Titles and abstracts

To be updated

1. Name: Javier Alvarez Jimenez
   Affiliation: UNAM, Mexico
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   Title: The quantum geometric tensor from generating functions

   Abstract: We introduce a new method to compute the Quantum Geometric Tensor, this procedure allow us to compute the Quantum Information Metric and the Berry curvature perturbatively for a theory with an arbitrary interaction Hamiltonian. The calculation uses the generating function method, and it is illustrated with the harmonic oscillator with a linear and a quartic perturbation.

2. Name: Adam Rutkowski
   Affiliation: University of Gdańsk, Poland
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   Title: Necessary and sufficient condition of separability for D-symmetric diagonal states

   Abstract: For multipartite states, we consider a notion of D symmetry. For a system of N qubits, it coincides with the usual permutational symmetry. In the case of N qudits \((d \geq 3)\), the D symmetry is stronger than the permutational one. For the space of all D-symmetric vectors in \((C_d)^{\otimes N}\), we define a basis composed of vectors which are analogues of Dicke states. The aim of this paper is to discuss the problem of separability of D-symmetric states which are diagonal in this basis. We show that if N is even and \(d \geq 2\) is arbitrary then a positive partial transposition property is a necessary and sufficient condition of separability for D-invariant diagonal states. In this way, we generalize results obtained by Yu [Phys. Rev. A 94, 060101 (R)(2016)] and Wolfe and Yelin [Phys. Rev. Lett. 112, 140402 (2014)]. Our strategy is to use some classical mathematical results on a moment problem.

3. Name: Daniel Gutierrez-Ruiz
   Affiliation: National Autonomous University of Mexico
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   Title: Classical analog of the quantum metric tensor

   Abstract: We consider the problem of obtaining a classical analog of the
quantum metric tensor. After presenting the quantum results, we introduce another point of view where distance between quantum states can be measured by means of an operator that generates translations in parameter space. This will provide a natural generalization of Berry’s connection, the curvature and the metric to the realm of classical mechanics which we will justify using the semiclassical approximation. In addition to this, it is shown through some examples that both the quantum and classical metric tensors possess a similar structure, differing only by a quantization rule.

4. Name: Hui-Hsiung Kuo  
Affiliation: Louisiana State University  
E-mail: kuomath.lsu.edu  
Title: The Ito formula and near-martingale property for adapted and instantly independent stochastic processes  
Abstract: A stochastic integral for adapted and instantly independent stochastic processes was introduced by Ayed and Kuo in 2008. This new stochastic integral, being inspired by K. Ito in his lecture at the 1976 Kyoto Symposium on Stochastic Differential Equations, provides an extension of the Ito integral to include integrands which can be anticipating. We obtain an extension of the Ito formula to this new stochastic integral. We explain an observation leading to the concept of near-martingale property, which is an extension of the martingale property for the Ito integral. Then we extend the Doob-Meyer decomposition theorem to near-submartingales. The concept of near-martingales is used to study exponential processes and to obtain an extension of the Girsanov theorem. Finally we study linear stochastic differential equations with certain anticipating initial conditions.

5. Name: Pradip Kumar Das  
Affiliation: Indian Statistical Institute, Baranagar, India  
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Title: Advances In Interacting Fock Space  
Abstract: I shall be presenting on the recent advances on one mode interacting Fock space.

6. Name: Noboru Watanabe  
Affiliation: Tokyo University of Science, Japan  
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Title: On Complexity of Communication Processes  
Abstract: The quantum entropy was introduced by von Neumann around
1932, which describes the amount of information of the quantum state itself. It was extended by Ohya for $C^*$-systems before CNT entropy. The quantum relative entropy was first defined by Umegaki for $\sigma$-finite von Neumann algebras, which was extended by Araki and Uhlmann for general von Neumann algebras and $*$-algebras, respectively. By introducing a new notion, the so-called compound state, in 1983 Ohya succeeded to formulate the mutual entropy in a complete quantum mechanical system (i.e., input state, output state and channel are all quantum mechanical) describing the amount of information correctly transmitted through the quantum channel. In this talk, we briefly review the Ohya’s S mixing entropy and the quantum mutual entropy for general quantum systems. Based on a concept of structure equivalent, we apply the general frames of quantum communication to the Gaussian communication processes.

