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Quantum speedup in memory environment ZHEN-YU XU, School of Physical Science and Technology, Soochow University, Suzhou 215006, China, SHUNLONG LUO, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China, W.L. YANG, State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, CHEN LIU, SHIQUN ZHU, School of Physical Science and Technology, Soochow University, Suzhou 215006, China — Memory (non-Markovian) effect is found to be able to accelerate quantum evolution [S. Deffner and E. Lutz, Phys. Rev. Lett. 111, 010402 (2013)], for the intrinsic quantum speed limit time is decreased when the non-Markovianity becomes stronger. In this work, for an atom in a structured reservoir, we show that the mechanism for the speedup is not only related to non-Markovianity but also to the population of excited states under a given driving time. In other words, it is the competition between non-Markovianity and population of excited states that ultimately determines the acceleration of quantum evolution in memory environment. A potential experimental realization for verifying the above phenomena is discussed by using a nitrogen-vacancy center embedded in a planar photonic crystal cavity under the current experimental conditions.

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