NON-COMMUTATIVE ANALYSIS 2017

1. Titles and Abstracts of Talks

- Roland Vergnioux- The radial MASA in free orthogonal quantum groups.

  Abstract- In joint work with Amaury Freslon, we prove that the subalgebra generated by the fundamental character in a free orthogonal quantum group factor is maximal abelian and mixing, and we compute the associated measure class. I will recall the construction of these objects and present the main ideas of the proof by using the analogy with the radial MASA in free group factors.

- Reiji Tomatsu- Title: On the continuous decomposition of an ultraproduct von Neumann algebra.

  Abstract- I will talk about ultraproduct von Neumann algebras and the description of its Takesaki dual.

- Alex Chirvasitu- Non-commutative dynamics and equivariant rigidity

  Abstract- The Borsuk-Ulam theorem is a classical result in algebraic topology that, in one of its many incarnations, asserts the non-existence of continuous maps from larger to smaller spheres sending antipodes to antipodes. It comes in many flavors (e.g. discrete / combinatorial as opposed to continuous) and has many striking applications, such as the celebrated Brouwer fixed point theorem.

  I will discuss versions of the theorem inspired by the desire to extend it and the attendant machinery to the context of non-commutative topology, whereby a topological space is recast as a possibly non-commutative algebra of functions on the otherwise non-existent non-commutative (or quantum) space.

  The generalizations in question apply to the setting of compact groups acting on compact (classical or quantum) topological spaces, and provide insight into an array of seemingly disparate topics such as homotopy types of compact groups and the quantum analogues thereof, to be mentioned if time permits, actions of p-adic groups on certain compact spaces of a fractal nature known as Menger compacta, cohomological invariants of topological joins (e.g. K-theory), and the deformation theory of varieties of representations for discrete groups. (joint w/ Ben Passer)

- Prahlad Vaidyanathan- Dimension functions and the Radius of Comparison for C*-algebras.

  Abstract- We discuss the Cuntz semigroup of a C*-algebra, and its dimension functions. We then discuss the radius of comparison, a non-commutative version of covering dimension. Finally, we show that, for a unital, stably finite C*-algebra with finite radius of comparison, the space of lower semicontinuous dimension functions is dense in the space of all dimension functions. This confirms a conjecture of Blackadar and Handelman for these algebras.

- Luigi Accardi- Extensions of quantum mechanics canonically associated to classical probability.

  Abstract- The main thesis advocated in the present talk is that:
  Quantum probability is not a generalization of classical, but a deeper level of it.

  The main idea is the following.
  It is known that every classical random variable X, with all moments, has a canonical quantum decomposition in terms of the so called CAP operators, that naturally extend the usual quantum mechanical Creation, Annihilation and Preservation operators .

In the 1-dimensional case the commutation relations among the CAP operators are uniquely fixed by the two principal Jacobi sequences canonically associated to X. In the multi-dimensional case, additional commutation relations arise from **the commutativity of coordinates**.
In this sense **non commutativity is deduced from commutativity** and not put by hands.

Probability measures on $\mathbb{R}^d$ are partitioned into classes for a natural equivalence relation. For $d = 1$ the Gaussian and the Poisson measures are in the same class and the associated commutation relations are the Heisenberg ones. For $d > 1$, it is not known if the Gaussian and the Poisson measures are in the same class, but the commutation relations of the Gaussian class again coincide with the Heisenberg ones.

The quantum decomposition of classical random variables has allowed to solve some open problems in classical probability. Another interesting consequence of it is the **Gaussianization phenomenon** (here meant as the possibility to express the mixed moments in terms of pair correlations) that becomes universal among measures with all moments.

The algebraic classification of probability measures suggested by the quantum decomposition suggests a *complexity index* for such measures and many familiar measures correspond to the lowest values of this index.

In conclusion:

To each equivalence class of probability measures on $\mathbb{R}^d$, it is canonically associated an **extension of quantum mechanics** and quantum fields correspond to the case $d = \infty$.
The usual theories correspond to the Gaussian class.
This shows the probabilistic origins of the commutation relations and places in a general framework the program of **non linear quantization**, developed since 1999, starting from completely different motivations.

- Kenny de Commer- I-factorial quantum torsors

Abstract- Given a locally compact quantum group, a quantum torsor consists of a von Neumann algebra with a special action of the quantum group (free, ergodic and integrable), while a projective representation consists of an action of the quantum group on a special von Neumann algebra (a type I-factor). In general, there is a one-to-one correspondence (up to the appropriate notion of equivalence) between quantum torsors of a quantum group and projective representations for the dual quantum group. In this talk, we will discuss I-factorial quantum torsors, that is, quantum torsors which are at the same time a projective representation. It turns out that such quantum torsors allow for a nice duality theory. In particular, as one can twist quantum groups with respect to a quantum torsor, the combination of twisting and taking duals allows, in principle, for an infinite family of quantum groups constructed by this method. We will discuss our general theory with the simple example of the Heisenberg double.

- Michael Brannan- Dual bases in Temperley-Lieb algebras and quantum group integrals.

