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A Class of Nontrivial Weakly Local Massive Wightman Fields with Interpolating Properties

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Abstract. It is shown that in a quantum field theory satisfying Wightman's axioms with locality replaced by weak locality and cyclicity by a weak irreducibility, every unitary Poincaré invariant and CPT-invariant operator is a scattering operator (in the LSZ-sense). The proof is given by explicit construction of a corresponding class of nontrivial weakly local massive Wightman fields. This result implies Jost's conjecture that only locality leads to nontrivial restrictions for the scattering operator and extends corresponding results of Schneider.

1. Introduction

In an interesting paper Jost [1] gave some arguments for the conjectures that, in the framework of a Wightman theory without locality, first the existence of a scattering operator $S \neq 1$ and the weak locality are compatible, i.e. noncontradicting, conditions and, second, the CPT-invariance of the scattering operator is the only condition for the scattering operator implied by weak locality. As Jost himself says (in this paper), the arguments for these purposes are "formal considerations" (formal construction of models which can be used to prove the assertions just mentioned).

Schneider [2] undertook the attempt to make these arguments in Jost's paper rigorous, i.e. he tried to get the corresponding models rigorous. In fact the results of Schneider are rigorous but there are some deficiencies. The first essential defect is that the test functions for his quantum fields are not the functions from $\mathscr{S}(\mathbb{R}^4)$, as required by the Wightman axioms. Another defect is that his construction of the weakly local quantum fields from the given scattering operator S works only under additional assumptions on S (not only under unitarity, Poincaré invariance and CPT-invariance).

Some remarks of Todorov [3, pp. 666 and 686] suggest the impression that it is easy to construct rigorously quantum fields along the lines sketched by Jost implying the conjectures mentioned above. Perhaps this is true, but we were not