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Bosonization, Topological Solitons and Fractional Charges in Two-Dimensional Quantum Field Theory

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Abstract. We further develop the quantization of topological solitons in two-dimensional quantum field theory in terms of Euclidean region functional integrals. Our approach is nonperturbative and mathematically rigorous. We apply it to construct physical states with fractional fermion number in models of interacting bosons and fermions without recurring to a semiclassical approximation. A related issue discussed in this paper is two-dimensional chiral bosonization.

1. Introduction

In this paper we reconsider the quantum theory of solitons in quantum field models in two space-time dimensions. Our purpose is to construct Euclidean Green functions of *local* order fields and soliton fields in terms of Euclidean region functional integrals. We also discuss the algebraic structure defined by the order- and the soliton fields [1] and associated monodromy structure of their Euclidean Green functions. It will turn out that those Green functions are simply correlation functions of products of order- and disorder variables.

A mathematically rigorous approach to soliton quantization within the Hamiltonian formalism of quantum field theory was first developed in [1]. It turned out, however, that for purposes of a detailed analysis of concrete models a Euclidean approach to soliton quantization would be more powerful; (see [2] for a systematic treatment of soliton quantization in terms of Euclidean region functional integrals within the context of lattice theory).

The idea that the superselection structure of a large class of quantum field theories in two and more space-time dimensions is encoded, in a mathematically precise sense, in the set of correlation functions of general local order- and disorder variables (especially disorder variables associated with *line defects* of the corresponding Euclidean field theory) was first conceived in the first reference quoted in [3], although of course order-disorder correlation functions had already been studied earlier, and attempts had been made to extract information about the field theory from such order-disorder correlation functions [4]. The proposal in