A new example of a compact quantum group will be provided. It can be considered as a 'twisted' permutation group but it is not the same as 'free' permutation group defined by Wang and van Daele.

37. **Ion Nechita (CNRS, Université de Toulouse)**

Positive and completely positive maps via free additive powers of probability measures

Abstract: We give examples of maps between matrix algebras with different "degrees" of positivity using ideas from free probability. We discuss applications to entanglement detection in quantum information theory, and compare the new methods with existing ones.

38. **Nobuaki Obata (Tohoku University)**

Spectral Analysis of Digraphs and Coupled Oscillators with Self-Adaptive Dynamics

Abstract: We discuss spectral analysis of digraphs (directed graphs), in particular, of Manhattan products, with applications to coupled oscillators with self-adaptive dynamics defined by the system of differential equations:

$$\begin{cases} \dot{\phi}_k = \omega_k - c \sum_{j \in V} A_{kj}(\phi_k - \phi_j), \\ \dot{\omega}_k = -s \sum_{j \in V} A_{kj}(\phi_k - \phi_j) \end{cases}$$

where $A = [A_{kj}]$ is the adjacency matrix of a digraph $G = (V, E)$, and $c > 0$ and $s > 0$ are constant numbers. We derive conditions under which the system enjoys the synchronization:

$$\lim_{t \to \infty} \omega_k(t) = \bar{\omega},$$

where $\bar{\omega}$ is a constant independent of $j \in V$. This work is partly based on the joint work with J. Rodriguez (ETH Lausanne).

39. **Carlos Vargas Obieta (Universität des Saarlandes)**

A General Solution to Eigenvalue Distributions of Hermitian Random Matrices

Abstract: We give an algorithm to numerically compute the distribution of any Deterministic Equivalent of any RM model consisting of Wigner, Haar-unitary random matrices of different sizes and (possibly rectangular) deterministic matrices.

Deterministic equivalents (DE's) (apparently going back to Girko) for the Cauchy-Stieltjes transforms of eigenvalue distributions of Hermitian RM models have been proved to yield very good approximations of the averaged empirical eigenvalue distributions. In recent years, the most sophisticated RM models (e.g. those coming from electrical engineering) employed such DE's. However, as the complexity of the model grows, it becomes less clear how to perform such simplifications.

In a previous joint work with R. Speicher, we found a conceptual interpretation of DE's in terms of Voiculescu's Free Probability. Instead simplifying the matrix model at the level of equations, we rather proposed a deterministic, operator-algebraic simplification (called "Free Deterministic Equivalent") of the RM model itself, replacing the matrices by suitable deterministic operators. Free Independence (in many of its instances) plays an important role in the definition of the FDE's. In contrast to DE's, the FDE's can be defined quite easily (regardless of the complexity of the model). However, the actual computation of the spectral distribution of these FDE's still depended on the specific choice of the model.

Recent developments in Free Probability (specifically, on the operator-valued generalization of the analytic subordination theory of the additive and multiplicative free convolutions) allowed Belinschi et al. to compute spectral distributions of certain operator-algebraic models, related to quite general RM.

In this talk (joint work with T. Mai) we show how their method can be generalized to obtain the spectral distribution of any FDE.

40. **Izumi Ojima (Research Institute for Mathematical Sciences, Kyoto University)**

Holonomy as geometric template in physical emergence of Macro objects

Abstract: Along the line of my research titled "Geometry of Symmetry Breakingżeported in Sapporo workshop last summer, universal roles played by holonomy terms have been found in relation with Élie Cartan's characterization of symmetric spaces: they can be regarded as geometric templates in the physical emergence processes of Macro classical objects from Micro quantum dynamics, as typically exemplified by Maxwell's equation in electromagnetism and by Einstein's equation in general relativity.

