ÉCOLE D'ÉTÉ ≪ MÉCANIQUE STATISTIQUE DE NON-ÉQUILIBRE ≫
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A mathematical introduction to quantum electrodynamics

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QED is a beautiful, logically coherent theory that can be developed from a small number of postulates, even though, most probably, it cannot be defined non-perturbatively and exists only as a formal perturbative expansion. In my lectures I will try to give a systematic presentation of introductory chapters of QED. I will include some topics which in most standard textbooks are neglected or, in my opinion, treated in an unsatisfactory fashion.

Below is an approximate plan of the lectures :

• General quantum theory (adiabatic scattering theory, Gell-Mann–Low theorem, Sucher formula, time-ordered Green's functions).

• Postulates of QFT (Poincaré covariance, spectral condition, Einstein causality, Haag-Kastler axioms, Wightman axioms).

• Real Klein-Gordon equation and its quantization (symplectic space of real solutions of the Klein-Gordon equation, positive energy quantization of neutral bosons, causal propagator).

• Proca equation and its quantization (massive photons interacting with a current, freedom of the choice of a propagator).

• Maxwell equation and its quantization (massless photons interacting with a current, freedom of the choice of a propagator, gauge invariance, infrared problem).

• Complex Klein-Gordon equation and its quantization (positive energy quantization of charged bosons, interaction with an external potential, gauge invariance, Ward identities).

• Dirac equation and its quantization (natural scalar product on the space of solutions of the Dirac equation, positive energy quantization of charged fermions, interaction with an external potential, gauge invariance, Ward identities).

• Full QED (Feynman rules for Green's functions and scattering amplitudes, tree amplitudes, renormalization, scattering in an external potential, anomalous magnetic moment, quasi-bound states in an external potential, Lamb shift).

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