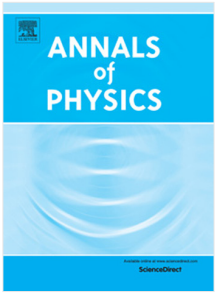
Accepted Manuscript



Trajectory-based understanding of the quantum–classical transition for barrier scattering

Chia-Chun Chou

PII: S0003-4916(18)30104-0
DOI: https://doi.org/10.1016/j.aop.2018.04.017
Reference: YAPHY 67648

To appear in: *Annals of Physics*

Received date : 25 October 2017
Accepted date : 11 April 2018

Please cite this article as: C.-C. Chou, Trajectory-based understanding of the quantum–classical transition for barrier scattering, *Annals of Physics* (2018), https://doi.org/10.1016/j.aop.2018.04.017

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

*Manuscript
Click here to view linked References

Trajectory-based understanding of the quantum-classical transition for barrier scattering

Chia-Chun Chou*

Department of Chemistry, National Tsing Hua University, Hsinchu 30013, Taiwan

Abstract

The quantum-classical transition of wave packet barrier scattering is investigated using a hydrodynamic description in the framework of a nonlinear Schrödinger equation. The nonlinear equation provides a continuous description for the quantum-classical transition of physical systems by introducing a degree of quantumness. Based on the transition equation, the transition trajectory formalism is developed to establish the connection between classical and quantum trajectories. The quantum-classical transition is then analyzed for the scattering of a Gaussian wave packet from an Eckart barrier and the decay of a metastable state. Computational results for the evolution of the wave packet and the transmission probabilities indicate that classical results are recovered when the degree of quantumness tends to zero. Classical trajectories are in excellent agreement with the transition trajectories in the classical limit, except in some regions where transition trajectories cannot cross because of the single-valuedness of the transition wave function. As the computational results demonstrate, the process that the Planck constant tends to zero is equivalent to the gradual removal of quantum effects originating from the quantum potential. This study provides an insightful trajectory interpretation for the quantum-classical transition of wave packet barrier scattering.

Keywords: Quantum-classical transition, Nonlinear Schrödinger equation, Transition trajectory, Eckart barrier scattering, Metastable state.

*Corresponding author
Email address: ccchou@mx.nthu.edu.tw (Chia-Chun Chou)

Download English Version:

https://daneshyari.com/en/article/8201334

Download Persian Version:

https://daneshyari.com/article/8201334

Daneshyari.com