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The Charged Sectors of Quantum Electrodynamics in a Framework of Local Observables

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Abstract. The construction of charged sectors in Quantum Electrodynamics (QED) is analyzed within a framework of algebras of local observables. It is argued that charged sectors arise by composing a vacuum state with charged * morphisms of an algebra of (neutral) quasi-local observables. Charged * morphisms, in turn, are obtained as weak limits of charge transfer cocycles. These are non-local elements of the algebra of all quasi-local observables obeying "topological" commutation relations with the local charge operators. It is shown that in this framework, charged sectors are invariant under the time evolution and satisfy the relativistic spectrum condition. The total charge operator is well defined and time-independent (conserved) on all charged sectors. Under an additional hypothesis the spectrum of the total charge operator is shown to be a discrete subgroup of the real line. A generalized Haag-Ruelle scattering theory for charged infra-particles is suggested, and some comments on non-abelian gauge theories are described.

0. Introduction

This paper is a continuation of the analysis presented in [1], hereafter referred to as I. In that paper we have investigated charged sectors in gauge theories with unconfined, abelian charges, in particular QED, from the points of view of a local, covariant formulation on an indefinite metric space and of collision theory, using as one basic input Buchholz' results [2]. Moreover, the construction of charged states in QED was analyzed heuristically, extrapolating procedures applicable in lattice gauge theories to the continuum theory. In this paper that analysis is replaced by a mathematically rigorous one, based on a few general, physical principles.

The main results of Paper I are as follows:

Asymptotic charged fields (if they exist; see Sect. 7 of this paper) are non-local relative to the asymptotic, electromagnetic field and are not covariant under Lorentz boosts.

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