Interference between different Rubidium Dark States

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We show an experiment in which we have studied the behavior of two different Dark States [1] selected by two diode lasers, one tuned at the D_1 transition and the other at the D_2. The Dark States are obtained in cells filled with vapor of Rubidium 85 and both are selected in the same spatial region. The modulation frequency ν corresponds to the hyperfine energy separation between the F=2 and the F=3 levels of the $5S_{1/2}$ ground state, so a double Λ scheme [2] between the $5S_{1/2}$ and the $5P_{1/2}$ states and between the $5S_{1/2}$ and the $5P_{3/2}$ is reproduced. We developed a method to compare and change the phase difference $\gamma = \Theta_{D1} - \Theta_{D2}$ between the optical beats emitted by each laser.

Finally we show the behavior of the dark states when are obtained by alone and together. A strong relation between the value of the phase difference γ and the interference between the two dark state is found out. In particular the dark state D_1 coexists with the D_2 when the phase difference γ is π, while they interfere destructively when the phase difference is zero.

Furthermore, as application of the set up used in the experiment described above, we show a way to modulate the laser beam intensity by interaction with the Rb atoms pumped in a dark state by a second laser.

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[2] E. Arimondo in *Progress in Optics XXXV*, ed. by E. Wolf (Elsevier Science, 1996), pag.257