

A Relativistic Extension of Stochastic Electrodynamics

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Based on the approach to quantization of Cetto's et al. [1-4], we develop a relativistic extension of stochastic electrodynamics. The proposed framework reproduces the relativistic quantum theory in appropriate limits and enables the systematic study of quantum phenomena of relativistic origin. Our formulation is based on the Lorentz-covariant, canonical description of the particle-field system provided by the multisymplectic Hamiltonian formalism [5-7] and relies on a generalized Poisson bracket that yields a unified description of the system [8]. We show that in the stationary regime the particle's canonical variables can be expressed as a Fourier expansion in terms of the field's normal modes, rendering the particle dynamics fully driven by the field. This assigns a new kinematic meaning to the associated Poisson bracket, forming the basis of our relativistic generalization of stochastic electrodynamics [9]. The results suggest a physical basis for the replacement of phase-space functions by operators in quantum theory and contribute toward a Lorentz-covariant formulation of canonical quantization.

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