Generalized quantum Ehrenfest equations including radiative corrections

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Within the framework of our programme on the Foundations of Quantum Theory, a central role is played by the generalized (phase-space) Fokker-Planck equation of Stochastic Electrodynamics. This equation is established on the assumption that the random zero-point field is the source of the stochasticity of the particle motion leading to their quantum behavior.

From the Fokker-Planck equation a series of average balance equations can be derived, which apply to the mechanical system in the quantum regime, i.e. when the Schrödinger equation holds. Valuable information about the average behavior of dynamical quantities is thus obtained, reminiscent of the Ehrenfest equations of quantum mechanics, but containing additional terms that represent radiative corrections. Without the need of conventional perturbative methods, one can thus obtain the set of formulas for the first-order radiative corrections of nonrelativistic QED, including: the atomic radiative lifetimes, the Lamb shift, and modifications to these due to changes that affect the background radiation field.