41. **Adam Paszkiewicz (University of Łódź)**

On projections, quantum effects and solutions of some old problems on representations

Abstract: We present a general descriptions of multilinear forms on operator algebras $\phi : B(H) \times \cdots \times B(H) \to \mathbb{C}$, when ϕ is orthogonal in the following sense: $\phi(x_1, \ldots, x_n) = 0$ if only $x_i, x_{i+1} \in \operatorname{Proj} H$, $x_i \perp x_{i+1}$ for some $1 \leq i \leq n-1$. We show that $n = 4$ is the smallest n satisfying the following condition: For any $x = x^*$ there exists $\lambda_i \in \mathbb{R}$, $p_i \in \operatorname{Proj} H$ such that $x = \sum_{1 \leq i \leq n} \lambda_i p_i$. Some interpretations of these results for quantum effects are mentioned.

42. **Yuchen Pei (University of Warwick)**

Poster – A Dyck path counting problem and a recursive integral equation

Abstract: We show that an operator related to a quantum version of the stochastic Levy area is unitary. We show this by counting the generalised Dyck paths, obtaining a generating function related to the Catalan triangle and showing that the generating function satisfies an integral equation equivalent to the statement that the operator is coisometry. And since the function is symmetric in a certain sense, this also proves the isometry, hence unitarity. This is joint work with Robin Hudson.

43. **Karol Penson (Université Pierre et Marie Curie, Paris 6)**

Combinatorial sequences in classical and free probability

Abstract: We consider several families of combinatorial sequences, which are related to binomial coefficients. Some of them are certain generalizations of the binomial numbers and Catalan numbers. We consider these sequences as moment sequences of probability measures defined on the positive half-axis, i.e. we find the range of parameters for which they are positive definite. We employ the method of inverse Mellin transform to construct exact and explicit expressions for these densities in terms of the Meijer G-functions and generalized hypergeometric functions. These densities represent generalizations of the Marchenko-Pastur and of the Wigner distributions. We prove that certain of these distributions are infinitely divisible with respect to the free additive convolution.

Work done in collaboration with W. Młotkowski (Univ. Wroclaw, Poland)

44. **Karol Penson (Université Pierre et Marie Curie, Paris 6)**

Baby Talk – From coherent states to combinatorics and back

Abstract: We shall discuss various connections between combinatorial sequences and generalized coherent states. We shall demonstrate that such known objects as Catalan, Bell numbers and numbers related to binomial coefficients appear naturally in the theory of coherent states. This fact is examined in view of energy spectra of initial quantum systems for which the coherent states are constructed.

45. **Hanna Podsękowska (University of Łódź)**

Poster – Lüders theorem for ideal measurements and sufficiency of the fixed-point algebra (joint work with Andrzej Łuczak)

Abstract: A generalisation of Lüders theorem is proved for an extended class of Lüders transformations. A similar result is obtained for quantum measurements represented by ideal instrument. It is shown that the fixed-point algebra of this quantum operation is sufficient for the family of states determined by the PVM defined by the instrument.

46. **Mihai Popa (University of Texas at San Antonio)**

Asymptotic Freeness and Matrix Transpose for Wishart and Unitarily Invariant Ensembles of Random Matrices

Abstract: From the beginnings of Free Probability Theory, free independence was connected to the asymptotic behavior of various classes of independent random matrices. Motivated by some questions concerning fluctuations moments of unitarily and orthogonally invariant random matrices, we obtained the surprising result that unitarily invariant random matrices are asymptotically free from their transposes. Some more general results are shown for the the cases of GUE, GOE and Wishart ensembles. Joint work with J. A. Mingo.

47. **Mykhailo Poplavskyi (University of Warwick)**

Annihilated random walks as an extended Pfaffian point process

Abstract: We present an analysis of Annihilated Random Walks (ARW) process on Z. This process is well-known in physics and chemistry as a reaction-diffusion system with one specie and describe diffusion systems with particles undergo a chemical reaction on a collision. Namely we consider independent random walks on Z which start from some initial distribution and evolve with annihilation reaction. This process is closely connected to Glauber dynamics on Z and eigenvalue distribution of real Ginibre matrices. Using the connection to spin system we calculate one- and multi-time correlation functions and prove they form an Extended Pfaffian Point Process (EPPP). Asymptotic analysis of the kernel is given and it is shown that the answer in thermodynamic limit corresponds to the previous result of Tribe, Zaboronski on Annihilated Brownian Motions (ABM). We also present several classical results from point processes theory for our process. This is a joint work with Barnaby Garrod and Siu Kwan Yip.