7. Name: George Androulakis
   Affiliation: University of South Carolina
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   Title: The role of entropy in quantum communications

   Abstract: We will review the properties of quantum entropy and indicate its uses in quantum communications.

8. Name: Duncan Wright
   Affiliation: University of South Carolina
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   Title: Optimality in Quantum Data Compression using Dynamical Entropy

   Abstract: The notion of lossless compression of strings of pure quantum states of indeterminate-length quantum codes was first introduced by Schumacher and Westmoreland in 2001. Past work has assumed that the strings of quantum data are prepared to be encoded in an independent and identically distributed way. We introduce the notion of quantum stochastic ensembles, allowing us to consider strings of quantum states prepared in a more general way. For any identically distributed (but not necessarily independently distributed) quantum stochastic ensemble we define an associated quantum Markov chain and show that the optimal average codeword length per symbol is equal to the quantum dynamical entropy of the associated quantum Markov chain.

9. Name: Parisa Fatheddin
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   Title: Asymptotic Limits for some Fluid Models
Abstract: We consider the stochastic Boussinesq and Navier-Stokes equations in two dimensions in the incompressible case. Unlike most previous results on Boussinesq equations, we do not include a diffusion term in the temperature equation and establish the global existence and uniqueness of solutions in the case of additive noise and then achieve the large deviations by the weak convergence approach. As for stochastic Navier-Stokes equations, we prove the large deviations by the classical Azencott method and as a consequence derive the Strassen’s compact law of the iterated logarithm. The results presented are from joint work with Zhaoyang Qui and Dedua Wang.

10. Name: Santanu Dey
Affiliation: IIT Bombay, India
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Title: The order-$n$ minors of certain $(nk) \times n$ matrices

Abstract: We determine sufficient conditions for certain classes of $(nk) \times n$ matrices $E$ to have all order-$n$ minors to be nonzero. For a special class of $(n1) \times n$ matrices $E$, we give the formula for the order-$n$ minors. As an application we construct subspaces of $\mathbb{C}^m \otimes \mathbb{C}^n$ of maximal dimension, which does not contain any vector of Schmidt rank less than $k$ and which has a basis of Schmidt rank $k$ for $k = 2, 3, 4$.

11. Name: Artem Pulemotov
Affiliation: The University of Queensland, Australia
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Title: The Ricci Iteration on Homogeneous Spheres

Abstract: The Ricci iteration is a discrete analogue of the Ricci flow. Introduced in 2007, it has been studied extensively as a new approach to uniformisation. In this talk, we will discuss the Ricci iteration on spheres that are equipped with transitive Lie group actions. Joint work with Timothy Buttsworth (Queensland), Yanir Rubinstein (Maryland) and Wolfgang Ziller (Pennsylvania).

12. Name: Alexander Wiedemann
Affiliation: University of South Carolina
E-mail: akw@email.sc.edu
Title: The Extended Generator of a Quantum Markov Semigroup

Abstract: Let $\mathcal{B}(\mathcal{H})$ denote the von Neumann algebra of all bounded linear operators on a Hilbert space $\mathcal{H}$. We prove that every semigroup of Schwarz maps on $\mathcal{B}(\mathcal{H})$ which has a subinvariant faithful normal state induces an
associated semigroup of contractions on the space of Hilbert-Schmidt operators of the \( \mathcal{H} \). We introduce the notion of the extended generator of a semigroup on \( B(\mathcal{H}) \) with respect to an orthonormal basis of the \( \mathcal{H} \). We relate the domains and actions of the generator, extended generator, and of the associated semigroup. We describe the form of the (possibly unbounded) extended generator of a quantum Markov semigroup under the assumption that the semigroup possesses an invariant faithful normal state and that the generator of the associated semigroup has compact resolvent.

