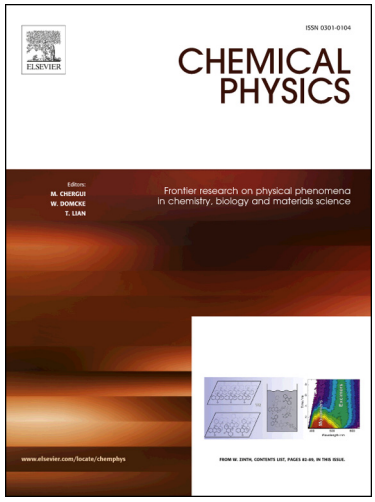

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Quantum dynamics modeled by interacting trajectories

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Abstract

We present quantum dynamical simulations based on the propagation of interacting trajectories where the effect of the quantum potential is mimicked by effective pseudo-particle interactions. The method is applied to several quantum systems, both for bound and scattering problems. For the bound systems, the quantum ground state density and zero point energy are shown to be perfectly obtained by the interacting trajectories. In the case of time-dependent quantum scattering, the Eckart barrier and uphill ramp are considered, with transmission coefficients in very good agreement with standard quantum calculations. Finally, we show that via wave function synthesis along the trajectories, correlation functions and energy spectra can be obtained based on the dynamics of interacting trajectories.

Keywords: quantum dynamics, quantum trajectory, time-dependent quantum mechanics, quantum scattering
2010 MSC: 00-01, 99-00

1. Introduction

The investigation of the real-time dynamics of complex, anharmonic, correlated many-body systems is one of the major challenges in contemporary physics, with implications for reaction dynamics in chemistry and biology. The development of ultrashort laser pulses, first in the femtosecond and more recently in the attosecond domain, allows to follow the dynamics of such systems in real time, yielding a wealth of detailed dynamical information which was formerly unavailable [1, 2]. The interpretation of those measurements require detailed theoretical simulations, which in turn demand the incorporation of the quantum nature of atomic motion.

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