48. **Yanqi Qiu (Aix-Marseille Université)**

The spectral measure of infinite random matrices with Hua-Pickrell laws

Abstract: In this talk, following Borodin-Olshanski, I will introduce the spectral measure for invariant measure on the space of infinite Hermitian matrices and show that the ergodic decomposition for so-called Hua-Pickrell measures have no Gaussian factors. Our results show that the ergodic decomposition of Hua-Pickrell measure is completely discribed by a determinantal point process previously obtained by Borodin-Olshanski. This a joint work with Alexander Bufetov.

49. **Hayato Saigo (Nagahama Institute of Bio-Science and Technology)**

The Arcsine law and an asymptotic behavior of orthogonal polynomials

Abstract: Recently we have generalized "quantum-classical correspondence"for harmonic oscillators to the context of "interacting Fock spaces". Under a simple condition for Jacobi sequences, it is shown that the Arcsine law is the unique probability distribution corresponding to the łarge quantum number limits". As a corollary, we obtain that the squared n-th orthogonal polynomials for a probability distribution corresponding to such kinds of interacting Fock spaces, multiplied by the probability distribution and normalized, weakly converge to the Arcsine law as n tends to infinity. This is a joint work with Hiroki Sako.

50. **Noriyoshi Sakuma (Aichi University of Education)**

On Marchenko-Pastur limit of random matrices with dependent entries

Abstract: We discuss the limiting spectral distribution of large random matrix with dependent entries from a free probabilistic point of view.

In this talk, first, we will see that such a limit spectral measure is a compound free Poisson law and, in the case where dependence is given by MA modeled Gaussian process, the sample covariance matrix can be regarded as compound Wishart matrix and, hence, gives the random matrix model for a compound free Poisson law. Finally, we will treat wider class of large random matrix with dependent entries.

This talk is based on joint work with Ayako Hasegawa and Hiroaki Yoshida.

51. **Adam Skalski (Polish Academy of Sciences &University of Warsaw)**

Haagerup property for quantum groups and arbitrary von Neumann algebras

Abstract: The Haagerup property is one of the most intensively studied in recent 20 years properties of locally compact groups, exhibiting both geometric and analytic character. In this talk we will discuss its extension to quantum groups, in particular presenting equivalence of four fundamental classical definitions, as listed for example in the 'little green book', in the quantum context. We will also introduce another equivalent characterisation in terms of 'typical' representations, show that the Haagerup property for discrete quantum groups is preserved under taking free products and finally discuss the Haagerup approximation property for non-tracial von Neumann algebras (based on joint work with Matt Daws, Pierre Fima and Stuart White and also with Martijn Caspers)

52. **Piotr Sołtan (University of Warsaw)**

A characterization of amenability of locally compact groups and quantum groups

Abstract: I will recall the notion of amenability of locally compact quantum groups which extends the concept of amenability of locally compact groups. Then I will show that a locally compact quantum group is amenable if and only if the von Neumann algebra corresponding to its dual quantum group is injective in a special way. This result generalizes the well known theorem describing amenability of a discrete group in terms of amenability of its group von Neumann algebra, yet it applies to all locally compact groups and locally compact quantum groups.

53. **Kamil Szpojankowski (Warsaw University of Technology)**

The Lukacs property in free probability and related characterization

Abstract: We shall present results concerning Lukacs property in free probability. In particular we will prove that for X, Y free, free Poisson distributed random variables $X+Y$ and $(X+Y)^{-\frac{1}{2}}X(X+Y)^{-\frac{1}{2}}$ are free. As an auxiliary results we will give free joint cumulants of X and X^{-1} for invertible, free Poisson distributed X.

We will also discuss related characterizations of distributions of free random variables.

54. **Tatsuya Tate (Tohoku University)**

Powers of certain quantum walks

Abstract: The notion of quantum walks are defined as a non-commutative analogue of the usual random walks and they are investigated mainly in quantum physics, information science, combinatorics and probability theory. As in the theory of random walks, one of the main issues for the quantum walks is to find various asymptotic properties of transition probabilities, which are defined by using the powers of a unitary operator expressing a quantum walk, and hence it is important to understand powers of quantum walks. In this talk an effective and concrete formulas for the powers of certain quantum walks are given. These formulas involve the Chebyshev polynomials and it can be used to deduce weak limit distributions.

