J Phys Chem Biophys 2018, Volume 8
DOI: 10.4172/2161-0398-C1-029

Quantum physics in phase space

Ronni G G Amorim
University of Brasília, Brazil

In this work we discuss about non-relativistic and relativistic quantum theory in pase space. The notion of phase space in quantum mechanics arose in 1932, in a seminal paper by Wigner, motived by problem of finding a way to improving the quantum statistical mechanics. Wigner introduced his formalism by using a kind of Fourier transform of density matrix giving rise to what is nowadays called the Wigner function. The Wigner function is identified as a quasi-probability density, and as such cannot interpreted as a probability. However, when we integrate the Wigner function in position or momentum, distribution functions are founded. In the Wigner formalism, each operator, defined in the Hilbert space is associated with a function, in phase space. This procedure is precisely specified by a mapping, such that, the associative but non-commutative algebra of operator defined in Hilbert space associated to phase space. The Wigner function in several areas, such as condensed matter physics, nuclear physics, quantum computation and statistical quantum mechanics. In this work, in non-relativistic case, we construct using star operators, a representation of Galilei group on a symplectic manifold and obtained the Schrödinger equation in phase space, such that the wave function is closely associated with the Wigner function. This provides a fundamental ingredient for the physical interpretation of the formalism. In relativistic perspective, we also star operators to construct a representation of Poincaré group and we obtained the Klein-Gordon and Dirac equations in phase space and related the solutions in phase space with Wigner function. This provides a new approach to calculate the Wigner function. As application, we solved tthe Schrödinger equation in phase space for harmonic oscilattor and we calculated the Wigner function associated with them.

ronniamorim@yahoo.com.br