KBS Fest

December 12-14, 2019
Titles and Abstracts

Luigi Accardi. University of Rome Tor Vergata, Italy.
Title: *First and second order Bogolyubov transformations for Bosons.*
Abstract: There are two types of Bogolyubov transformations for Bosons. The original one ,dealt with by Bogolyubov, acts on a tensor product space and another one acting on a single space. Both lead to a non-commutative extension of the trigonometric functions, but they are different because in the latter case an additional condition arises in the structure theorem.
The generators of (semi-)groups of these transformations are characterized.
A quadratic extension of transformations of the former type is at the moment not available.
We characterize quadratic extensions of transformations of tensor product type.

Indranil Biswas. TIFR Mumbai, India.
Title: *A characterization of finite vector bundles on compact complex manifolds*
Abstract: A vector bundle E on a projective variety X is called finite if it satisfies a nontrivial polynomial equation with integral coefficients. A theorem of Nori says that E is finite if and only if the pullback of E to some finite etale Galois covering of X is trivial. We prove the same statement when X is a compact complex manifold.

Arup Chattopadhyay. IIT Guwahati, India.
Title: *Koplienko–Neidhardt trace formulae.*
Abstract: Koplienko (Sibirsk. Mat. Zh. 25(5) (1984) 62) found a trace formula for perturbations of self-adjoint operators by operators of Hilbert Schmidt class which is an extension of Krein's formula on the trace of the difference of suitable functions of a self-adjoint operator and of its trace-class perturbation to the next order for the bounded case. A similar formula in

the case of unitary operators was obtained by Neidhardt (Math. Nachr. 138 (1988) 7). Here a new proof, using a finite-dimensional approximation of the given operators are discussed in case of unitary. This is a ongoing work with Soma Das and Chandan Pradhan.

Franco Fagnola. Politecnico di Milano, Italy.
Title: *Structure of generators of quantum Markov semigroups: symmetry and detailed balance.*
Abstract: A quantum Markov semigroup $\mathcal{T}$ on $\mathcal{B}(\mathsf{h})$ with a faithful normal invariant state ρ admits a dual $\widetilde{\mathcal{T}}$ satisfying $\mathrm{tr}(\rho^s x\rho^{1-s}\mathcal{T}_t(y)) = \mathrm{tr}(\rho^s\widetilde{\mathcal{T}}_t(x)\rho^{1-s}y)$ $(0 \leq s \leq 1)$ for all $x, y \in \mathcal{B}(\mathsf{h})$. In this talk we discuss the characterisation of the GKSL generators $\mathcal{L}(x) = G^*x + \sum_\ell L_\ell^* x L_\ell + xG$ of norm continuous quantum Markov semigroups that are symmetric (i.e. $\mathcal{T} = \widetilde{\mathcal{T}}$) or satisfy a quantum detailed balance condition.

In the most important case when $s = 1/2$, we show that symmetry and detailed balance conditions are essentially equivalent to intertwining relationships between the operators $L_\ell\rho^{1/2}$ and $G\rho^{1/2}$ and their adjoints. We also discuss entropy production as an intrinsic index to measure deviation form detailed balance.

This talk is based on joint works with V. Umanità and R. Rebolledo.

Uwe Franz. University of Franche-Comte, France.
Title: *What is Brownian motion of a noncommutative manifold?.*
Abstract: Quantum probabilists and noncommutative geometers have proposed various definitions and constructions of quantum stochastic processes that can be viewed as natural generalizations of Brownian motion. In my talk I will review a few of the approaches that have been studied in the past. Then I will give a review of recent results on the classification of generating functionals, Lévy processes, and invariant Markov semigroups on compact quantum groups and on their homogeneous space. Finally, I shall discuss the question whether these processes can be considered as Brownian motions.

Debashish Goswami. ISI Kolkata, India.
Title: *Quantum isometry groups of the odd dimensional quantum spheres.*
Abstract: We will briefly exlain the notion of quantum isometry groups and then compute it for the odd dimensional quantum spheres. We approach

the problem both from analytic and algenraic perspectnives (joint work with Suvtajit Bhattacharjee).

