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Stored Light under conditions of electromagnetically induced transparency and four-wave mixing in an optically dense atomic gas

NATHANIEL PHILLIPS, College of William & Mary, ALEXEY GORSHKOV, Harvard University, IRINA NOVIKOVA, College of William & Mary — A promising avenue towards efficient and reliable quantum communication is based on light storage via electromagnetically induced transparency (EIT) in an optically thick atomic gas. A strong classical control field modifies the optical properties of a weak signal field such that a previously opaque medium becomes transparent to the signal field. The accompanying steep dispersion in refractive index enables pulses of light to be decelerated, then stored as an atomic excitation, and later retrieved as a photonic mode. In any storage device, the objective is to minimize losses during storage time and maximize the read efficiency. With consideration to an atomic gas, these criteria are met when the gas density, and hence optical depth, is high. However, at high optical depth, resonant four-wave mixing (FWM), in which a near-resonant Stokes field is simultaneously created by the interaction of probe and control photons, interferes with EIT and disturbs the memory. We experimentally and theoretically study stored light in a hot ^{87}Rb gas under conditions of EIT and FWM, and show that a seeded Stokes pulse largely affects the FWM-EIT interaction. We further discuss the prospect of simultaneously storing signal and Stokes pulses and investigate the memory decay in both channels.

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