13. Name: Hyun Jae Yoo  
Affiliation: Hankyong National University, South Korea  
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Title: Quantum walks and the associated quantum Markov chains  
Abstract: We discuss some of the dynamical properties of the quantum walks, both the unitary and the open quantum walks, by constructing the associated quantum Markov chains. We start with a brief definition of the quantum walks. Then we construct the associated quantum Markov chains (QMCs). The QMC is a convenient tool for the investigation of the dynamical properties such as reducibility/irreducibility, recurrence/transience. In addition to providing with some examples, we also compare with the classical results. In the meanwhile, we will also see the difference between the unitary quantum walks and the open quantum walks.

14. Name: Kalyan Sinha  
Affiliation: J.N. Center for Advanced Scientific Research, Jakkur, India  
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Title: Martingales in Quantum Probability II  
Abstract: Starting with a holomorphic semigroup \( P_t \) in a Hilbert space \( H \), and the formal Lindblad condition, a canonical contraction-valued cocycle \( V_t \) is constructed (cocycle with CCR-or Brownian shift) in \( Hx \) Fock space over \( L^2(\mathbb{R}_+) \) such that \( P_t \) is the (vacuum-) expectation semigroup. If \( V_t \) is furthermore isometric, then it induces a *-homomorphic flow-cocycle \( j_t \) on \( B(\mathcal{H}) \). It is shown that the cocycle property (i) for \( V_t \) in \( H \), and (ii) for \( j_t \) on \( B(\mathcal{H}) \) are equivalent to the quantum martingale property.

15. Name: Mahouton Norbert Hounkonnou  
Affiliation: University of Abomey-Calavi, Benin Republic  
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Title: \( R(p,q) \)- quantum analogs of discrete distributions: general formalism and application
Abstract: In this paper, we investigate and discuss an $R(p,q)$-deformation of basic univariate discrete distributions of the probability theory. We mainly focus on uniform, binomial, logarithmic, Euler, Polya, hypergeometric, and contagious distributions. We discuss relevant $R(p,q)$-deformed factorial moments and factorial moments of a random variable, and derive associated mean value and variance. Furthermore, we establish a recursion relation for the probability distributions, and apply the presented formalism to the well known generalized $q$-Quesne quantum algebra to deduce related distributions, as a case of study.

16. Name: Alexander Belton
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Title: To be confirmed
Abstract: To be confirmed

17. Name: Daniel Markiewicz
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Title: An $E_0$-semigroup arising from boundary weight maps
Abstract: An $E_0$-semigroup of $B(H)$ is a one parameter strongly continuous semigroup of $\star$-endomorphisms of $B(H)$ that preserve the identity. The classification of $E_0$-semigroups up to cocycle conjugacy remains an intriguing problem. In this talk we will discuss it in a slightly different guise: the search for a rich class where classification is possible. Every $E_0$-semigroup that possesses a strongly continuous intertwining semigroup of isometries is cocycle conjugate to an $E_0$-semigroup obtained by the Bhat dilation of a $CP$-flow over a separable Hilbert space $K$. And Robert T. Powers showed how to construct $CP$-flows from boundary weight maps over $K$. In this talk we show how to construct and classify all $E_0$-semigroups (up to cocycle conjugacy) arising from boundary weight maps over finite-dimensional spaces that are $q$-pure in the following sense. We say an $E_0$-semigroup $\alpha$ is $q$-pure if the $CP$-subordinates $\beta$ of norm one (i.e. $\| \beta_t(I) \| = 1$ and $\alpha_t - \beta_t$ is completely positive for all $t \geq 0$) are totally ordered in the sense that if $\beta$ and $\gamma$ are two $CP$-subordinates of $\alpha$ of norm one, then $\beta \geq \gamma$ or $\gamma \geq \beta$.

18. Name: Nobuhiro Asai
Affiliation: Aichi University of Education, Japan
Title: Global Existence of $RDE$s on Manifolds

Abstract: In this talk we will discuss a theorem guaranteeing the existence of global (in time) solutions to rough path differential equations ($RDE$s) on a smooth manifold. These results will depend on quantitative estimates of the quality of the truncated Baker-Cambel-Hausdorff-Dynkin formula for vector fields on the manifold.

