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Time-bin quantum RAM

Moiseev E., Moiseev S.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016 Informa UK Limited, trading as Taylor & Francis Group.We have proposed a compact scheme of quantum random access memory (qRAM) based on the impedance matched multi-qubit photon echo quantum memory incorporated with the control four-level atom in two coupled QED cavities. A set of matching conditions for basic physical parameters of the qRAM scheme that provides an efficient quantum control of the fast single photon storage and readout has been found. In particular, it has been discovered that the efficient qRAM operations are determined by the specific properties of the excited photonic molecule coupling the two QED cavities. Herein, the maximal efficiency of the qRAM is realized when the cooperativity parameter of the photonic molecule equals to unity that can be experimentally achievable. We have also elaborated upon the new quantum address scheme where the multi-time-bin photon state is used for the control of the four-level atom during the readout of the photonic qubits from the quantum memory. The scheme reduces the required number of logical elements to one. Experimental implementation by means of current quantum technologies in the optical and microwave domains is also discussed.

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Keywords

cavity QED, optical quantum memory, photonic molecule, Quantum information, quantum random access memory, time-bin photon state