**Evolution of laser pulse propagation in Four Wave Mixing atomic medium**

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Electromagnetically induced transparency (EIT) and EIT based Four Wave Mixing (FWM), the two effects of quantum coherence and nonlinearity induced in atomic systems, are important because of related phenomena, like slow and storage of light pulses. From the practical point it is important to ensure parameters of EIT and FWM so that pulses propagate through medium without (any) distortion.

In this work we investigate propagation of probe and conjugate pulses through potassium vapor, which is made FWM medium by a double Λ atomic scheme. We are interested in finding conditions when initial Gaussian probe pulse begins to brake, bringing multiple pulses at the exit of the K cell. In our previous works with FWM in potassium we studded slow light and therefore worked with conditions that ensure preservations of Gaussian pulse at the exit of the K cell [1].

We are interested in pulse propagation dynamics that leads to pulse splitting in hot alkali vapor. Understanding mechanism which govern the final shape of the pulse will help to tailor FWM parameters optimal for slowing and storing Gaussian pulses, with minimum distortion and broadening. Theoretically and experimentally we investigate propagations of 80 ns Gaussian probe pulse through double Λ type atomic media, when the second leg of the lower Λ scheme is the strong cw pump laser.

We developed detailed numerical model to describe the FWM in hot potassium vapor, using Maxwell-Bloch equations (MBE). Potassium atoms in vapor cell have large Doppler line broadening, of the order of 800 MHz. The model carefully takes into account pump photon detuning from the D1 line due to Doppler effect, in addition to the detuning set for the pump laser (valid for zero velocity atoms). We select a number of velocity groups of atoms and form separate density matrices for each group and a corresponding set of Bloch equations. At initial time and position (entrance to the cell) for starting point of propagation, for a given pump and probe detuning, we first solve the MBE with all derivatives over time set to zero. Thus obtained spatial dependence of atomic polarizations are initial condition for the probe pulse at the cell entrance. Comparison with experiment has shown that small steps between two velocity groups are necessary, of the order of 10 MHz. The total number of atom velocity groups, and the type of uneven distribution of groups along the Doppler profile, is the compromise between proximity of results to results of the experiment, and reasonable computer time.

We will present results of the model and of the experiment for ranges of one photon pump laser detuning, two pump-probe laser beams detuning, potassium density, when slowed probe and conjugate pulses start to deform from Gaussian, and begin to split.

REFERENCES

[1] B. Zlatković, M. M. Ćurčić, I. S. Radojičić, D. Arsenović, A. J. Krmpot, and B. M. Jelenković, Optics Express Vol. 26, Issue 26 (2018).