Title: On the error bound in the normal approximation for Jack measures

Abstract: The one-parameter family of Jack$_\alpha$ measures on partitions of $n$ is an important discrete analog of Dyson’s $\beta$ ensembles of random matrix theory. In the case $\alpha = 1$, the Jack measure agrees with the Plancherel measure on the irreducible representations of the symmetric group $S_n$, parametrized by the partitions of $n$. The normal approximation for the character ratio evaluated at the transposition $(12)$ under the Plancherel measure has been well studied, notably by Fulman (2005, 2006) and Shao and Su (2006). A generalization of the character ratio under the Jack$_\alpha$ measure has also been studied by Fulman (2004, 2006) and Fulman and Goldstein (2011). In this talk, we present results on both uniform and non-uniform error bounds on the normal approximation for the Jack$_\alpha$ measure for $\alpha > 0$. Our results improve those in the literature and come very close to solving a conjecture of Fulman (2004). Our proofs use Stein’s method and zero-bias coupling. This talk is based on joint work with Le Van Thanh.

Title: Some asymptotic applications of integrals over hyperfinite dimensional spheres
Abstract: Beginning with a review of basic nonstandard analysis, the limiting behavior of surface integrals over high-dimensional spheres will be interpreted as Loeb integrals over an "infinite-dimensional sphere." This interpretation will lead to natural proofs of some results on Gaussian Radon transforms of finite dimensional functions over affine subspaces of $\ell^2(\mathbb{R})$. These results are similar in spirit to recent works of Peterson and Sengupta on high-dimensional spherical means, and extend their work in some cases.

22. Name: Luigi Accardi
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Title: Extensions of quantum mechanics canonically emerging from the theory of orthogonal polynomials.

Abstract: The algebraic approach to the theory of orthogonal polynomials shows that every classical $V$-valued random variable with all moments ($V$ is a real vector space) has a canonical quantum decomposition in terms of generalized creation, annihilation and preservation (CAP) operators which satisfy generalized commutation relations (GCR). These GCR characterize the given random variable in the sense of moments. The Heisenberg commutation relations characterize the Gaussian class which is included in the larger class of measures "linearly equivalent" to product measures. The latter class is characterized by the property that CAP operators associated to different degrees of freedom commute. For this class the theory of multi-dimensional orthogonal polynomials is essentially reduced to the tensor product of 1-dimensional cases. For truly interacting classes (i.e. with non-trivial correlations among the components of the random variable) new commutations relations (called type II commutation relations) arise from the commutativity of the multiplication operators associated to different components of the random variable. These new commutation relations are identically satisfied in the class of product measures. It is not easy to prove that a given probability measure is not "linearly equivalent" to a product measure. Recently this result has been obtained for the vacuum distributions of the Virasoro fields. Thus the new approach produces extensions of usual quantum mechanics when $V$ is finite dimensional and of quantum field theory when $V$ is infinite dimensional.

The theory is very young but it has already produced new non-trivial examples of infinite dimensional Lie algebras and of their representations, a unified approach to the various "deformations" of the CCR, as well as many new examples, with the associated $C^*$- and $W^*$- algebras, an index of information complexity for probability measures, new examples of quantum and classical Markov semi-groups (the generalized Ornstein-Uhlenbeck semi-groups), . . .
But what has been understood is a tiny fraction of the problems posed by this generalized quantization program. The functorial properties of the generalized Fock functor raise subtle problems some of which are open even in the quadratic case (which at the moment is the best understood among all the new examples). Extensions of the Bogolyubov transformations to the new framework begin to appear (again in the quadratic case) and show the emergence of quite interesting new structures. The structure of the generators of the generalized Ornstein-Uhlenbeck semi-groups is poorly understood, in particular the problem to determine which of them admit integral kernels is open and its solution will require a deep interaction with the theory of classical multi-dimensional orthogonal polynomials and with harmonic analysis. The quadratic extension of the Weyl relations and the corresponding “quadratic Heisenberg group, is fully understood only in the 1-dimensional case, . . . But, even within this multiplicity of open problems, one message clearly emerges from these new developments namely that a future truly interacting (non-Gaussian) quantum field theory cannot be based on Heisenberg commutation relations.

