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Some Remarks on the "Null Plane Development" of a Relativistic Quantum Field Theory

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Abstract. We give conditions for the existence of field operators on so-called null planes and discuss some consequences of the necessary restriction of the test function space, concerning Haag's theorem and the possibility of unitary mappings intertwining between free fields of different masses. In the last section we discuss conditions under which a unitary representation of the dilatations in the null plane gives rise to a unitary representation of the dilatations in Minkowski space.

1. Introduction

During the last years there has been a growing interest in the formulation of current algebra and field theory in the so-called "infinite momentum frame". The starting point was the observation made by Fubini and Furlan [1] that certain current algebra sum rules become especially simple if a space component of the momentum (e.g. p_z) goes to infinity. In the meantime several papers treating related problems have been published [2–14]. To express these ideas in a mathematically more rigorous form some authors [8–14] introduced the concept of field operators defined on so-called null planes, i.e. planes tangent to the light cone.

The following remarks are inspired by a talk given by Rohrlich [12] and the paper by Leutwyler, Klauder and Streit [13] (in the following quoted as "LKS"). We hope that they may give some further insight into the questions concerning Haag's theorem, unitary equivalence of different fields and "dilatation invariance" in the case of field operators on null planes.

We use the notation of Leutwyler, Klauder and Streit [13]:

The null plane Σ is given by the equation

$$n_\mu x^\mu = 0 \tag{1.1}$$

where

$$n_\mu = \frac{1}{\sqrt{2}}(1, 0, 0, 1). \tag{1.2}$$