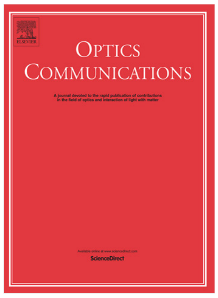
Accepted Manuscript



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PII: S0030-4018(18)30800-9
DOI: https://doi.org/10.1016/j.optcom.2018.09.019
Reference: OPTICS 23458

To appear in: *Optics Communications*

Received date : 5 July 2018
Revised date : 18 August 2018
Accepted date : 9 September 2018

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Abstract:

Population transfer between the fine structure levels of the cesium atom is numerically investigated when a linearly chirped Gaussian pulse interacts with the atom. For this purpose, the time-dependent Hamiltonian of the quantum system is developed and the Schrödinger equation is solved. In result the transition probabilities are obtained and discussed towards precise controlling of the system dynamics. The results show that for both single-pulse and multi-pulse cases, the probability of the final population distribution of levels can be flexibly controlled by optimal adjustment of the laser parameters. In addition, it is shown that the transition probabilities increase with the increasing of the pulse duration in the single pulse case as well as increasing the number of pulses in the multi-pulse system.

Keywords: Two level system, cesium atom, chirped laser

1. Introduction

In this work we have investigated the population transfer between the energy levels of Cesium atoms using chirped laser source. The alkaline cesium with one unpaired electron in outer shell has many applications in atomic physics including its application in magnetic optical traps [1], atomic clocks, atomic magnetometers, and etc. [2, 3].

Cesium atom in the ground state, has the zero orbital angular momentum (L=0) and because of the electron spin (S=1/2), the total angular momentum equals to J=1/2. For the first excited state (L=1), the total angular momentum equals to J=1/2 or J=3/2. Thus there are two transition lines corresponding to L=0 → L=1, which are typically shown as [$6^2S_{1/2} \rightarrow 6^2P_{1/2}$] and [$6^2S^{1/2} \rightarrow 6^2P_{3/2}$] and are called D_1 and D_2 line respectively [4].

Although there are two transition lines, when the laser frequency is tuned to a particular transition, the two-level model can be approximately used for the study of the population transfer