

Spontaneous Breakdown of Symmetries and Zero-Mass States*

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Abstract. In a relativistic field theory Goldstone's theorem is proved without any assumption about the existence of covariant fields and for arbitrary expectation values.

I. Introduction

In a recent paper [1] the problem of spontaneous breakdown of symmetries and the connection between algebraic automorphism and their unitary implementation in a Hilbert space was investigated.

In the framework of an algebraic field theory of the type formulated by HAAG and KASTLER [2], it was shown that automorphism connected with locally conserved currents are always unitarily implementable in a representation in which the energy-momentum spectrum has a gap between the vacuum and a lowest mass hyperboloid. Therefore a spontaneous breakdown of the symmetry which is associated with the conservation law can occur only if the energy-momentum spectrum has no such gap.

In the present note under the same assumptions as in [1] a stronger result is obtained: The automorphisms are unitarily implementable unless the mass spectrum has a $\delta(\kappa^2)$ -singularity at the light cone. This is closer to what is usually understood by Goldstone's theorem [3] than the result of [1].

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