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# On the Adiabatic Limit for Dirac Particles in External Fields

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**Abstract.** An adiabatic switching formalism is proposed to bypass the difficulties in defining the spontaneous pair creation in static electromagnetic fields.

## 1. Introduction

The interest in the basic theoretical problems of Q.E.D. (Quantum Electro-Dynamics) in strong external electromagnetic fields has been stimulated in the last years by the experimental facilities of the heavy ion physics. During the collision of two heavy nuclei a very strong electromagnetic field is created and new phenomena, absent in weak fields, are expected to arrise.

From the experimental point of view, the most striking phenomenon which is expected to set in is the "spontaneous" creation of electron-positron pairs.

A rich literature exists [1–4] concerning Q.E.D. in strong fields, but most of the results are based on nonrigorous treatments, analogies and speculations. In particular, the mechanism of spontaneous pair creation is explained usually [3] by a "gedanken" experiment as an adiabatic increase of the external charge, via the analogy with selfionization of helium. In our opinion, it is very hard to put these calculations on firm basis without relying on scattering theory. In fact the pair creation, spontaneously or not, is a scattering phenomenon and must be treated as such.

The main difficulty in the subject is the fact that one cannot use perturbation theory with respect to the external field. On the other hand, if one neglects the electromagnetic field created by the electron-positron field, the problem can be treated by nonperturbative methods. This approximation is known as the external field problem in Q.E.D. and there exist a lot of rigorous result about it (see [5, 6] and references therein, also [7–10] for recent results; for a review of rigorous results, relevant to strong field phenomena see [11]).

Unfortunately, the discussion of the problem of spontaneous pair creation, in the framework of the external field problem in Q.E.D., meets some difficulties

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