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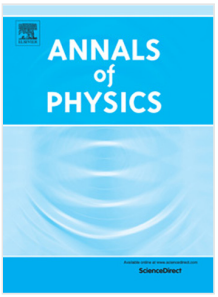

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Xinyu Zhao, Wufu Shi, J.Q. You, Ting Yu

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Non-Markovian Dynamics of Quantum Open Systems Embedded in a Hybrid Environment

Xinyu Zhao[1], Wufu Shi[1], J. Q. You[2,3], Ting Yu[1,2,4*]

[1] *Department of Physics and Engineering Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030, USA*

[2] *Beijing Computational Science Research Center, Beijing 100094, China*

[3] *Synergetic Innovation Center of Quantum Information and Quantum Physics, University of Science and Technology of China, Hefei, Anhui 230026, China*

[4] *School of Physics and Optoelectronic Engineering, Yangtze University, Jingzhou 434023, China*

Abstract

Quantum systems of interest are typically coupled to several quantum channels (more generally environments). In this paper, we develop an exact stochastic Schrödinger equation for an open quantum system coupled to a hybrid environment containing both bosonic and fermionic particles. Such a stochastic differential equation may be obtained directly from a microscopic model through employing a classical complex Gaussian noise and a non-commutative fermionic noise to simulate the hybrid bath. As an immediate application of our developed stochastic approach, we show that the evolution of the reduced density matrix can be derived by taking the average over both the bosonic noise and the fermionic noise. Three specific examples are given in this paper to illustrate that the hybrid quantum trajectory is fully consistent with the standard quantum mechanics. Our examples also shed new light on the special features exhibited by the fermionic bath and bosnoic bath.

Keywords: Open Quantum System, Non-Markovian, Stochastic

1. Introduction

A quantum system, when it is not isolated, can be in contact with several types of environments. Physically, such open quantum systems like an electron relaxation in a solid may interact with a bosonic system and be coupled to some fermionic systems at the same time [1, 2, 3]. In a similar manner, one can recognize that an atomic system of interest can be coupled to both classical laser fields and quantized radiation fields [4]. Therefore, a hybrid quantum open system

*Corresponding author's email: Ting.Yu@stevens.edu