Trajectory interpretation of the uncertainty principle in 1D systems using complex Bohmian mechanics

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Abstract

Complex Bohmian mechanics is introduced to investigate the validity of a trajectory interpretation of the uncertainty principles $\Delta q \Delta p \geqslant \hbar/2$ and $\Delta E \Delta t \geqslant \hbar/2$ by replacing probability mean values with time-averaged mean values. It is found that the $\hbar/2$ factor in the uncertainty relation $\Delta E \Delta t \geqslant \hbar/2$ stems from a quantum potential whose time-averaged mean value taken along any closed trajectory with a period $T=2\pi/\omega$ is proved to be an integer multiple of $\hbar\omega/2$ for one-dimensional systems.

Keywords: Complex Bohmian mechanics; Uncertainty principle; Trajectory interpretation