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Characterization of a high efficiency optical memory for the storage of quantum light states CONNOR KUPCHAK, RYAN THOMAS, ALEX LVOVSKY, Institute for Quantum Information Science, University of Calgary, INSTITUTE FOR QUANTUM INFORMATION SCIENCE, UNIVERSITY OF CALGARY TEAM — We have developed a coherent optical storage device based on a Gradient Echo Memory scheme showing efficiencies of above 65%. The memory is realized in a warm vapor of ^{87}Rb atoms utilizing a Λ-type energy level scheme. We use a co-propagating, co-rotating circular polarized pump beam coupled with pulsed coherent states to create an off-resonant Raman absorption line suitable for storage. Through sufficient filtration of the strong pump field, the stored light pulse is retrieved after a desired time and subjected to time-domain homodyne tomography. By repeating this sequence on an ensemble of 50 000 identical coherent states we gain enough information to completely reconstruct the quantum state of light retrieved from the memory. Furthermore, by repeating this characterization for a set of coherent states with at sufficient range of amplitudes we can completely characterize the memory process itself. This is possible by implementing a method devised by our group called coherent state Quantum Process Tomography which also has the capability to predict how well the memory will perform on any arbitrary quantum input state. We show our current storage efficiencies and what needs to be further done to demonstrate a true high efficiency, quantum optical memory.

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