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Background Noise Analysis in a Few-Photon-Level Qubit Memory THOMAS MITTIGA, CONNOR KUPCHAK, BERTUS JORDAAN, MEHDI NAMAZI, CHRISTIAN NOLLEKE, EDEN FIGEROA, SUNY Stony Brook — We have developed an Electromagnetically Induced Transparency based polarization qubit memory. The device is composed of a dual-rail probe field polarization setup colinear with an intense control field to store and retrieve any arbitrary polarization state by addressing a Λ -type energy level scheme in a ^{87}Rb vapor cell. To achieve a signal-to-background ratio at the few photon level sufficient for polarization tomography of the retrieved state, the intense control field is filtered out through an etalon filtrating system. We have developed an analytical model predicting the influence of the signal-to-background ratio on the fidelities and compared it to experimental data. Experimentally measured global fidelities have been found to follow closely the theoretical prediction as signal-to-background decreases. These results suggest the plausibility of employing room temperature memories to store photonic qubits at the single photon level and for future applications in long distance quantum communication schemes.

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