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Adiabaticity in Open Quantum Systems DANIEL LIDAR, University of Southern California, MARCELO SARANDY, Universidade Federal Fluminense, Brazil — The adiabatic approximation is an 80+ year old pillar of quantum mechanics, which has found rich applications in a variety of physics and chemistry problems. However, in its original formulation the adiabatic theorem was derived in the context of closed quantum systems, described by unitary dynamics. We have recently introduced a generalization of the the adiabatic theorem to open quantum systems described by convolutionless master equations [1]. This version of the adiabatic theorem is naturally suited to problems in quantum information theory, and we describe applications to the adiabatic quantum computing paradigm [2], and to the problem of geometric phases (both Abelian and non-Abelian) in open quantum systems undergoing cyclic adiabatic evolution [3]. One of our main findings is that, in general, adiabaticity in an open quantum system depends on two competing timescales: the speed of the driving field and the decoherence due to the interaction with the environment. These timescales generically determine a finite interval for adiabaticity. This has implications for both adiabatic quantum computing and the robustness of geometric phases to decoherence.

[1] M.S. Sarandy and D.A. Lidar, PRA 71, 012331 (2005).
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[3] M.S.S. and D.A.L., PRA 73, 062101 (2006).

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