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Transients of Electromagnetically Induced Transparency-Enhanced Cross-Phase Modulation GREG DMOCHOWSKI, AMIR FEIZPOUR, MATIN HALLAJI, CHAO ZHUANG, ALEX HAYAT, AEPHRAIM STEINBERG, University of Toronto, STEINBERG TEAM
— Electromagnetically induced transparency (EIT) has been studied extensively in the context of quantum information for a variety of applications including quantum non demolition measurements and quantum logic gates. Here we show that the response time of the EIT-enhanced nonlinearity is not limited to the inverse window width in the case of a short, pulsed signal field. To investigate the time response of XPM under EIT conditions, we monitor the phase shift of a probe beam in real time as a function of EIT window width for a given pump pulse power and bandwidth using a cloud of magneto-optically trapped rubidium atoms. We find that the rise time of the phase shift is dictated by the pump pulse bandwidth and is independent of the EIT window width, even as the latter becomes narrower than the former. That is, the rise time of XPM is not limited by the EIT window width in the case of a pulsed pump field. Once the pump pulse passes through the atomic medium, the phase shift of the probe beam begins to decay at a rate given by the EIT window width. This suggests that the practical application of EIT-based nonlinearities, which often relies on single photon pulses, is not hindered by the slow rise times that were reported in the case of step responses.

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