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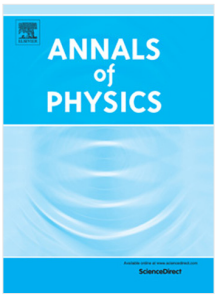

Damped Rabi oscillations produced by adiabatic pulses in atomic systems

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Damped Rabi oscillations produced by adiabatic pulses in atomic systems

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Abstract

Propagation of optical pulses in adiabatic conditions in two-level systems was reported to induce Rabi oscillations if the initial state has atomic coherence. This is a surprising result since in ordinary conditions the population dynamics follows the temporal field profile. In this paper we construct a simple two-level atom model and examine the role of Rabi oscillations in the presence of a damping γ term (decoherence). We have found that, depending on the time scale between $1/\gamma$ and the pulse, Rabi oscillations are still present. However, if the atom decays faster than when the interaction takes place, Rabi oscillations are suppressed. Analytical solutions are also provided for this general case.

Keywords: Quantum optics, Rabi oscillations, adiabatic pulses, atomic coherence

1. Introduction

A two level system is said to perform Rabi oscillations when the population dynamics, usually driven by an external applied field, varies in a periodic manner [1, 2]. This effect was first studied by I. Rabi eighty years ago, in the context of magnetic resonance, and its formalism can still be used to shed light into problems in several different contexts, not only in the atomic domain. In particular, Rabi-type oscillations were studied in the context of quantum dots [3], optical lattices [4, 5] and Bloch bands in a crystal [6], to cite a few. In the semiclassical approach, the field is treated classically and the atom (or a general two level system) is quantized. One then seeks a solution for the population