INFLUENCE OF THE LASER SPECTRUM ON THE FORM OF THE COHERENT POPULATION TRAPPING RESONANCE IN OPTICAL DENSE MEDIUM

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The frequency standards based on the coherent population trapping (CPT) resonance [1,2] are able to provide high sort-term stability (about 10^{-13} for one second). Due to such high accuracy the same quantum frequency standards [3] have the wide spectrum of potential applications. For example precise clocks are able to observe drift of the fundamental constants and sense fluctuations of gravitational field of the Earth. At the same time such standards have a small size due to optical pumping without a microwave resonator.

In this work we consider the CPT frequency standard, based on gas cell with atoms of ^{87}Rb. Two frequency laser radiation excites D_1-line of ^{87}Rb. The width of CPT resonance determines stability of frequency standard. The aim of our work is investigation of influence of the spectrum of laser on the width of CPT resonance. We suppose that the medium of atoms is optically dense therefore it is necessary to consider transfer and deformation of the spectrum of laser inside the cell. On the one hand the interaction of wide laser with atoms should be better because such laser is able to capture more atoms with the high Doppler shift therefore the contrast of CPT signal is stronger. On the other hand the technology of cold atoms is moving forward and the Doppler shifts in such ensemble are negligible. In this case the narrow laser may be preferable. Also, the laser induced constriction of CPT resonance can be achieved by the narrow laser. Thus the question about width and form of laser spectrum for providing better short-term stability of frequency standard is opened.

The main part of this work is comparison of contrast of the CPT resonances which are excited by wide and narrow laser and calculation of short-term stability. Also, we will optimize the stability by different parameters, such as atomic concentration, laser intensity, etc.

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