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Existence of the Spontaneous Pair Creation in the External Field Approximation of Q.E.D.

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Abstract. The problem of the spontaneous pair creation in strong electromagnetic fields is considered in the adiabatic switching formalism. The existence of a critical value of the strength of the external field at which the behaviour of the pair production probability has an abrupt change is proved.

1. Introduction

This note is a direct continuation of [1], and concerns the existence of the overcritical fields in the framework of the external field approximation of Q.E.D. (see [2] and references therein). In [1] the existence of the overcritical fields (or in other words the existence of the spontaneous pair creation) was viewed as the breakdown of the adiabatic switching theorem: for sufficiently strong external fields the pair creation is by far more copious than one expected from the time variation of the external fields; in particular it does not vanish as the "speed" of the time variation of the external fields goes to zero. This is completely different from the low field regime where the pair creation comes entirely from the time variation of the external fields and vanishes in the adiabatic limit, i.e. the adiabatic limit coincides with the static result [3]. It is believed (for references to the physical literature about the subject see [4–6]) that the change in the behavior of the pair production probability is an abrupt one and takes place at a value of the external field called the critical field.

In [1] the notions of the "undercritical" and "overcritical" static fields were made precise, some conjectures were put forward and the "undercritical" part of these conjectures was proved. On the other hand, the important problem of the existence of the overcritical fields was left open. Unfortunately, due to a technical difficulty (see the remark at the end of Sect. 3) at the present we are unable to prove the existence of the overcritical fields as described by the conjectures put forward in [1]. However, we are able to prove the existence of the sudden change from

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