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Free Field Representation For Massive Integrable Models

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Abstract. A new approach to massive integrable models is considered. It allows one to find symmetry algebras which define the spaces of local operators and to get general integral representations for form-factors in the $SU(2)$ Thirring and Sine–Gordon models.

1. Introduction

Two dimensional integrable field theory today is among the most advanced topics in relativistic field theory. The reason essentially lies in specific two-dimensional symmetries which lead to exact solutions of the quantum field dynamics.

In a massive theory these symmetries show up as a drastically simplified scattering theory called Factorized Scattering Theory (FST). This structure was first observed in non-relativistic scattering of spin waves [1] and quantum particles with point-like interaction [2, 3], and also in classical scattering of solitons in nonlinear field models [4, 5]. Factorized scattering preserves the number of particles and the set of their on-mass-shell momenta. This conservation is ensured by an infinite series of commuting integrals of motion [6, 7]. The computation of the exact factorized S-matrix may be performed by combining the standard requirements of unitarity and crossing symmetry together with the symmetry properties of the model [8–10]. Large variety of the factorized scattering theories was constructed explicitly (see e.g. [11–16]).

The two particle S-matrix uniquely specifies a structure of a space of local operators for integrable models. In other words, its knowledge can be used to compute off-shell quantities, like correlation functions of elementary or composite fields of the integrable models under investigation. This can be achieved by considering the form-factors of local fields, which are matrix elements of operators between asymptotic states [17, 18]. A very important step in this direction was taken in a series of papers [19–21], where it was shown that general properties of unitarity, analyticity

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