

High fidelity phase gate in an unconventional EIT medium.

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The interaction of Rydberg polaritons under conditions of electromagnetically induced transparency (EIT) represents a promising route towards realizing a photonic phase gate. The basic principle exploits the establishment of a locally refractive medium for a polariton in response to the conditional presence of another in its vicinity, allowing for the accumulation of a relative phase shift. However, previous studies have shown that high gate fidelities require such large atomic densities that ground state interactions would begin to manifest, bringing with it additional undesired decoherence effects. We report on recent progress in alleviating this issue by considering a modified EIT setting involving an auxiliary ground state. We show that this gives rise to a slowly propagating bright state polariton in response to Rydberg interactions that, in contrast to ladder excitation schemes, enables high fidelity phase gates at moderate densities.