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Quantum Probability and Contextuality

The complete description of the state of a quantum system involves a collection of incompatible measurement contexts [1]. Each context can be seen as a classical random variable, defined by a complete set of commuting observables [2]. But contexts are intertwined: quantum probabilistic models can be described as very specific pastings of Boolean algebras, which are globally non-Boolean and determine a non-Kolmogorovian probability calculus [3, 4]. States are represented by density operators and give place to classical probabilities when restricted to the maximal Boolean subalgebras associated to measurement contexts. Related to the peculiar properties of quantum probabilities, *contextuality* is one of the characteristic traits of quantum theory [5, 6]. Understanding this quantum feature is central for a deeper understanding of the foundations of the theory and the development of quantum information technologies [7, 8]. In this talk we give an introductory exposition of quantum probabilities and contextuality, and analyze these notions under the light of different interpretations of quantum mechanics.

References

[1] Marcelo Losada, Federico Holik, Cesar Massri, and Angelo Plastino. Solutions for the maxent problem with symmetry constraints. *Quantum Information Processing*, 18(9):293, Aug 2019.

[2] Federico Holik, Manuel Sáenz, and Angel Plastino. A discussion on the origin of quantum probabilities. *Annals of Physics*, 340(1):293–310, Jan 2014.

[3] Federico Holik, Sebastian Fortin, Gustavo Bosyk, and Angelo Plastino. On the interpretation of probabilities in generalized probabilistic models. In Jose Acacio de Barros, Bob Coecke, and Emmanuel Pothos, editors, *Quantum Interaction*, pages 194–205, Cham, 2017. Springer International Publishing.

[4] Federico Holik, A. Plastino, and Manuel Sáenz. Natural Information Measures in Cox's Approach for Contextual Probabilistic Theories. *Quantum Information and Computation*, 16(1&2):0115–0133, 2016.

[5] José Acacio de Barros, Federico Holik, and Décio Krause. Contextuality and Indistinguishability. *Entropy*, 19(9):435, August 2017.

[6] J. Acacio de Barros, Federico Holik, and Décio Krause. Indistinguishability and the origins of contextuality in physics. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 2019.

[7] Federico Holik, Giuseppe Sergioli, Hector Freytes, and Angel Plastino. Logical structures underlying quantum computing. *Entropy*, 21(1):77, 2019.

[8] Federico Holik, Gustavo M. Bosyk, and Guido Bellomo. Quantum information as a non-kolmogorovian generalization of shannon's theory. *Entropy*, 17(11):7349–7373, 2015.