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Photon-echo quantum memory with complete use of natural inhomogeneous broadening

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Abstract

The photon-echo quantum memory is based on a controlled rephasing of the atomic coherence excited by a signal light field in the inhomogeneously broadened resonant line. Here, we demonstrate an active mechanism of the atomic rephasing that provides a perfect retrieval of the stored light field in the photon-echo quantum memory based on the use of arbitrary initial inhomogeneous broadening of the resonant line. We show that the rephasing mechanism can exploit all resonant atoms, thereby maximally increasing an optical depth of the resonant transition, which is one of the critical parameters for the realization of highly efficient quantum memory. We also demonstrate that the rephasing mechanism can be used for various realizations of the photon-echo quantum memory, thereby creating many possibilities for its practical realization.

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