55. **Michaël Ulrich (Université de Franche-Comté, Besançon)**

Random Matrices and Free Lévy Processes

Abstract: We study and discuss the asymptotic behaviour for large dimesion of Brownian motion in the unitary group.

56. **Dániel Virosztek (Budapest University of Technology and Economics)**

Decomposition of matrix variances and subadditivities of certain entropies

Abstract: In this talk we discuss some loosely related topics of non-commutative probability theory.

In quantum information theory the traditional variance is defined by

$$[\mathrm{Var}_D(A_1,\dots,A_r)]_{i,j} = \mathrm{Tr}\, DA_iA_j - (\mathrm{Tr}\, DA_i)(\mathrm{Tr} DA_j) \qquad (1 \le i,j \le r),$$

where D is a density matrix and A_j is a self-adjoint operator for all j. This non-commutative variance is a natural extension of the variance in probability theory. The variance functional

$$D \mapsto \mathrm{Var}_D(A_1,\dots,A_r)$$

is concave, hence the question naturally appears: is the variance the concave roof of itself? That is, for a density D do there exist rank-one projections $P_1,\dots,P_m$ such that $D = \sum_{k=1}^m \lambda_k P_k$ and

$$\mathrm{Var}_D(A_1,\dots,A_r) = \sum_{k=1}^m \lambda_k \mathrm{Var}_{P_k}(A_1,\dots,A_r)$$

with some $0 \le \lambda_k,\ \sum_k \lambda_k = 1$? ($A_1,\dots,A_r$ are fixed.) It was shown in 2012 that if r=1, every density D can be decomposed this way, and a similar result appeared in the r=2 case in 2013. In our recent work [1] we characterized those finite sets of self-adjoint operators for which the variance is its own concave roof. This general thoerem immediately shows that for any $r > 2$ we can choose $A_1,\dots,A_r$ such that the decomposition of a density D is not possible in general. On the other hand, it clearly recovers the former results about the $r = 1,2$ cases.

The strong subadditivity of the von Neumnann entropy is a central result in quantum information theory. A one-parameter extension of the von Neumnann entropy is the Tsallis entropy. The strong subadditivity inequality would be

$$S_q(\rho_{123}) + S_q(\rho_2) \le S_q(\rho_{12}) + S_q(\rho_{23}), \tag{9}$$

where ρ_{123} is a state on a finite dimensional Hilbert space $\mathcal{H}_1 \otimes \mathcal{H}_2 \otimes \mathcal{H}_3$, and S_q is the Tsallis entropy. We present a simple and picturescue example that shows that (9) does not hold in general and we derive an inequality of the form

$$S_q(\rho_{123}) + S_q(\rho_2) \le S_q(\rho_{12}) + S_q(\rho_{23}) + f_q(\rho_{123}),$$

where $f_1(\rho_{123}) = 0$ [2]. Such a result can be considered as a generalization of the strong subadditivity of the von Neumnann entropy. We give a sufficient condition for (9), as well.

In the recent paper [3] we prove that the Bregman f-divergence of matrices

$$H_f : \mathbf{M}_n^+ \times \mathbf{M}_n^+ \to \mathbb{R}^+ \cup \{\infty\}; \quad (X,Y) \mapsto H_f(X,Y) := \mathrm{Tr}\,\big(f(X) - f(Y) - f'(Y)(X-Y)\big)$$

is jointly convex if and only if f'' is operator convex and numerically decreasing. As an application of this characterization, we derive a sharp inequality for the quantum Tsallis entropy of a tripartite state, which is closely related to the strong subadditivity.

This talk is based on joint works with Dénes Petz and József Pitrik.

