Classical explanation of the quantum problem of the particle in a well: Role of the zero-point radiation field

Luis de la Peña, Ana María Cetto, and Andrea Valdés-Hernández

Instituto de Física, UNAM, Apartado postal 20-364, Ciudad Universitaria, 01000 Mexico, DF, Mexico

The problem of a quantum particle confined in an infinite square-well potential is approached from a novel point of view that helps to throw light on the physics behind its known solution. Our approach consists in the study of an ensemble of charged particles (typically electrons) confined inside the well, described by classical physics and subject to the action of the stochastic zero-point radiation field. The high-frequency modes generate a jiggling motion and give rise to the de Broglie wave that accompanies the particle along its mean trajectory. This endows de Broglie's wave with an electromagnetic nature. The associated Lorentz force is responsible for the odd distribution of particles inside the well. Though the calculation, being strictly classical, leads to an approximate result, it serves to disclose the key role played by the field in producing the counterintuitive quantum behavior.

Acknowledgment. The authors acknowledge financial support from DGAPA-UNAM through project IN104816.