Phenomenological stochastic approach: Brownianlike vs quantumlike processes

A. M. Cetto and L. de la Peña

Instituto de Física, Universidad Nacional Autónoma de México

We present a phenomenological approach to stochastic processes, based on the theory of stochastic quantum mechanics. The kinematics of the process is developed using a description that involves finite time intervals Δt and up to second-order derivatives, leading to two different velocities and four accelerations. An extended `Newton's Second Law' expressed as a linear combination of these accelerations, leads under appropriate conditions to two equations, one being equivalent to the continuity equation and the second one representing a general dynamical law. The Schrödinger equation follows from this set of equations for a particular selection of the parameters. More generally, a neat distinction is established between classical (or Einstein type) and quantum (or de Broglie type) stochastic processes, by showing that they imply an altogether different and incompatible choice of the parameters. The convergence with hydrodynamics under certain conditions is noted. A discussion is made of the appearance of wavelike properties and nonlocality in stochastic quantum mechanics.