Meeting on Functional Analysis & Quantum Information Theory

Venue: Campus Bouloie Besançon, bâtiment métrologie, room 324-2B

Date : Monday, November 27th, 2017, from 11:00 to 17:00

Program

- 10:00 - 11:00: Informal discussion (research plans, EU projects, etc.)
- 11:00 - 12:00: Talk on "Quantum groups and quantum information" by Benoît Collins (Kyoto University)

  Abstract: The rapid decay property for quantum groups, introduced by Vergnioux and Vaes, allowed to prove a lot about the operator algebraic structure of free quantum groups. It also turns out to be a very powerful tool to construct vector subspaces of a tensor product such that all its elements are highly entangled. We study this phenomenon in depth and supply a few applications to Quantum Information Theory. This talk is based on joint work with Michael Brannan.
- 12:00 - 13:30: Lunch at the Chinese Restaurant "Grand Buffet"

  address: 5, rue Auguste Jouchoux, 25000 Besançon

- 13:30 - 14:30: Talk on "What representation theory tells us about quantum information (and vice versa)" by Frédéric Holweck (Université de Technologie de Belfort-Montbéliard)

  Abstract: In this talk I will present two geometric constructions used to describe two resources of quantum information: entanglement of pure quantum systems and contextuality provided by configurations of Pauli operators. In the first part I will show how classication results in representation theory allows us to recover in one single picture various entanglement classification of tripartite systems. In the second part I will show how configurations of the two and three qubit Pauli groups naturally encapsulate weights diagrams of some simple Lie group representations.

- 14:30 - 15:30 Talk on "Le théorème de Dvoretzky et la complexité de l'intrication" by Guillaume Aubrun (Institut Camille Jordan, Université Claude Bernard Lyon 1)

  Abstract: Nous appliquons une ingalité due à Figiel-Lindenstrauss-Milman (une conséquence du théorème de Dvoretzky) pour obtenir des résultats sur la complexit de l'intrication quantique. Le "critère de Horodecki" affirme qu'un état quantique ρ sur $\mathbb{C}^d \otimes \mathbb{C}^d$ est intriqué si et seulement s'il existe une application positive $\Phi : M_d \to M_d$ telle que l'opérateur $(\Phi \otimes \mathrm{Id})(\rho)$ n'est pas positif. Nous montrons que le nombre de telles applications ncessaires pour détecter (essentiellement) tous les états intriqués est au moins $\exp(d^3/\log(d))$.

- 15:30 - 16:00 Coffee break

- 16:00 - 17:00 Talk on "Measurement uncertainty relations: a relative entropy approach" by Alberto Barchielli (Politecnico di Milano)

  Abstract: Preparation uncertainty relations (PURs), as the Robertson-Schroedinger one for variances, give bounds on the spreads of the distributions of incompatible observables in the same state. However, Heisenberg's uncertainty principle gave rise not only to PURs, but also to measurement uncertainty relations (MURs) for quantum systems: incompatible observables can be jointly measured only with unavoidable approximations, which have been quantified in various ways. The relative entropy is the natural theoretical quantifier of the information loss when a ‘true’ probability distribution is replaced by an approximating one. Starting from the notion of relative entropy, we constructed a new index quantifying the degree of incompatibility and gave an entropic formulation of MURs. After a presentation of our results for discrete observables, in this talk I want to discuss the case of position and momentum, where we developed the whole theory only for Gaussian states and measurements, while the general formulation presents open analytical problems. Our approach provides a lower bound for the amount of information that is lost by replacing the distributions of the sharp position and momentum observables (as they could be obtained in independent experiments) by the marginals of any smeared joint measurement. The bound is constructed by introducing an entropic error function and solving a suitable optimization problem. As I shall explain, this optimization introduces in the continuous case new features and difficulties, which are not present in the case of discrete observables.

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Participants

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7.	Colin, Petitjean	LMB
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9.	Fagnola, Franco	Politecnico di Milano
10.	Ferrières, Sylvain	CRESE
11.	Franz, Uwe	LMB
12.	Holweck, Frédéric	UTBM, Belfort
13.	Jaffali, Hamza	Femto-ST
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23.	Viennot, David	UTINAM
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