Non-degenerate four wave mixing based slow light in hot potassium vapor

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We have studied propagation of Gaussian probe pulses of various duration in hot potassium vapor (120^{o}C) under conditions of non-degenerate four wave mixing (FWM). FWM is realized in co-propagating geometry by off-resonant double Lambda scheme at D1 line (770nm) of ^{39}K. Pulse duration was in the range 20 - 120ns, while one and two photon detuning were 700 - 1300MHz and -10 – 10 MHz, respectively. A typical trace of three pulses, reference, amplified probe and conjugate is shown in figure 1 with clearly observable delay of the latter two. The optimal fractional delay and fractinal broadening were measured to be 1.1 and 1.2, respectively and they are comparable to those obtained in Rb (0.57, -) [1] and Na (1.03, 1.12) [2]. Unlike in Rb and Na, fractional delay and broadening of both, probe and conjugate, vary slowly with two photon detuning [3]. In the measurements of fractional delay and fractional broadening with various pulse durations all the pulses had the Gaussian temporal shape. By lowering the pulse duration fractional delay and fractional broadening were increased simultaneously. We found that the 120 ns long input pulse, gives the best results in terms of delay and broadening.

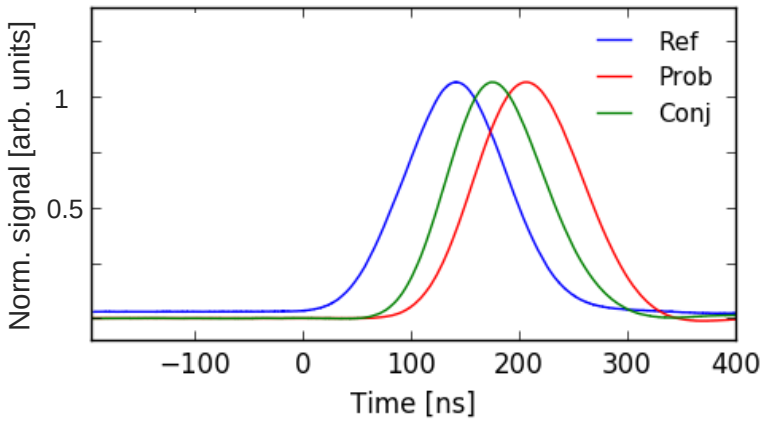

Figure 1. Propagation of the 120 ns optical pulses by the FWM in hot ^{39}K vapor. The curves are obtained upon 1000 averaged measurements. Two photon detuning 0 MHz, one photon detuning 700MHz, T=120^{o}C , I pump = 200mW, I ref = 20µW, angle between probe and pump beams θ = 3mrad.

[1] V.Boyer,C.F.McCormick,E.Arimondo,andP.D.Lett,"Ultraslow propagation of matched pulses by four-wave mixing in an atomic vapor," Phys. Rev. Lett. 99, 143601 (2007).

[2] J. Okuma, N. Hayashi, A. Fujisawa, and M. Mitsunaga, "Ultraslow matched-pulse propagation in sodium vapor," Opt.Lett. 34, 1654–1656 (2009).

[3] B. Zlatković, M. M. Ćurčić, I. S. Radojičić, D. Arsenović, A. J. Krmpot, and B. M. Jelenković, „Slowing probe and conjugate pulses in potassium vapor using four wave mixing", in preparation