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Some Remarks on Local Operators in Quantum Electrodynamics*

R. Ferrari and L. E. Picasso

Istituto di Fisica dell'Università, Pisa, Istituto Nazionale de Fisica Nucleare, Sezione di Pisa, Pisa, Italy

F. Strocchi**

Joseph Henry Laboratories of Physics, Princeton University, Princeton, New Jersey, USA

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Abstract. We assume the existence of a conserved current which generates locally gauge transformations of first kind. We are working in a local quantum Field Theory, where the fields are defined on a vector space where indefinite metric is allowed.

We show that the Maxwell equations are not consistent with the above assumptions and the vectors obtained by applying local charged operators on the vacuum cannot describe physical states.

Moreover we show that, if charged fields have non-trivial expectation value on the physical states, the vector space must contain vectors with negative norm.

We discuss the relation between the local formulation of QED and a formulation in terms of physical states. As an example we study the transition from Gupta-Bleuler free QED to the Coulomb-gauge formulation.

1. Introduction

The aim of the present note is to discuss locality in quantum electrodynamics (QED) and in particular to analyze the restrictions imposed by this property on the structure of the theory. A way to get information about the formal structure of the theory is to use perturbation theory. In that way, the general properties like locality and covariance are essentially dictated by the free field case and one is essentially led to the standard formulations (the local and manifestly covariant Gupta-Bleuler formulation [1] or the non local and non manifestly covariant Coulomb gauge formulation [2]). However, since very little is known about the convergence of the renormalized perturbation expansion, it is of some interest to discuss some general features of the theory, in

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** Present address: Istituto Nazionale di Fisica Nucleare, Sezione di Pisa, Pisa, Italy.