DOI: doi.org/10.47363/JPSOS/ICWOQ2025/2025(7)2

International Conference on
Wave Equations, Optical Engineering and Quantum Mechanics (ICWOQ-2025)

Conference Proceedings April 25, 2025 - Barcelona, Spain

Reappraisal of QED Mathematical and Physical Fundamentals

Constantin Meis

Professor at the National Institute for Nuclear Science and Technology, and Research Director at the French Atomic Energy Commission (CEA-Saclay), France

The Quantum Electrodynamics fundamental drawbacks are revisited and analyzed. It is question of the photon vector potential amplitude operators, the electromagnetic field harmonic oscillator Hamiltonian with the associated zero-point energy singularity and the electron-vacuum interaction Hamiltonian. Without stating postulates or advancing any hypothesis it is shown that the QED ambiguities can be readily overcome by enhancing the quantization of the vector potential amplitude to a single photon level. This process does not compromise any of the QED achievements. Ensuing the single photon vector potential quantization the electromagnetic vacuum, a zero-energy universal field depending on the photon creation and annihilation operators, appears naturally complementing coherently the normal ordering Hamiltonian without involving singularities. It permits the establishment of an electron-vacuum interaction Hamiltonian which could not be defined in QED previously. Finally, it leads to the definition of a real photon wave function as a probability amplitude, normalized within an intrinsic quantization volume and satisfying Maxwell's propagation equation as well as Schrödinger's equation for both the photon energy and vector potential.