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Optimal control of light pulse storage and retrieval in atomic vapor NATHANIEL PHILLIPS, IRINA NOVIKOVA, The College of William & Mary, ALEXEY GORSHKOV, Harvard University — Efficient and reliable quantum communication will require the coherent control of individual photons. As a step toward this objective, we have demonstrated promising techniques that involve using the dynamic form of electromagnetically induced transparency to optimally and reversibly map arbitrary classical pulse shapes of light onto an ensemble of hot Rubidium atoms. One technique employs time-reversal to determine, using an iterative procedure, the optimally-stored signal field for a given control field. Another method makes use of the one-to-one mapping between the decayless spin modes of the atoms and the signal field to calculate the optimal control field for a given signal field. We show that both techniques equivalently obtain optimal memory efficiency for a given optical depth. We observe good agreement with theoretical predictions for lower optical depth (< 15), but memory efficiency falls below predictions at higher optical depths (> 25). We analyze possible effects responsible for this reduced memory, such as resonant four-wave mixing, ac-Stark shifts, etc, and present the results of current investigations into the optical depth dependence of such phenomena.

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