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Tunneling, reflection and gravitational weak equivalence principle in the continuous transition from quantum to classical mechanics

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Abstract

In an effort to describe quantum and classical mechanics with the same language, a wave equation for a continuous transition from quantum to classical mechanics has been proposed. Furthermore, the equivalence of this nonlinear equation with a linear one, known as the scaled equation, which is just the Schrodinger equation with the scaled Planck constant instead of the usual one, has been proved. Using this equation, we'll study three interesting phenomena; these include tunneling through a rectangular barrier, total reflection from a hard wall, and the gravitational weak equivalence principle in quantum, transition and classical regions. Time-independent scaled equation for the stationary states is derived and solved for a flux of particles incident on the barrier. The relations show that tunneling probability is exactly zero in the classical regime. For the other problems, we use a Gaussian wavepacket to calculate the expectation value of the position operator in reflection from the hard wall and to estimate the detection probability and arrival time in the problem of the gravitational weak equivalence.

Keywords: quantum-classical transition, scaled wave equation, tunneling, reflection, gravitational weak equivalence principle

For full article, refer to the Persian section