References:

[1] D. Petz and D. Virosztek, A characterization theorem for matrix variances, to appear in Acta Sci. Math. (Szeged) in 2014. Available at **arXiv:1311.3908**

[2] D. Petz and D. Virosztek, Some inequalities for quantum Tsallis entropy related to the strong subadditivity, to appear in Math. Inequal. Appl. in 2014. Available at **arXiv:1403.7062**

[3] J. Pitrik and D. Virosztek, On the joint convexity of the Bregman divergence of matrices, available at **arXiv:1405.7885**

57. **Wilhelm von Waldenfels (Heidelberg)**

Measure theoretic formulation of quantum white noise

Abstract: We present a method of treating quantum stochastic processes by classical analysis.Following the ideas of quantum field theory we formulate quantum stochastic processes as normal ordered power series in annihilation and creation operators. More explicitly, the products of these operators form measures on a high dimensional space. The process is given by a sum of integrals over the measures. Any of the common quantum stochastic differential equations with constant coefficients can be solved that way. The coefficients have remarkable simple analytical properties. Exploiting these properties one can prove Ito's formula and many other theorems. We shall exemplify these ideas by a simple quantum stochastic differential equation, whose solution is not unitary but belongs to the group $U(1, infinity)$.

58. **Jiun-Chau Wang (University of Saskatchewan)**

Superconvergence to freely infinitely divisible laws

Abstract: We report on the recent progress of the superconvergence results relative to free additive and multiplicative convolutions. This is a joint work with Ping Zhong, Michael Anshelevich, and Hari Bercovici.

59. **Piotr Warchoł (Jagiellonian University, Kraków)**

Dysonian dynamics of the Ginibre ensemble

Abstract: We study the time evolution of Ginibre matrices whose elements undergo Brownian motion. The non-Hermitian character of the Ginibre ensemble binds the dynamics of eigenvalues to the evolution of eigenvectors in a non-trivial way, leading to a system of coupled nonlinear equations resembling those for turbulent systems. We formulate a mathematical framework allowing simultaneous description of the flow of eigenvalues and eigenvectors, and we unravel a hidden dynamics as a function of new complex variable, which in the standard description is treated as a regulator only. We solve the evolution equations for large matrices and demonstrate that the non-analytic behavior of the Green's functions is associated with a shock wave stemming from a Burgers-like equation describing correlations of eigenvectors. As an example we show the calculation for the simplest initial condition.

60. **Mateusz Wasilewski (Warsaw University)**

Amalgamated direct sums of operator spaces

Abstract: Theory of operator spaces may be thought of as a 'quantized' version of the theory of Banach spaces. In this talk we will consider amalgamated direct sums of operator spaces (and their dual counterparts – fibered products) and discuss their behaviour with respect to minimal and maximal quantisations. In particular, using results of Kalton and Pełczyński, we present the first example of two minimal operator spaces (in fact, commutative von Neumann algebras) such that their amalgamated sum over common subspace (spanned by Steinhaus random variables) is not itself minimal; this answers the question asked by Vern Paulsen (based on my master's thesis, written under supervision of Piotr Sołtan).

61. **Rafał Wieczorek (University of Łódź)**

Poster – Qubit state discrimination

Abstract: Let $\rho_1, \rho_2, \dots, \rho_n$ be a quantum states on a $\mathbb{C}^d$ with *a priori* probability $\pi_1, \pi_2, \dots, \pi_n$. We want to find a positive operator valued measure $M = (M_1, M_2, \dots, M_n)$ which maximizes the mutual information

$$\mathbb{P}_D(M) = \sum_i \pi_i \operatorname{tr}(\rho_i M_i).$$

For two states it's simple. For arbitrary number of states it's more complicated. We show how to find optimal POVM for arbitrary number of states on a $\mathbb{C}^2$.

62. **Łukasz Wojakowski (University of Wrocław)**

Poster – TBA

Abstract:

63. **Michał Wojtylak (Jagiellonian University, Kraków)**

On the Weyl function for operators, linear pencils and structured random matrices

Abstract: The function

$$Q(\lambda) = \langle R(\lambda)e, e\rangle,$$

where $R(\lambda)$ denotes the resolvent and e is a fixed vector, is well known in the literature under many names. It is a powerful tool in the analysis of spectra, especially in studying rank one perturbations. We will consider the following instances:

(i) A is an H-selfadjoint operator, i.e, HA is selfadjoint in a Hilbert space, $R(\lambda) = (A - \lambda I)^{-1}$,
(ii) A is a large H-selfadjoint random matrix, $R(\lambda) = (A - \lambda I)^{-1}$,
(iii) $A + \lambda E$ is a linear pencil, with A, E being Hermitian matrices, $R(\lambda) = (A - \lambda E)^{-1}$.

