

An Analytical Framework for the Storage and Retrieval of Arbitrary Light Pulses

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As quantum information progresses towards quantum networking, the need for temporary storage and efficient retrieval of qubits at the networking nodes becomes critical. Viable quantum memory will require the storage and predictable retrieval of quantum states as light pulses. Previous works have experimentally determined retrieved pulse shapes for different control fields, but an analytical expression for a retrieved pulse has only been derived for a Gaussian pulse. This work develops a formula to store and retrieve an arbitrary pulse shape with explicit factors for controlling the output pulses' amplitude and width. The numerical implementation of this formula should be much faster than direct numerical solutions of the differential equations governing the evolution of the system.

- [1] A. Patnaik, F.L. Kien, and K. Hakuta, Phys. Rev. A 69, 035803 (2004)
- [2] I. Novikova, N. Phillips, and A. Gorshkov, Phys. Rev. A 78, 021802 (2008)
- [3] P. Tsai, Y. Hsiao, and Y. Chen, Phys. Rev. Research 2, 33155 (2020)