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Signatures of non-Markovianity in open-system dynamics

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In recent research, a great effort has been put into the study and understanding of non-Markovian features within the dynamics of open quantum systems. At the same time, quantum non-Markovianity has been defined and quantified in terms of quantum dynamical maps, using either a divisibility property or the behavior of the trace distance between pairs of reduced states evolved from different initial states. We investigate these approaches by means of several examples, especially focusing on their relation with the very definition of non-Markov process used in classical probability theory. Indeed, the notion of non Markovian behavior in the dynamics of the state of a physical system and the notion of non-Markov process are quite different and it will appear how the former represents sufficient, but not necessary condition with respect to the latter. In particular, we explicitly show that the divisibility property in the classical case is not, in general, equivalent to the Chapman-Kolmogorov equation, proper to Markov stochastic processes.

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