2012 Annual Report of the String Theory Group

M. Beccaria, [1] [2] G. F. De Angelis[1] [2], G. Macorini [3] and C. Ratti[1] [2]

[1]Dipartimento di Matematica e Fisica "*Ennio de Giorgi*", Università del Salento, Italy

[2]Istituto Nazionale di Fisica Nucleare sez. di Lecce, Italy

[3]Niels Bohr International Academy, Niels Bohr Institute, University of Copenhagen, Denmark

The activity of the String Theory Group has been mainly concerned with AdS/CFT tests and developments. Here below, we present the main results that have been obtained and published.

Quantum corrections to short folded superstring in $AdS_3 \times S^3 \times M^4$ [1]

We considered integrable superstring theory on $AdS_3 \times S^3 \times M^4$ where $M^4 = T^4$ or $M^4 = S^3 \times S^1$ with generic ratio of the radii of the two 3-spheres. We computed the one-loop energy of a short folded string spinning in AdS_3 and rotating in S^3. The computation has been performed by world-sheet small spin perturbation theory as well as by quantizing the classical algebraic curve characterizing the finite-gap equations. The two methods give equal results up to regularization contributions that are under control. One important byproduct of the calculation is the part of the energy which is due to the dressing phase in the Bethe Ansatz. Remarkably, this contribution $E_1^{\rm dressing}$ turns out to be independent on the radii ratio. In the $M^4 = T^4$ limit, we discussed how $E_1^{\rm dressing}$ relates to a recent proposal for the dressing phase tested in the $\mathfrak{su}(2)$ sector. We pointed out some difficulties suggesting that quantization of the AdS_3 classical finite-gap equations could be subtler than the easier $AdS_5 \times S^5$ case.

Quantum corrections to spinning superstrings in $AdS_3 \times S^3 \times M^4$: determining the dressing phase [2]

We studied the leading quantum string correction to the dressing phase in the asymptotic Bethe Ansatz system for superstring in $AdS_3 \times S^3 \times T^4$ supported by RR flux. We find that the phase should be different from the phase appearing in the $AdS_5 \times S^5$ case. We used the simplest example of a rigid circular string with two equal spins in S^3 and also considered the general approach based on the algebraic curve description. We also discussed the case of the $AdS_3 \times S^3 \times S^3 \times S^1$ theory and find the dependence of the 1-loop correction to the effective string tension function $h(\lambda)$ (expected to enter the magnon dispersion relation) on the parameters α related to the ratio of the two 3-sphere radii. This correction vanishes in the $AdS_3 \times S^3 \times T^4$ case.

A staggered fermion chain with supersymmetry on open intervals [3]

A strongly-interacting fermion chain with supersymmetry on the lattice and open boundary conditions is analysed. The local coupling constants of the model are staggered, and the properties of the ground states as a function of the staggering parameter are examined. In particular, a connection between certain ground-state components and solutions of non-linear recursion relations associated with the Painlev e VI equation is conjectured. Moreover, various local occupation probabilities in the ground state have the so-called scale-free property, and allow for an exact resummation in the limit of infinite system size.

"'Short' spinning strings and structure of quantum $AdS_5 \times S^5$ spectrum [4–7]

Using information from the marginality conditions of vertex operators for the $AdS_5 \times S^5$ superstring, we determineed the structure of the dependence of the energy of quantum string states on their conserved charges and the string tension $\sim \sqrt{\lambda}$. We considered states on the leading Regge trajectory in the flat space limit which carry one or two (equal) spins in AdS5 or S5 and an orbital momentum in S5, with Konishi multiplet states being particular cases. We argued that the coefficients in the energy may be found by using a semiclassical expansion. By analyzing the examples of folded spinning strings in AdS5 and S5 as well as three cases of circular two-spin strings we demonstrated the universality of transcendental (zeta-function) parts of few leading coefficients. We also show the consistency with target space supersymmetry with different states belonging to the same multiplet having the same non-trivial part of the energy. We suggested, in particular,

folded string using Bethe Ansatz considerations and which, in general, is yet to be determined by a direct two-loop string calculation) should, in fact, be universal.

Wrapping corrections beyond the sl(2) sector in N=4 SYM [8]

The sl(2) sector of N = 4 SYM theory has been much studied and the anomalous dimensions of those operators are well known. Nevertheless, many interesting operators are not included in this sector. We considered a class of twist operators beyond the sl(2) subsector introduced by Freyhult, Rej and Zieme. They are spin n, length-3 operators. At one-loop they can be identified with three gluon operators. At strong coupling, they are associated with spinning strings with two spins in AdS space and charge in S5. We exploit the Y-system to compute the leading weak-coupling four loop wrapping correction to their anomalous dimension. The result is written in closed form as a function of the spin n. We combined the wrapping correction with the known four loop asymptotic Bethe Ansatz contribution and analyze special limits in the spin n. In particular, at large n, we prove that a generalized Gribov-Lipatov reciprocity holds. At negative unphysical spin, we present a simple BFKL-like equation predicting the rightmost leading poles.

REFERENCES

1. M. Beccaria and G. Macorini, arXiv:1212.5672 [hep-th], accepted by JHEP.
2. M. Beccaria, F. Levkovich-Maslyuk, G. Macorini and A. A. Tseytlin, arXiv:1211.6090 [hep-th], accepted by JHEP.
3. M. Beccaria and C. Hagendorf, J. Phys. A **45**, 365201 (2012) [arXiv:1206.4194 [cond-mat.stat-mech]].
4. M. Beccaria and A. A. Tseytlin, JHEP **1207**, 089 (2012) [arXiv:1205.3656 [hep-th]].
5. M. Beccaria, S. Giombi, G. Macorini, R. Roiban and A. A. Tseytlin, Phys. Rev. D **86**, 066006 (2012) [arXiv:1203.5710 [hep-th]].
6. M. Beccaria, C. Ratti and A. A. Tseytlin, J. Phys. A **45**, 155401 (2012) [arXiv:1201.5033 [hep-th]].
7. M. Beccaria and G. Macorini, JHEP **1202**, 092 (2012) [arXiv:1201.0608 [hep-th]].
8. M. Beccaria, G. Macorini and C. A. Ratti, Fortsch. Phys. **60**, 875 (2012) [arXiv:1201.5222 [hep-th]].