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A q-Deformation of Wakimoto Modules, Primary Fields and Screening Operators

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Abstract: The q-vertex operators of Frenkel and Reshetikhin are studied by means of a q-deformation of the Wakimoto module for the quantum affine algebra $U_q(\widehat{\mathfrak{sl}}_2)$ at an arbitrary level $k \neq 0, -2$. A Fock-module version of the q-deformed primary field of spin j is introduced, as well as the screening operators which (anti-)commute with the action of $U_q(\widehat{\mathfrak{sl}}_2)$ up to a total difference of a field. A proof of the intertwining property is given for the q-vertex operators corresponding to the primary fields of spin $j \notin \frac{1}{2}\mathbf{Z}_{\geqq 0}$. A sample calculation of the correlation function is also given.

1. Introduction

In a recent paper [FR], Frenkel and Reshetikhin constructed a certain q-deformation of the Wess–Zumino–Witten (WZW) model on the sphere in the operator formalism based on the representation theory of the quantum affine algebras. They defined q-deformed chiral vertex operators as certain intertwining operators, which give an analogue of the primary fields. In principle, the intertwining property characterizes them, however, it is not easy to find an explicit expression for them.

For the $\widehat{\mathfrak{sl}}_2$ WZW model, the following realization is known (cf. [FLMSS]). The standard $\mathfrak{sl}_2$ currents $J^{\pm}(z), J^0(z)$, screening operators $S(z), S^+(z)$ and the primary fields $\phi_{j,m}(z)$ of spin j are explicitly written as

$$J^{\pm}(z) = :\frac{1}{\sqrt{2}}[\sqrt{k+2}\partial\varphi_1(z) \pm i\sqrt{k}\partial\varphi_2(z)]\, e^{\pm\sqrt{\frac{2}{k}}[i\varphi_2(z)-\varphi_0(z)]}:,$$

$$J^0(z) = -\sqrt{\frac{k}{2}}\,\partial\varphi_0(z),$$

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