23. Name: Radhakrishnan Balu
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   Title: Covariant Quantum Fields via Lorentz Group Representation of Weyl Operators

   Abstract: The building blocks of Hudson-Parthasarathy quantum stochastic calculus start with Weyl operators on a symmetric Fock space. We build representations of Poincaré group in terms of Weyl operators on suitably constructed Boson Fock spaces. We proceed by describing the orbits of homogeneous Lorentz group on R4 and build fiber bundle representations of Poincaré group induced from the stabilizer subgroups (little groups) and build the boson Fock space of the Hilbert space formed of the sections of the bundle. Our Weyl operators are constructed on this space and the corresponding annihilation and creation operators are synthesized in the usual fashion in relativistic theories for space-like, time-like, and light-like fields. Subsequently, we construct systems of imprimitivity (second-quantized SI) by induced representations, from cocycles, and from the basic definition. We indicate the ways to construct adapted processes paving way for building covariant quantum stochastic calculus.

24. Name: Nelia Charalambous
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   Title: The Yang-Mills heat equation on compact manifolds with boundary

   Abstract: The gauge theoretic format with a nonabelian bundle was first
introduced by Mills and Yang in 1954 to model the strong and weak interactions in the nucleus of a particle. The Yang-Mills heat equation is the gradient flow corresponding to the Yang-Mills functional in this setting. It is a nonlinear weakly parabolic equation whose solutions can blow-up in finite time depending on the dimension. We will consider this equation over compact three-manifolds with boundary, and illustrate its existence and uniqueness properties as well as regularity results for its solutions. We will also present some more recent progress on the properties of the space of solutions. This is joint work with Leonard Gross.

25. Name: Emanuela Sasso
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   Title: Covariant uniformly continuous quantum Markov semigroups

   Abstract: We analyzed the structure of decoherence free-subalgebra $N(T)$ of a uniformly continuous covariant semigroup with respect to a representation of a compact group $G$ on $h$. In particular, we obtained that, when the representation is irreducible, $N(T)$ is isomorphic to a $d$-direct product of a I type factor, where the integer $d$ is related to the connected components of $G$. We extended this result when the representation is reducible and $N(T)$ is atomic by the decomposition of $h$ due to the Peter-Weyl. Finally we tried to remove the hypothesis of atomicity of the decoherence free-subalgebra by using the integral decomposition of $B(h)$, induced by $N(T)$. It is a joint work with Nicolò Ginatta and Veronica Umanità.

26. Name: Brian Hall
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   Title: Eigenvalues for Brownian motion in the general linear group

   Abstract: Following a suggestion of Len Gross, I introduced in 1994 a generalized Segal-Bargmann transform for compact Lie groups. This transform was then given a probabilistic interpretation by Gross and Malliavin in 1996. In 1997, Biane then introduced a “free” version of the Gross-Malliavin result. In this paper, Biane introduced a family of domains in the complex plane, labeled by a time-parameter $t$. The domains exhibit a transition from simply connected to doubly connected at $t = 4$.

   In my talk, I will describe a joint work with Driver and Kemp in which we show that eigenvalues for Brownian motion in the general linear group cluster into Biane’s domain for large $N$. We also determine the limiting distribution of the eigenvalues. The talk will be self-contained and have lots of pictures.

27. Name: Ching Wei Ho
Affiliation: Indiana University Bloomington
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Title: A Local Limit Theorem for Polynomials in Two Asymptotically Free Matrices

Abstract: Given two freely independent self-adjoint operators $x, y$ in a $W^*$-probability space $(A, \tau)$, it is known that there are two subordination functions $\omega_1, \omega_2$ which are unique analytic self-maps on the upper half plane $\mathbb{C}^+$ such that

$$\tau((\omega_1(z) - x)^{-1}) = \tau((\omega_2(z) - y)^{-1}) = (\omega_1(z) + \omega_2(z) - z)^{-1} = \tau((z - x - y)^{-1})$$

