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**Title: Non-Markovian open quantum systems and some applications of memory effects**

Open quantum systems including memory effects have been under intense scrutiny and research during the last fifteen years. We describe the basic framework for characterizing non-Markovianity within open quantum system context and diverse approaches this includes [1]. Non-Markovian memory effects can be exploited for a number of tasks and this also leads to a full control of decoherence within a paradigmatic open qubit system model [2]. Moreover, we can also change the perspective, and ask whether decoherence and noise can lead to state purification and increase of quantum properties — instead of destroying them — and how this can be exploited, e.g., in quantum teleportation [3].

[1] H.-P. Breuer, E.-M. Laine, J. Piilo, and B. Vacchini, *Rev. Mod. Phys.* 88, 021002 (2016).

[2] Z.-D. Liu, H. Lyyra, Y.-N. Sun, B.-H. Liu, C.-F. Li, G.-C. Guo, S. Maniscalco, and J. Piilo, *Nature Comm.* 9, 3453 (2018).

[3] Z.-D. Liu, O. Siltanen, T. Kuusela, R.-H. Miao, C.-X. Ning, C.-F. Li, G.-C. Guo, and J. Piilo, “Efficient quantum teleportation via noise-assisted state purification and hidden nonlocality”, submitted (2022).