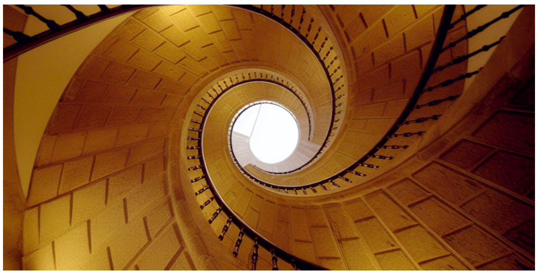

Contribution ID: **100**

Type: **Poster**

Quantum theory in finite dimension cannot explain every general process with finite memory

Arguably, the largest class of stochastic processes generated by means of a finite memory consists of those that are sequences of observations produced by sequential measurements in a suitable generalized probabilistic theory (GPT). These are constructed from a finite-dimensional memory evolving under a set of possible linear maps, and with probabilities of outcomes determined by linear functions of the memory state. Examples of such models are given by classical hidden Markov processes, where the memory state is a probability distribution, and at each step it evolves according to a non-negative matrix, and hidden quantum Markov processes, where the memory state is a finite dimensional quantum state, and at each step it evolves according to a completely positive map. Here we show that the set of processes admitting a finite-dimensional explanation do not need to be explainable in terms of either classical probability or quantum mechanics. To wit, we exhibit families of processes that have a finite-dimensional explanation, defined manifestly by the dynamics of explicitly given GPT, but that do not admit a quantum, and therefore not even classical, explanation in finite dimension. Furthermore, we present a family of quantum processes on qubits and qutrits that do not admit a classical finite-dimensional realization, which includes examples introduced earlier by Fox, Rubin, Dharmadikari and Nadkarni as functions of infinite dimensional Markov chains, and lower bound the size of the memory of a classical model realizing a noisy version of the qubit processes.

Authors: FANIZZA, Marco (Universitat Autònoma de Barcelona); Mr LUMBRERAS, Josep (National University of Singapore); Prof. WINTER, Andreas (Universitat Autònoma de Barcelona, ICREA)

Presenter: Mr LUMBRERAS, Josep (National University of Singapore)