Abstract- The Temperley-Lieb algebras form a remarkable family of finite dimensional algebras, arising in a variety of contexts, including quantum groups, subfactors, knot theory, and topological quantum computation. In this talk, I will discuss a "quantum group" approach to computing the dual basis associated to the usual planar diagram basis in the Temperley-Lieb algebra. Our approach to this problem is to interpret the structure coefficients of this basis in terms of polynomial integrals over free orthogonal quantum groups. Using this new perspective, we derive a Laurent series expansion for the dual basis coefficients, and using this expansion we answer a question of Jones on the non-vanishing of such coefficients. We also deduce, as a special case of our results, the non-vanishing of the structure

coefficients of the Jones-Wenzl projections. (This is joint work with Benoit Collins).

- Andrzej Zuk- Discrete analogues of the KdV equation.

  Abstract- TBA

- Sutanu Roy- Braided C^*-quantum groups and quantum plane.

  Abstract- Semidirect product of groups is equivalent to a group with an idempotent endomorphism. Quantum analogue of this result says that every braided quantum group is equivalent to a quantum group with a projection. In the first part of this talk I shall explain the general construction of braided quantum groups in the C*-algebraic setting and this equivalence. In the second part, I shall discuss braided quantum structure of the quantum plane over the group of circle, and show that the ambient quantum group with projection coincides with Woronowicz's (simplified) $E_q(2)$ group. A part of this talk is based on a joint work with Ralf Meyer and Stanislaw Lech Woronowicz.

- Boguslaw Zegarlinski- Dissipative Dynamics for Large interacting Systems.

  Abstract- I will review some results and open problems concerning constructions and ergodicity of dissipative dynamics for noncommutative large interacting systems.

- Jyotishman Bhowmick- Quantum Isometry Groups of Noncommutative Manifolds.

  Abstract- TBA

- Francois Le Maitre- On the spaces of subalgebras of finite von Neumann algebras.

  Abstract- In this talk, we will investigate properties of the space of subalgebras of a fixed finite von Neumann algebras for the Effros-Marechal topology. This is joint work with Pierre Fima, Kunal Mukherjee and Issan Patri.

- Marcin Marciniak- Positive maps: examples and applications.

  Abstract- We discuss a few questions concerning the problem of classification of positive maps on operator algebras. In the first part we present a construction of some new classes of indecomposable (even extremal) positive maps. Next, we describe their possible applications to the construction of non-PPT bound-entangled states. Finally, we present some geometric condition for 2-positivity.

- Adam Majewski- Dynamical Maps on Quantum Orlicz Spaces.

  Abstract- We present a new rigorous approach based on Orlicz spaces for the description of the statistics of large regular statistical systems, both classical and quantum. The pair of Orlicz spaces we explicitly use are respectively built on the exponential function (for the description of regular observables) and on an entropic type function (for the corresponding states). They form a dual pair (both for classical and quantum systems). This pair has the advantage of being general enough to encompass regular observables, and specific enough for the latter Orlicz space to select states with a well- defined entropy function. Quantum dynamical maps are defined and studied for quantum statistical physics based on Orlicz spaces. We show that even in the most general non-commutative contexts, completely positive Markov maps satisfying a natural Detailed Balance condition, canonically admit an action on a large class of quantum Orlicz spaces. This is achieved by the development of a new interpolation technique, specifically suited to the above context, for extending the action of such maps to the appropriate intermediate spaces of the pair $\langle L^\infty, L^1 \rangle$.

- Pierre Fima- Homogeneous actions on the random graph.

  Abstract- We study countable dense subgroups of the automorphisms group of the random graph. We show that many groups acting on trees (i.e. amalgamated free products and HNN extensions) are isomorphic to countable dense subgroups of the automorphisms group of the random graph. This is a joint work with S. Moon and Y. Stalder.

- Martijn Caspers- Weight lifting with ultrapowers.

  Abstract- For a family of von Neumann algebras M_j equipped with normal weights φ_j we define the ultraproduct weight $\varphi = (\varphi_j)_\omega$ on the Raynaud ultrapower $\prod_{j,\omega} M_j$. We study modular theory by considering ultraproducts of Connes' spatial derivatives. This extends earlier results by Ando-Haagerup and Raynaud for the case of bounded functionals, giving yet another proof. We also provide a new proof of a famous result by Raynaud that says that $L^p(\prod_{j,\omega} M_j)$ is isomorphic to $\prod_{j,\omega} L^p(M_j)$.

- Makoto Yamashita- Weak Morita equivalence of compact quantum groups.

  Abstract: Motivated by the 2-categorical interpretation of constructs in subfactor theory, Mger introduced the notion of weak Morita equivalence for tensor categories. This relation roughly says that the tensor categories have the same quantum double, or the same "representation theory". We give a characterization of this equivalence relation for representation categories of compact quantum groups in terms of certain commuting actions. This extends a similar characterization of monoidal equivalence due to Schauenburg and Bichon-De Rijdt-Vaes. Based on joint work with Sergey Neshveyev.