

2014 Annual Report of the String Theory Group

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The research of the group during the 2014 involved a variety of themes related to the gauge/gravity correspondence, ranging from integrability, entanglement entropy of AdS_3 black holes, supergravity, higher spin theories and superconformal W_∞ algebras. Here we present a brief summary of the published works:

1. On the next-to-leading holographic entanglement entropy in AdS_3/CFT_2 [1]

We reconsider the one-loop correction to the holographic entanglement entropy in AdS_3/CFT_2 by analysing the contributions due to a bulk higher spin s current or a scalar field with scaling dimension Δ . We consider the two-interval case and work perturbatively in their small cross ratio x . We provide various results for the entanglement entropy due to the so-called CDW elements of the associated Schottky group. In the higher spin current case, we obtain a closed formula for all the contributions of the form $\mathcal{O}(x^{2s+p})$ up to $\mathcal{O}(x^{4s})$, where 2-CDW elements are relevant. In the scalar field case, we calculate the similar contributions for generic values of Δ . The terms up to $\mathcal{O}(x^{2\Delta+5})$ are compared with an explicit CFT calculation with full agreement. This allows to identify in a clean way the relevant operators that provide the gravity result. The 2-CDW contributions are also analysed and a closed formula for the leading $\mathcal{O}(x^{4s})$ coefficient is presented.

2. On the one-loop curvature function in the $sl(2)$ sector of $N = 4$ SYM [2]

We consider twist J operators with spin S in the $sl(2)$ sector of $N = 4$ SYM. The small spin expansion of their anomalous dimension defines the so-called slope functions. Much is known about the linear term, but the study of the quadratic correction, the curvature function, started only very recently. At any fixed J , the curvature function can be extracted at all loops from the $P\mu$ -system formulation of the Thermodynamical

Bethe Ansatz. Here, we work at the one-loop level and follow a different approach. We present a systematic double expansion of the Bethe Ansatz equations at large J and small winding number. We succeed in fully resumming this expansion and obtain a closed explicit simple formula for the one-loop curvature function. The result is an explicit series in odd-index ζ values. Our approach provides a complete reconciliation between the $P\mu$ -system predictions and the large J approach.

3. The large $N = 4$ superconformal W_∞ algebra [3]

The most general large $N = 4$ superconformal W_∞ algebra, containing in addition to the superconformal algebra one supermultiplet for each integer spin, is analysed in detail. It is found that the W_∞ algebra is uniquely determined by the levels of the two $su(2)$ algebras, a conclusion that holds both for the linear and the non-linear case.

4. Partition function of free conformal higher spin theory [4]

We compute the canonical partition function Z of non-interacting conformal higher spin (CHS) theory viewed as a collection of free spin s CFT's in R^d . We discuss in detail the 4-dimensional case (where $s = 1$ is the standard Maxwell vector, $s = 2$ is the Weyl graviton, etc.), but also present a generalization for all even dimensions d . Z may be found by counting the numbers of conformal operators and their descendants (modulo gauge identities and equations of motion) weighted by scaling dimensions. There is also a close relation to massless higher spin partition functions with alternative boundary conditions in AdS_{d+1} . The same partition function Z may also be computed from the CHS path integral on a curved $S^1 \times S^{d-1}$ background. This allows us to determine a simple factorized form of the CHS kinetic operator on this conformally flat background. Summing the individual conformal spin contributions Z_s over all spins we obtain the total partition function of the CHS theory. We also find the correspond-

ing Casimir energy and show that it vanishes if one uses the same regularization prescription that implies the cancellation of the total conformal anomaly a -coefficient. This happens to be true in all even dimensions $d \geq 2$.

5. Higher spins in AdS_5 at one loop: vacuum energy, boundary conformal anomalies and AdS/CFT [5]

We consider general-symmetry higher spin fields in AdS_5 and derive expressions for their one-loop corrections to vacuum energy E and the associated $4d$ boundary conformal anomaly a -coefficient. We propose a similar expression for the second conformal anomaly c -coefficient. We show that all the three quantities (E, a, c) computed for $N = 8$ gauged $5d$ supergravity are $-1/2$ of the values for $N = 4$ conformal $4d$ supergravity and also twice the values for $N = 4$ Maxwell multiplet. This gives $5d$ derivation of the fact that the system of $N = 4$ conformal supergravity and four $N = 4$ Maxwell multiplets is anomaly free. The values of (E, a, c) for the states at level p of Kaluza-Klein tower of $10d$ type IIB supergravity compactified on S^5 turn out to be equal to those for p copies of $N = 4$ Maxwell multiplets. Under a natural regularization of the sum over p , the full $10d$ supergravity contribution is then minus that of the Maxwell multiplet, in agreement with the standard adjoint AdS/CFT duality. We also verify the matching of (E, a, c) for spin 0 and $1/2$ boundary theory cases of vectorial AdS/CFT duality. The consistency conditions for vectorial AdS/CFT turn out to be equivalent to the cancellation of anomalies in the closely related $4d$ conformal higher spin theories. In addition, we study novel example of vectorial AdS/CFT duality when the boundary theory is described by free spin 1 fields and is dual to a particular higher spin theory in AdS_5 containing fields in mixed-symmetry representations. We also discuss its supersymmetric generalizations.

6. Vectorial AdS_5/CFT_4 duality for spin-one boundary theory [6]

We consider an example of vectorial AdS_5/CFT_4 duality when the boundary theory is described by N free complex or real Maxwell fields. It is dual to a particular ("type C") higher spin theory in AdS_5 containing fields in special mixed-symmetry representations. We extend the study of this theory in arXiv:1410.3273 by deriving the expression for the large N limit of the corresponding singlet-sector partition function on $S^1 \times S^3$. We find that in both complex $U(N)$

and real $O(N)$ invariant cases the form of the one-particle partition function is as required by the AdS/CFT duality. We also demonstrate the matching of the Casimir energy on S^3 by assuming an integer shift in the bulk theory coupling.

7. Supergravity one-loop corrections on AdS_7 and AdS_3 , higher spins and AdS/CFT [7]

As was shown earlier, the one-loop correction in $10d$ supergravity on $AdS_5 \times S^5$ corresponds to the contributions to the vacuum energy and $4d$ boundary conformal anomaly which are minus the values for one $N = 4$ Maxwell supermultiplet, thus reproducing the subleading term in the $N^2 - 1$ coefficient in the dual $SU(N)$ SYM theory. We perform similar one-loop computations in $11d$ supergravity on $AdS_7 \times S_4$ and $10d$ supergravity on $AdS_3 \times S_3 \times T^4$. In the AdS_7 case we find that the corrections to the $6d$ conformal anomaly a -coefficient and the vacuum energy are again minus the ones for one $(2, 0)$ tensor multiplet, suggesting that the total a -anomaly coefficient for the dual $(2, 0)$ theory is $4N^3 - 9/4N - 7/4$ and thus vanishes for $N = 1$. In the AdS_3 case the one-loop correction to the vacuum energy or $2d$ central charge turns out to be equal to that of one free $(4, 4)$ scalar multiplet, i.e. is $c = 6$. This reproduces the subleading term in the central charge $c = 6(Q_1 Q_5 + 1)$ of the dual $2d$ CFT describing decoupling limit of $D5 - D1$ system. We also present the expressions for the $6d$ a -anomaly coefficient and vacuum energy contributions of general-symmetry higher spin field in AdS_7 and consider their application to tests of vectorial AdS/CFT with the boundary conformal $6d$ theory represented by free scalars, spinors or rank-2 antisymmetric tensors.

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