Peter D. Hislop. University of Kentucky, USA.
Title: *Some recent results on eigenvalue statistics for random Schrödinger operators.*
Abstract: This review talk will cover some recent results concerning local eigenvalue statistics (LES) for random Schrödinger operators by the presenter and others. Random Schrödinger operators in three or more dimensions are expected to exhibit a localization-delocalization transition for weak disorder at some energy. It is anticipated that the LES in the localized phase is Poissonian whereas in the delocalized phase the LES is similar those of the Gaussian orthogonal ensemble in random matrix theory. Two simple models for which a transition has been proved to exist, the random band matrix model and the scaled disorder model, will be discussed.

Un Cig Ji. Chungbuk National University, South Korea.
Title: *White Noise Delta Functions and Quantum White Noise Delta Operators.*
Abstract: Motivated by the Donsker's delta function of a one dimensional Brownian motion, we first introduce a new white noise delta function based on the Kubo-Yokoi delta function and an infinite dimensional Brownian motion.

Then we discuss a white noise differential equation induced by the white noise delta function through the Itô formula introducing a differential operator directed by the time derivative of the infinite dimensional Brownian motion and an extension of the Voterra-Gross Laplacian.

Secondly, as a natural quantum extension of the white noise delta function, we introduce a new notion of quantum white noise delta operator and discuss a quantum white noise differential equations induced by the quantum white noise delta operator. The first part of this talk is based on a joint work with L. Accardi, A. Hasegawa and K. Saito, and the second part of this talk is based on a joint work with L. Accardi and K. Saito.

Apoorva Khare. IISc, India.
Title: *Moments in the history of positivity.*

Abstract: We present a "sequence of moments" in the work of Schoenberg: from his metric space embeddings into Euclidean space and into spheres (Ann. of Math. 1935), to his characterization of entrywise positivity preservers (Duke Math. J. 1942). This last is followed by strengthenings by Rudin (Duke Math. J. 1959) and in joint work (2016), the latter involving the "sequence of moments" of measures on the real line. The proof uses strengthenings of results by Loewner/Horn (Trans. AMS 1969) and H.L. Vasudeva (IJPAM 1977). If time permits, I will mention a novel characterization of weak majorization, using Schur polynomials. (Mostly joint with Alexander Belton, Dominique Guillot, and Mihai Putinar; and partly with Terence Tao.)

Martin Lindsay. Lancaster University, UK.
Title: *Lévy–Khintchine for $SUq(N)$.*
Abstract: Let $\ell^{(1)}, \cdots, \ell^{(n)}$ be Lévy processes on a compact quantum group $\mathbb{G}$. The sum of their generating functionals is the generating functional of another Lévy process ℓ. Moreover, ℓ is expressible as a limit of evolution Trotter-products of the $\ell^{(i)}$'s.

In this talk I shall discuss the possibility of reversing this procedure in the following sense. Given a Lévy process on $\mathbb{G}$, can we express its generating functional γ as a sum of two generating functionals, where the first is 'gaussian' and the second 'wholly non-gaussian'. In short, does γ have a 'Lévy–Khintchine decomposition'? It turns out that, unlike in the classical situation, the answer depends on the quantum group $\mathbb{G}$. The question has a satisfactory (and positive) answer in the case of the following families of compact quantum groups: $SUq(N)$ and $Uq(N)$.

The talk is based on joint work, over a period of several years (begun in Oberwolfach), with Uwe Franz, Anna Kula and Michael Skeide.

Krishna Maddaly. Ashoka University, India.
Title: *Regularity of integrated density of states of Random Schrodinger operators.*
Abstract: In the spectral theory of Random operators, especially the Anderson type models and Random Schrodigner operators, integrated density of states (IDS) is an important quantity that is studied. In this talk, we present the ideas involved in a recent proof of the regularity of the IDS in some of these models.

