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STRONG FIELD EFFECTS IN RABI OSCILLATIONS BETWEEN A SINGLE SATE AND SUPERPOSITION OF DIRAC POTENTIALS

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Rabi oscillations of quantum population are known to occur in two level systems driven by spectrally narrow laser fields. In this work we study Rabi Oscillation induced by shaped broadbond fematosecond laser pulses. The electromagnetic filed potential in one dimensional stationary Dirac model in which the Pauli and revival of the Rabi Oscillations.

INTRODUCTION

The coherent population transfer with broadband laswer pulses has been the focus of much theoretical work in the last two decades. The population dynamics and the origin of population oscillations are weak and strong laser fields. In weak laser pulse driving a single photo transition, and the population of the target excited state linearly proportional to the spectral power density at the transition frequency [1]. In this perturbative regime of interaction, oscillatory dynamics of the excited state population have been observed and attributed to coherent transients. [2]. The later have been used for quantum state reconstruction [3] and for enhancing the excited state population by means of femtosecond pulses shaping [4].

In the recent years, there have been several efforts to control the collapses and revivals [5, 6, 7, 8]. The Darboux transfer is very useful to describe the evalution of a physical system due to the change of its Hamiltonian potential as found in wide range of non-linear physics. However its contribution to the field of quantum conputation is still poorly understood.

In this work we discuss the Oscillations of atomic population in strong fields governed by the non-purturbative regime of atom-photon interaction. Two level atoms in strong laser fields have been thoroughly studied in a series of works on selective population of dressed states both with transform-limited and shaped femtosecond pulses. When applied to multi-level systems, strong laser fields often shift the energy of near-resonant atomic levels, creating a number of time-dependent dressed states evolving on a femtosecond time scale.

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The Application of Darboux transformations to one-dimensional Dirac equation is performed by interwining the Hamiltonian in Dirac Equation :

$$\hat{L}h_0 = h_1\hat{L} \quad \text{... (1)}$$

where $\hat{L}$ is interwining operator and $h_0[h_1]$ is the old (new) Dirac Hamiltonian. Is the sense of perturbation theory, h_0 (h_1) is unperturbed Dirac Hamiltonian, where $h_1 = h_0 + v\ (\alpha, \beta)$ in which $\{\alpha, \beta\}$ contributing into the perturbation of terms.

Schrodinger Equation into one-dimensional stationary Dirac equation of Rabi model.

$$\hat{h}\psi = \varepsilon_0\psi \quad \text{... (2)}$$

where $\hat{h} = \left(i\sigma_z \frac{d}{dt} + v\right)$, $v = -h(\sigma^+ b(t) - \sigma^- b(t))$ and ϵ_0 is $h\omega_0/2$, We also use the following assumption $b(t) = b_0 e^{-iwt}$, and $b_i[1](t) = 2\beta_i(t) - b(t)$

Because b_0 is a constant and real, $b_0^+ = b_0$, then

$$V(t) = uh\Omega b_0\,[\sigma_x \,\text{sine}\,(wt - \sigma_y \,\text{con}\,(wt)]$$

The Dirac potential in the equation (2) can be easily changed into $V(t) = ih\Omega b_0[\sigma_x \,\text{sine}\,(wt - \sigma_y \,\text{con}\,(wt)]$ meaning that the potential is vector form using Pauli matrices as orthogonal basis.

CONCLUSION

Our results confirm the feasibility of applying π - pulses to multilevel systems for efficient population transfer on a femto second time scale. The Perturbation theory on the system is described by the application of one fold Darboux transformation for the potential transformations Rabi model. For simplicity, we use the result of this transformation to obtain the Rabi oscillations transformation by involving classical effect of electromagnetic in the equation.

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