Are Bohmian trajectories real? On the dynamical mismatch between de Broglie-Bohm and classical dynamics in semiclassical systems

Matzkin, A. and Nurock, V. (2007) Are Bohmian trajectories real? On the dynamical mismatch between de Broglie-Bohm and classical dynamics in semiclassical systems.

Abstract

The de Broglie-Bohm interpretation of quantum mechanics aims to give a realist description of quantum phenomena in terms of the motion of point-like particles following well-defined trajectories. This work is concerned by the de Broglie-Bohm account of the properties of semiclassical systems. Semiclassical systems are quantum systems that display the manifestation of classical trajectories: the wavefunction and the observable properties of such systems depend on the trajectories of the classical counterpart of the quantum system. For example the quantum properties have a regular or disordered aspect depending on whether the underlying classical system has regular or chaotic dynamics. In contrast, Bohmian trajectories in semiclassical systems have little in common with the trajectories of the classical counterpart, creating a dynamical mismatch relative to the quantum-classical correspondence visible in these systems. Our aim is to describe this mismatch (explicit illustrations are given), explain its origin, and examine some of the consequences on the status of Bohmian trajectories in semiclassical systems. We argue in particular that semiclassical systems put stronger constraints on the empirical acceptability and plausibility of Bohmian trajectories because the usual arguments given to dismiss the mismatch between the classical and the de Broglie-Bohm motions are weakened by the occurrence of classical trajectories in the quantum wavefunction of such systems.

Keywords:	Quantum mechanics De Broglie-Bohm interpretation Semiclassical approximation Scientific realism
Subjects:	Specific Sciences: Physics: Quantum Mechanics
ID Code:	3670
Deposited By:	Matzkin, Alex
Deposited On:	26 November 2007
Additional Information:	This is ver. 2 of the preprint quant-ph/0609172 posted on arxiv.org in April 2007. To appear in a slightly different form under the title "Classical and Bohmian trajectories in semiclassical systems: Mismatch in dynamics, mismatch in reality?" in Studies in Hist. and Philosophy of Science B (Modern Phys.)