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A Jost-Schroer Theorem for String Fields

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Abstract. It is shown that the truncated Wightman functions of three or more string-localized fields vanish if they are solutions of a Klein-Gordon equation in each variable. As an application it is shown that a string field is a free field if its two-point functions are those of a free field. Another application to perturbation theory is pointed out.

1. Introduction, Results

Gauge theories confront us with, among others, the following two problems.

i) There exist very different looking but physically equivalent formulations, called "gauges," of the theory. This makes the interpretation of the formalism, in particular the search for the physical significance of the basic fields, difficult.

ii) In the physical gauges, i.e. formulations which work in a physical state space with positive metric, the basic fields are neither covariant nor local. As a consequence, many of the well-known methods and results of local field theory are not immediately applicable. This holds especially for most of the rigorous results of axiomatic field theory.

Mandelstam [1] proposed to solve the first of these problems, e.g. in QED, by working only with the gauge independent fields $F_{\mu\nu}(x)$ and $\psi(x)\exp\left\{-ie\int_{-\infty}^{x} d\xi^\mu A_\mu(\xi)\right\}$. Since this device merely replaces gauge dependence by path dependence the gain might look doubtful at first. However, recently Buchholz and Fredenhagen [2] have shown that this strategy also goes a long way towards solving problem ii): important axiomatic results can be derived for fields which are localized on space-like strings or more generally in space-like cones. In particular this is true for the construction of asymptotic scattering states, i.e. for the very non-trivial problem of identifying states of the formalism with the states found in nature. Further investigation of charged string-localized fields is thus indicated, continuing both the rigorous approach of Buchholz and Fredenhagen as well as the more down-to-earth dynamical studies of specific models as carried out by Mandelstam and others [1, 3].

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