

Nonlocal Phenomena in Quantum Mechanics

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Abstract : In theoretical physics, nonlocal phenomena has always been subject of debate. However, in the conventional mathematical approach where the developments of the physical systems are investigated by using the standard mathematical tools, nonlocal effects are not taken into account. In order to investigate the nonlocality in quantum mechanics and fractal property of space, fractional derivative operators are employed in this study. In this manner, fractional creation and annihilation operators are introduced and Einstein coefficients are taken into account as an application of concomitant formalism in quantum field theory. Therefore, each energy mode of photons are considered as fractional quantized harmonic oscillator hereby Einstein coefficients are obtained. Nevertheless, wave function and energy eigenvalues of fractional quantum mechanical harmonic oscillator are obtained via the fractional derivative order α which is a measure of the influence of nonlocal effects. In the case $\alpha = 1$, where space becomes homogeneous and continuous, standard physical conclusions are recovered.

Keywords : Einstein's Coefficients, Fractional Calculus, Fractional Quantum Mechanics, Nonlocal Theories

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