In all three cases the Weyl function allows to derive results on spectral properties of the underlying objects, like localization of the spectrum (i,ii) and distance to a singular pencil (iii).

The talk is based on joint projects with Henk de Snoo and Henrik Winkler (i), Patryk Pagacz (ii), and with Christian Mehl and Volker Mehrmann (iii).

64. **Stanisław Lech Woronowicz (University of Warsaw)**

Monoidal categories of C^*-algebras

Abstract: We consider the category of C^*-algebras equipped with actions of a locally compact quantum group. We show that this category admits a monoidal structure satisfying certain natural conditions if and only if the group is quasitriangular. The monoidal structures are in bijective correspondence with unitary R-matrices.

65. **Anna Wysoczańska-Kula (University of Wrocław)**

Lévy processes on compact quantum groups

Abstract:

66. **Janusz Wysoczański (University of Wrocław)**

Generalisation of anyon statistics

Abstract:

67. **Zhi Yin (University of Gdańsk)**

Operator space approach to steering inequality - joint work with M. Horodecki and M. Marciniak.

Abstract: In this paper, we use operator space theory to study the steering scenario. We obtain a bipartite steering inequality $F = \{F_x^a \in \mathbb{M}_n, x, a = 1, \ldots, n\}$ with unbounded largest violation of order $\sqrt{\frac{n}{\log n}}$. We can also construct all ingredients explicitly. Moreover, we study the role of maximally and partially entangled state play in the violation of steering inequality. Finally, we focus on the bipartite dichotomic case, we can always find a steering inequality with unbounded largest violation. This is different to the Bell scenario. Since by any bipartite dichotomic Bell inequality, only bounded largest violation can be obtained.

68. **Joachim Zacharias (University of Glasgow)**

Construction of spectral triples and quantum metric spaces

Abstract: Spectral triples are a fundamental concept in Noncommutative Geometry with wide ranging applications in Mathematics and Physics. They can be regarded as non commutative analogues of elliptic operators. Despite many examples which have been constructed and studied in the literature most on them seem somewhat ad hoc and there seem to exist only few systematic tools to construct spectral triples on given C*-algebras or classes of C*-algebras. We will present some methods to construct spectral triples with various regularity properties starting from given ones, e.g. on extensions and crossed products and some new examples of spectral triples on quantum groups for quantum groups with property RD.

69. **Karol Życzkowski (Jagiellonian University, Kraków)**

On multiplicative free square root of the Marchenko-Pastur distribution (joint work with Wojciech Mlotkowski, Maciej Nowak and Karol Penson)

Abstract: Let G denote a square complex Ginibre matrix of size N. In the asymptotic limit $N \to \infty$ the level density of the random Wishart matrices $W = GG^*$ is described by the Marchenko-Pastur distribution, MP. Analogous distribution for a product of s independent random Ginibre matrices, called as Fuss-Catalan distribution of an integer order s, is given by the multiplicative power, $FC_s = MP^{\boxtimes s}$.

Making use of the Cauchy transform we we derive explicit cognate probability distributions related to Marchenko-Pastur, e.g. the multiplicative free power $MP^{\boxtimes s}$ with a real exponent s and free convolutions of MP and arcsine distributions. For this generalized Bures distribution we construct a corresponding ensemble of random matrices.

References:

[1] W. Młotkowski, K. A. Penson and K. Życzkowski, Densities of the Raney distributions, Documenta Math. 18 (2013) 1573–1596

[2] U. Haagerup and S. Möller, The law of large numbers for the free multiplicative convolution, preprint arXiv:1211.4457

[3] W. Młotkowski, M. A.Nowak, K. Penson, K. Życzkowski, Spectral density of generalized Wishart matrices and free multiplicative convolution, preprint 2014