for all $z \in \mathbb{C}^+$ in the upper half plane. The subordination relation can be extended to the matricial case in the framework of operator-valued free probability. Consider two sequences of asymptotically free self-adjoint random matrices $A_n, B_n$ with limiting distributions $A, B$ and some technical conditions, and a noncommutative polynomial $P$. Using linearization technique, there are three deterministic matrices $\gamma_0, \gamma_1, \gamma_2 \in M_m(\mathbb{C})$ such that the linear polynomial with matrix coefficients

$$L = \gamma_0 \otimes 1 + \gamma_1 \otimes A + \gamma_2 \otimes B$$

satisfies $z - P(A, B)$ is invertible if and only if $z e_{1,1} - L$ is invertible. The two operators $\gamma_1 \otimes A$ and $\gamma_2 \otimes B$ in $M_m(A)$ are freely independent over $M_m(\mathbb{C})$. If the subordination functions between $\gamma_1 \otimes A$ and $\gamma_2 \otimes B$ satisfy certain regularity assumptions, we prove a local limit theorem for polynomials, which says that for all $x \in \mathbb{R}$ in the bulk of the law of $P(A, B)$,

$$\lim_{n \to \infty} \frac{N_n(x)}{nl_n} = \rho(x)$$

where $\rho(x)$ is the density of the distribution of $P(A, B)$ at $x$, $N_n(x)$ is the number of eigenvalues of $P(A_n, B_n)$ in the interval centered at $x$ with length $l_n$ which tends to zero at a certain rate.

28. Name: Irina Holmes
Affiliation: Texas A&M University
E-mail: irinaholmesmath.tamu.edu

Title: The Gaussian Radon Transform on Infinite-Dimensional Banach Spaces

Abstract: This talk overviews the Ph.D. thesis of the speaker, which constructs a Radon transform on infinite-dimensional Banach spaces using the foundational framework of abstract Wiener spaces, developed by L. Gross. The classical Radon transform can be thought of as a way to obtain the density of an $n$-dimensional object from its $(n-1)$-dimensional sections in different directions. A generalization of this transform to infinite-dimensional spaces has the potential to allow one to obtain a function
defined on an infinite-dimensional space from its conditional expectations. As an application, we discuss briefly potential applications to machine learning theory.

29. Name: Ping Zhong
   University of Wyoming
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   Title: Some free probability aspects of meandric systems

   Abstract: The talk will consider a family of diagrammatic objects which go under the names of meandric systems or semi-meandric systems. I will review some connections which these objects are known to have with free probability. Inspired by the recent development of free probability for pairs of faces, I will show in particular how the so-called semi-meandric polynomials can be retrieved by the moment series of a natural consideration of operators on the $q$-Fock space. This is joint work with Alexandru Nica.

30. Name: Malte Gerhold
    Affiliations: Technion Israel Institute of Technology and University of Greifswald
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    Title: Dilations of $q$-commuting unitaries

    Abstract: Let $(u,v)$ be a pair of unitary operators on a Hilbert space $H$ such that $vu = quv$ for $q \in \mathbb{T}$ a complex of modulus 1. For $q' \in \mathbb{T}$, we determine the smallest constant $c > 0$ for which there exists a pair of $q'$ commuting unitaries $(U,V)$ on a larger Hilbert space $K$ containing $H$ such that $(u,v)$ is the compression of $(cU,cV)$ to $H$.

    It turns out that these constants are closely related to the norm of almost Mathieu operators and that the developed techniques can be used to give new and simplified proofs of known results on continuity of the spectra of almost Mathieu operators and of the field of rotation $C^*$-algebras based on the representation of $q$-commutation relation by Weyl unitaries on symmetric Fock space.

    Joint work with Orr Shalit.

31. Name: Roberto Quezada Batalla
    Affiliation: UAM-Iztapalapa, Mexico City
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    Title: Dynamics of quantum states induced by transition operators

    Abstract: We will discuss the dynamics of states of an open quantum
system with a generator defined in terms of operators performing transitions between two mutually orthogonal subspaces, similar to birth and death transitions in classical stochastic processes or creation and annihilation operators in the quantum setting. It turns out that any stationary state is a mixture of a portion supported on the first subspace and the remaining supported on the orthogonal. Some other notions related with the dynamics such as decoherence free sub-algebra, sub-harmonic projections and fast recurrent subspace will be discussed.