Abstract

Different candidates of Quantum Gravity such as String Theory, Doubly Special Relativity, Loop Quantum Gravity and black hole physics all predict the existence of a minimum observable length or a maximum observable momentum which modifies the Heisenberg uncertainty principle. This modified version is usually called the Generalized (Gravitational) Uncertainty Principle (GUP) and changes all Hamiltonians in quantum mechanics. In this Letter, we use a recently proposed GUP which is consistent with String Theory, Doubly Special Relativity and black hole physics and predicts both a minimum measurable length and a maximum measurable momentum. This form of GUP results in two additional terms in any quantum mechanical Hamiltonian, proportional to αp^3 and $\alpha^2 p^4$, respectively, where $\alpha \sim 1/M_{Pl}c$ is the GUP parameter. By considering both terms as perturbations, we study two quantum mechanical systems in the framework of the proposed GUP: a particle in a box and a simple harmonic oscillator. We demonstrate that, for the general polynomial potentials, the corrections to the highly excited eigenenergies are proportional to their square values. We show that this result is exact for the case of a particle in a box.