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Free Boson Realization of $U_q(\widehat{sl_N})$

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Abstract: We construct a realization of the quantum affine algebra $U_q(\widehat{sl_N})$ of an arbitrary level k in terms of free boson fields. In the $q \to 1$ limit this realization becomes the Wakimoto realization of $\widehat{sl_N}$. The screening currents and the vertex operators (primary fields) are also constructed; the former commutes with $U_q(\widehat{sl_N})$ modulo total difference, and the latter creates the $U_q(\widehat{sl_N})$ highest weight state from the vacuum state of the boson Fock space.

1. Introduction

Chiral algebras such as the Virasoro and current algebras play a central role in conformal field theory (CFT) in two dimensional space-time. This theory is a quantum field theory (QFT) of massless particles, in other words, a (massive) QFT at a critical point (renormalization-group fixed point) [1]. Perturbing CFT's suitably, we get integrable massive QFT's [2, 3, 4]. In these theories, the Virasoro algebra does not exist any longer. In many cases the quantum affine Lie algebra plays a crucial role instead of the Virasoro algebra [5]. This quantum algebra is, for a large part, at the origin of the integrability. Moreover it can almost determine the S-matrix of the theory, e.g. sine-Gordon model [5].

The Wess-Zumino-Novikov-Witten (WZNW) model is a fundamental example of CFT's; many CFT's can be realized through a coset construction of WZNW models. The WZNW model has been studied based on the representation theory of the affine Lie algebra. Correlation functions of this model, which are vacuum expectation values of vertex operators, satisfy certain holomorphic differential equations, what

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