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Quantum master equation for fermions and a unitary relativistic quantum theory

A system of fermions is usually described by a Hamiltonian with Fermionic operators. However, such a system is never isolated, but in a dissipative environment of the free electromagnetic field at a certain temperature, of the collective rotations and vibrations of this system, or of the support system, and of other neighboring particles. The dissipative dynamics is usually described as a time-dependent dynamic semigroup, depending on unspecified, phenomenological parameters. In this framework, more or less at the same time with other authors, we found that dissipation increases the penetrability of a potential barrier, fitted a cold fission spectrum, and calculated the width ratio of the two bumps of a double nuclear giant resonance. However, in the following investigations, we used the more physical method of Ford, Lewis, and O'Connell, providing explicit, microscopic coefficients. In this way, we derived master equations for Fermions, Bosons, and electromagnetic field, imagined a device converting environmental heat into usable energy, and effectively calculated the physical characteristics of such a device. This description is based on two different theories: quantum mechanics, and the electromagnetic theory. Here we show that the equations of these two theories can be obtained in the same theoretical framework, of a unitary relativistic quantum theory. We conceive a particle as an unconventional wave packet in the coordinate and momentum spaces, providing the two Hamilton equations as group velocities in these spaces, while the Hamiltonian in the time dependent phase of the conventional wave packet is replaced by the Lagrangian. We adopt a relativistic quantum principle, asserting that the time dependent phase is invariant to an arbitrary change of coordinates. When a finite spectrum is considered, the relativistic dynamics is obtained for a quantum particle. We describe the interaction of such a particle with a field by a variation of the time dependent phase, with terms proportional to the coordinate and time variations, while the coefficients of these terms define the vector and scalar potentials of this field. From the group velocities of a quantum particle, we obtain the Lagrange equation, the Lorentz form of a mechanical force, and three Maxwell equations. For a field propagating with the limit velocity c of the quantum particle waves, the fourth equation, Ampère-Maxwell, is obtained. In this theoretical framework, we obtain the spin as a characteristic of a quantum particle, and demonstrate the spin-statistics relation.

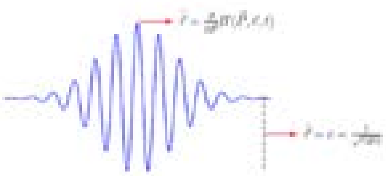

Figure: *Quantum particle wave-packet with a limit velocity c, interacting with an electromagnetic field propagating with this velocity.*

Biography

Eliade Stefanescu is a graduate of Faculty of Electronics, Section of Physicist Engineers in 1970 and completed PhD in Theoretical Physics in 1990, is a professional with multidisciplinary openness: electronics, physics of semiconductor devices, and open quantum physics with applications in quantum optics and nuclear physics.

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