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Towards a cavity electromagnetically induced transparency based quantum gate EDEN FIGUEROA, ZAKARY BURKLEY, BERTUS JORDAAN, CARL CHEUNG, CHRISTIAN NOELLEKE, CONNOR KUPCHAK, Stony Brook University — The processing of quantum information with photons and atoms has been established as one of the strongest candidates for future quantum technologies. Photons (quantum channels) are capable of encoding quantum information and traveling long distances without decohering, whereas atoms (quantum nodes) readily interact with light and therefore provide a natural platform for mediating interactions and storing it. The development of a node in which deterministic two-qubit gates can be realized still remains an elusive goal for the quantum optics community. The success of a photonic, two-qubit gate is contingent on a photon-photon interaction generating a sufficient relative phase between the fields. This can be achieved by utilizing a combination of cavity quantum-electrodynamics and electromagnetically-induced transparency. In our newly implemented experiment based on a magneto-optical trap coupled to two optical cavities, we aim to realize strong interactions between weak quantum optical fields. We report on the current status of the experiment and discuss possible implementations of photonic quantum gates.

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