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Quantum Particle on a Lattice: Interaction with a Periodic Potential MARK O'CALLAGHAN, BRUCE MILLER, Texas Christian University — We study the equilibrium properties of a single quantum particle (qp) interacting with a classical lattice gas for a wide range of temperatures that will explore the system's behavior in the classical as well as in the quantum regime. A path-integral formalism is developed in which the quantum particle is represented by a closed, variable-step random walk on the lattice. Monte Carlo methods are employed to determine the system's properties. For the case of a free particle, in earlier work the canonical ensemble was utilized to derive analytical expressions for the energy, its fluctuations, and the qp-qp correlation function. Here the Metropolis algorithm is employed to determine the effects of interactions between each atom and the qp for a specific potential. We consider a striped potential in one dimension, where every other lattice site is occupied by an atom with potential ?, and every other lattice site is empty. An analytical solution was determined in this case by utilizing Bloch's theorem due to the periodicity of the potential. Comparisons of the potential energy of the qp are made between the results of the Monte Carlo simulations and the analytical calculations.

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