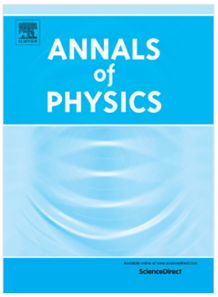
Accepted Manuscript



Perfect quantum state engineering by the combination of the counterdiabatic driving and the reverse-engineering technique

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PII: S0003-4916(17)30199-9
DOI: http://dx.doi.org/10.1016/j.aop.2017.07.010
Reference: YAPHY 67440

To appear in: *Annals of Physics*

Received date : 9 March 2017
Accepted date : 24 July 2017

Please cite this article as: Q. Wu, B. Huang, Y. Chen, Z. Shi, J. Song, Y. Xia, Perfect quantum state engineering by the combination of the counterdiabatic driving and the reverse-engineering technique, *Annals of Physics* (2017), http://dx.doi.org/10.1016/j.aop.2017.07.010

Perfect quantum state engineering by the combination of the counterdiabatic driving and the reverse-engineering technique

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We propose a method to design shortcuts to adiabaticity for implementing perfect quantum state engineering by the combination of the counterdiabatic driving and the reverse engineering technique. Based on the method, we can design simple schemes to realize the intended dynamics. For the sake of clearness, we apply this method to several examples including two-level, three-level and four-level system. We show that fast quantum state engineering can be realized by utilizing simply-designed auxiliary Hamiltonian. Furthermore, a suitable choice of the control parameters can eliminate the additional couplings in the introduced auxiliary Hamiltonian. Numerical simulation reveals that the constructed scheme is reliability and robust against various dissipation effects and the fluctuations of control parameters in current technology.

PACS numbers: 32.80.Qk, 32.80.Xx, 03.65.Yz, 42.50.Dv

Keywords: Shortcuts to adiabaticity, Quantum state engineering, Reverse-engineering technique.

I. INTRODUCTION

Controlling accurately a quantum system is a fundamental task in many areas of quantum information processing [1–3]. It has generated intense theoretical and experimental interests, with numerous approaches developed to allow high fidelity quantum state engineering [4–6] that are robust against dissipation and noise. Among the powerful and interesting strategies [7–9], the quantum adiabatic theorem offers a simple way to prepare and manipulate quantum states, in principle in a robust way, which are ubiquitous in many physics systems [10–15]. However, the schemes based on quantum adiabatic theorem will be limited

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