Gadadhar Misra. IISc, India.
Title: *Berger-Shaw theorem for commuting tuple of operators.*
Abstract: The Berger-Shaw theorem for a single operator states that "a hyponormal operator which is finitely cyclic has a trace-class self commutator". We introduce a notion of a determinant operator associated to block operators and show that it is related to the generalized commutator of a commuting tuple introduced earlier by Helton and Howe. We show that if the determinant operator (or generalized commutator) of a commuting tuple of operators is positive and it is finitely polynomially cyclic, then imposing mild growth conditions, we show that the determinant operator (or generalized commutator) is in trace-class, extending the Berger-Shaw theorem for a single operator.

This talk is based on joint work with K. B. Sinha and P. Pramanick.

K. R. Parthasarathy. ISI Delhi, India.
Title: *A new parametrization of gaussian states and an application.*
Abstract: Using the matrix entries in the continuous basis of exponential vectors in a finite mode boson Fock space a new parametrization of gaussian states is introduced. As an application the particle basis expansion of any mean zero pure gaussian state is obtained. For an arbitrary number of modes a hierarchy of completely entangled gaussian states is exhibited.

This is joint work with Tiju Cherian John.

Barry Simon. Caltech, USA.
Title: *Periodic Jacobi Matrices on Trees.*
Abstract: After summarizing 1D periodic Jacobi matrices, I will define periodic Jacobi matrices on infinite trees. I'll discuss the few known results and some interesting examples and then discuss lots and lots of interesting conjectures. This is joint work mainly with Nir Avni and Jonathan Breuer but also with Jacob Christensen, Gil Kilai and Maxim Zinchenko.

Sivaguru S Sritharan. M. S. Ramaiah University, India.
Title: *Stochastic Navier-Stokes equations and its connection to infinite dimensional analysis.*
Abstract: Stochastic Navier-Stokes equation (SNSE) with Gaussian and more general forcing such as Levy noise has been an object of intense research in

stochastic PDE literature. In this talk we will address one of the aspects of this theory, namely the connection between SNSE and PDEs in infinite dimension such as the infinite dimensional forward and backward Kolmogorov equations, infinite dimensional Hamilton-Jacobi equations, measure-valued evolution equation, etc which arise when we seek to study questions such as statistical solutions, large deviation theory and control theory. Optimal stopping and impulse control lead to variational inequalities and quasi-variational inequalities in infinite dimensions. We will indicate what is known in this context and also point out some interesting open problems.

S. Sunder. IMSc, India.
Title: *On multiparameter CCR flows.*
Abstract: Traditionally, by an E_0-semigroup on $B(H)$, we mean a one parameter semigroup of unital normal $*$-endomorphisms. Mathematically speaking there is no necessity to restrict attention to one parameter only. One could equally study E_0-semigroups indexed by more general semigroups in particular cones.

The simplest example of an E_0-semigroup is the CCR flow. In the multiparameter theory CCR flows exhibit phenomena not shared by its 1 parameter cousin. I will explain one such phenomenon in this talk.

Stephen Wills. University College Cork, Ireland.
Title: *The right Hudson-Parthasarathy Quantum Stochastic Differential Equation.*
Abstract: When studying Hudson-Parthasarathy QSDEs, whose solutions will be operator-valued quantum stochastic cocycles, one has a choice as to whether to put the coefficient on the left or the right of the process. In general the solution will depend nontrivially on this choice. For a bounded coefficient there are standard tools to transform from one version to the other. For an unbounded coefficient the situation is more tricky: the left equation (with the coefficient on the right!) is analytically easier, but it has been argued that the right equation (with coefficient on the left) is the correct equation from a physical point of view. The technical issue one must overcome is to make good sense of certain operator products. I will outline a method that supplies reasonable sufficient conditions to do this, based on results from minimal quantum dynamical semigroups.

Joint work with Franco Fagnola.