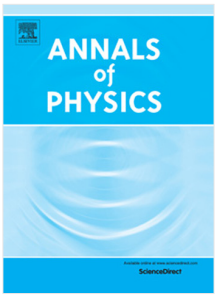
Accepted Manuscript



Geometric phase of entangled atomic qubits coupled to Lorentzian reservoirs

Ming-Feng Chen, Rong-Xin Chen, Zhen-Biao Yang

PII: S0003-4916(17)30272-5
DOI: https://doi.org/10.1016/j.aop.2017.09.011
Reference: YAPHY 67496

To appear in: *Annals of Physics*

Received date : 20 April 2017
Accepted date : 22 September 2017

Please cite this article as: M. Chen, R. Chen, Z.-B. Yang, Geometric phase of entangled atomic qubits coupled to Lorentzian reservoirs, *Annals of Physics* (2017), https://doi.org/10.1016/j.aop.2017.09.011

Geometric phase of entangled atomic qubits coupled to Lorentzian reservoirs

Ming-Feng Chen[a,b], Rong-Xin Chen[c], Zhen-Biao Yang[a,b,*]

[a] *Department of Physics, Fuzhou University, Fuzhou 350116, P. R. China*
[b] *Fujian Key Laboratory of quantum information and quantum optics, Fuzhou University, Fuzhou 350002, Peoples Republic of China*
[c] *Texas A&M University, College Station, Texas 77843, USA*

Abstract

We consider the unitary time evolution of the joint state of a complex quantum system, composed of two atomic qubits and two sets of Lorentzian reservoirs; two atomic qubits are initially in a maximally entangled state. We study the pure geometric phase for the joint system with the cases of both Markovian and non-Markovian Lorentzian reservoirs as the system undergoes parallel transport, and find that the geometric phase is related to the effective coupling between the entangled qubits and the reservoirs. This distinct result, as compared to that found in the previous studies, is due to the entanglement between the qubits and the reservoirs. Finally, the relation between entanglement and the geometric phase is discussed.

Keywords: Geometric phase, Open system, Entangled state

1. Introduction

Berry found that when a quantum system is driven by some slowly and cyclically changing external parameters as well as begins in an eigenstate and ends in the original state, the wave function of the quantum system will obtain an extra phase in addition to the usual dynamic phase[1], namely Berry phase. Such phase is also called geometric phase as it is independent of the dynamical

*Corresponding author
Email address: zbyang@fzu.edu.cn (Zhen-Biao Yang)