Complex dynamics in diatomic molecules. Part II: Quantum trajectories

Ciann-Dong Yang and Hung- Jen Weng

Accepted 29 March 2007.

Available online 25 May 2007.

Abstract

The second part of this paper deals with quantum trajectories in diatomic molecules, which has not been considered before in the literature. Morse potential serves as a more accurate function than a simple harmonic oscillator for illustrating a realistic picture about the vibration of diatomic molecules. However, if we determine molecular dynamics by integrating the classical force equations derived from a Morse potential, we will find that the resulting trajectories do not consist with the probabilistic prediction of quantum mechanics. On the other hand, the quantum trajectory determined by Bohmian mechanics [Bohm D. A suggested interpretation of the quantum theory in terms of hidden variable. Phys. Rev. 1952;85:166–179] leads to the conclusion that a diatomic molecule is motionless in all its vibrational eigen-states, which also contradicts probabilistic prediction of quantum mechanics. In this paper, we point out that the quantum trajectory of a diatomic molecule completely consistent with quantum mechanics does exist and can be solved from the quantum Hamilton equations of motion derived in Part I, which is based on a complex-space formulation of fractal spacetime [El Naschie MS. A review of

E-Infinity theory and the mass spectrum of high energy particle physics. Chaos, Solitons & Fractals 2004;19:209–36; El Naschie MS. E-Infinity theory – some recent results and new interpretations. Chaos, Solitons & Fractals 2006;29:845–853; El Naschie MS. The concepts of E-infinity. An elementary introduction to the cantorian-fractal theory of quantum physics. Chaos, Solitons & Fractals 2004;22:495–511; El Naschie MS. SU(5) grand unification in a transfinite form. Chaos, Solitons & Fractals 2007;32:370–374; Nottale L. Fractal space-time and microphysics: towards a theory of scale relativity. Singapore: World Scientific; 1993; Ord G. Fractal space time and the statistical mechanics of random works. Chaos, Soiltons & Fractals 1996;7:821–843] approach to quantum mechanics. The fine-structure internuclear potentials obtained in Part I will be exploited here to derive the eigen-trajectories corresponding to each vibrational substate and to find the scattering trajectories under molecular dissociation. Quantum trajectories computed from the real spectroscopic data for several diatomic molecules will be demonstrated and compared.