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Investigation of quantum impedance matching in a cavity based quantum memory ZAKARY BURKLEY, BERTUS JORDAAN, CARL CHEUNG, CHRISTIAN NOELLEKE, CONNOR KUPCHAK, EDEN FIGUEROA, Stony Brook University — Atomic ensembles are among the most promising candidates for the implementation of photonic quantum memories. A widely used technique to coherently store and retrieve photonic states from these systems is Electromagnetically Induced Transparency. Coupling the atoms to an optical cavity increases the light-matter interaction and results in high storage and retrieval efficiencies. Ultimately, the efficiency is limited by non-optimal impedance matching that results in partial reflection of the photon to be stored off the incoupling mirror. The reflection can be decreased by using control light of a certain temporal shape that causes the transmitted light to destructively interfere with the reflected light. We present an extensive study of impedance matching in a magneto-optical trap coupled to an optical cavity. We discuss the impact of our results towards real-world quantum networks, and how our system can be exploited to realize efficient photonic quantum gates.

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