WARD'S IDENTITIES AND CALCULATION OF MULTILOOP AMPLITUDES IN SUPERSTRING THEORY

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Multiple superstring amplitudes are usually obtained by the special summation over the spinning string ones [1,2]. The problem of the calculation of both the supermoduli volume form and the zero mode contribution to the ghost determinant is practically unsolved in this approach. Besides, the spinning string amplitudes were found to depend on a choice of basis for the gravitino zero modes [1]. As it has been argued in refs. [3,4], this "gravitino ambiguity" remains in the superstring amplitudes. That seems to be a serious difficulty in the approach discussed.

Indeed, the superstring presents a gauge theory in which gauge fields are the gravitino ξ_m and the vierbein e^a_m. Owing to the gauge invariance the "true" superstring amplitudes are independent of a choice of gauge of the e^a_m and ξ_m. So they have no dependence on a choice of basis for the gravitino zero modes.

Just the gauge invariance underlies the calculation of the superstring amplitude presented in this paper [5]. The superspace formulation appropriate for this aim is developed. Unlike ref. [6] the super Weyl transformations are included into this scheme. So, it is covariant under the whole gauge group of the superstring. In this scheme it is impossible to define the superconnection but this does not prevent to define those covariant differential operators which are necessary for the calculation of the superstring amplitudes. The considered amplitudes are the sums over odd and even superspin structures presenting suitable supersymmetrization of the ordinary odd and even spin structures.

The method developed here generalizes the results [7] of the author to the superstring theory. The superstring amplitudes are calculated from equations that are nothing more but Ward's identities. They result from the invariance of the superstring under its local gauge group.

There is no "gravitino ambiguity" in the scheme and this gives evidence for the theory to be gauge invariant. But the complete check of the gauge invariance needs a more detailed study.

In the method discussed there are no difficulties in the calculation of both the supermoduli volume form and the zero mode contribution to the ghost determinant. Both of them are reduced to the suitable choice of the boundary condition for the superghost Green function. This Green function has no unphysical poles unlike

the Green functions discussed in refs. [1,2]. So the nonrenormalization theorems [8] may be expected to be valid locally on the supermoduli manifold.

At last, the method presented used neither BRST quantization nor bosonization prescription.

The above Ward's identities determine every of the superspin structures up to constant factors independent of moduli and supermoduli. The problem of calculation of the factors considered will be discussed elsewhere. Here we concentrate on the calculation of contributions of even superspin structures into boson emission amplitudes. The problem of calculation of both the odd superspin structures and fermion emission amplitudes needs an additional study.

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