

On the renormalization group flow in two dimensional superconformal models

Changrim Ahn^{a,b,*}, Marian Stanishkov^{b,1}

^a Department of Physics, Ewha Womans University, Seoul 120-750, Republic of Korea

^b Institute for the Early Universe, Ewha Womans University, Seoul 120-750, Republic of Korea

Received 22 May 2014; accepted 11 June 2014

Available online 16 June 2014

Editor: Hubert Saleur

Abstract

We extend the results on the RG flow in the next to leading order to the case of the supersymmetric minimal models SM_p for $p \gg 1$. We explain how to compute the NS and Ramond fields conformal blocks in the leading order in $1/p$ and follow the renormalization scheme proposed in [1]. As a result we obtained the anomalous dimensions of certain NS and Ramond fields. It turns out that the linear combination expressing the infrared limit of these fields in term of the IR theory SM_{p-2} is exactly the same as those of the nonsupersymmetric minimal theory.

© 2014 Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/3.0/>). Funded by SCOAP³.

1. Introduction

In this paper we extend the results of the paper [1] to the case of supersymmetric minimal models SM_p , $p \rightarrow \infty$, perturbed by the least relevant fields. The first order corrections were already obtained a long time ago in [3]. It was argued that there exists an infrared (IR) fixed point of the renormalization group (RG) flow which coincides with the minimal superconformal model SM_{p-2} . In the paper [1] (see also [2]) the β function, the fixed point and the matrix of anomalous dimensions of certain fields were obtained up to the second order in perturbation theory. That

* Corresponding author.

E-mail addresses: ahn@ewha.ac.kr (C. Ahn), marian@inrne.bas.bg (M. Stanishkov).

¹ On leave of absence from INRNE, BAS, Bulgaria.

extends the famous results of A. Zamolodchikov [4]. Calculation up to the second order is always a challenge even in two dimensions. The problem is that one needs the corresponding four-point function which is not known exactly even in two dimensions. Fortunately, in the scheme proposed in [1] (which is an extension of that proposed by Zamolodchikov in [4]) one needs the value of this function up to the zeroth order in the small parameter $\epsilon = \frac{2}{p+2}$.

Basic ingredients for the computation of the correlation functions in two dimensions are the conformal blocks. In the last years an exact relation between the latter and the instanton partition functions of certain $N = 2$ super YM theories in four dimensions was established by the so-called AGT correspondence [5–8]. For the $N = 1$ superconformal theories that motivated the computation of the recurrence relation for the conformal blocks of the NS [9–11] and Ramond [12,13] fields of the theory. Indeed it was shown in [14–16] that these conformal blocks coincide with the instanton partition functions of super YM theories in certain spaces. With these basic ingredients in hand we computed here the four-point functions up to the desired order.

The other difficulty arises in the regularization of the integrals. We follow here the regularization proposed in [1] and show that it works perfectly in our case.

One can possibly further consider the more general $SU(2)$ coset models. It was shown time ago [17] that the structure constants and conformal blocks (basic ingredients for the calculation) for these theories can be obtained from just the usual minimal models by certain projected tensor product (this was recently generalized for the super-Liouville theory [18]). On that basis also a generalized AGT relation was proposed [19–21].

The paper [1] was also motivated by an alternative approach to the perturbed minimal models, the so-called RG domain wall [22]. The comparison gives a perfect agreement with the perturbative calculations to the second order. Moreover it was found there that the eigenvectors corresponding to the fields of the IR CFT do not receive any ϵ corrections and speculated to be exact. We obtained the same result in the supersymmetric case. Moreover, the aforementioned eigenvectors are exactly the same as in the $N = 0$ minimal models. One can speculate that probably this result is universal for all the coset models perturbed by the least relevant field.

This paper is organized as follows.

In Section 2 we present the $N = 1$ SM_p theory perturbed by the last component of the superfield $\Phi_{1,3}$. The basic ingredients necessary for the calculations in the second order of the perturbation theory are presented.

In Section 3 we give some details needed for the computation of the conformal blocks in the NS sector. We mention also the important issue of the normalization of the fields.

Section 4 is devoted to the computation of the beta function and the IR fixed point. It is confirmed that it coincides up to the second order with the model SM_{p-2} .

The matrix of anomalous dimensions for some components of the superfields $\Phi_{n,n\pm 2}$ and $D\bar{D}\Phi_{n,n}$ was computed in Section 5. It is in perfect agreement with the first order result in [3]. The same is proved also for the first component $\phi_{n,n}$.

In Section 6 we explain how to compute the mixed conformal blocks of the (last components of) NS and Ramond fields. They are necessary for the calculations of the anomalous dimensions for the Ramond fields which are also presented there. The results are again in agreement with the conjectured RG flow to SM_{p-2} .

2. The theory

In this paper we consider a minimal superconformal theory SM_p perturbed by the least relevant field. This theory is invariant under $N = 1$ superconformal algebra with central charge

Download English Version:

<https://daneshyari.com/en/article/1840579>

Download Persian Version:

<https://daneshyari.com/article/1840579>

[Daneshyari.com](https://daneshyari.com)