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PhD Proposal - Laboratoire ICB, Université Bourgogne Europe

Title: Quantum electrodynamics in external fields at finite times

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Consider a quantized Dirac field in an external electromagnetic or gravitational field. It is a well-known problem that the dynamics of a system cannot be implemented on the standard Fock space of electrons and positrons if the magnetic field is non-zero.
This problem has been approached in the past by constructing interacting space-time vacuum (Hadamard) states, or implementing the dynamics with a time-dependent splitting of electron/positron degrees of freedom and resulting Fock spaces. The first goal of the project is to examine these approaches and prove their equivalence or quantify any deviations. The second goal is a more quantitative study of the problem. For external fields vanishing at asymptotic times, it is known that the scattering operator can be implemented on the standard Fock space and describes, in particular, pair creation by the external field at asymptotic times. The detailed construction of finite-time dynamics will allow for the study of pair creation at such times, including quantitative estimates in terms of the magnetic and gravitational fields.

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