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During 2015, the research of the group focused on several themes related to the gauge/gravity correspondence, covering hot problems in integrability, supergravity quantum corrections, higher spin gauge theories, and conformal anomalies. Here we present a brief summary of the published works.

1. Higher Spin Lifshitz Theories and the KdV-Hierarchy [1]

In the paper [1], three dimensional higher spin theories in the Chern-Simons formulation with gauge algebra $\mathfrak{sl}(N, \mathbb{R})$ have been investigated which have Lifshitz symmetry with scaling exponent z. We showed that an explicit map exists for all z and N relating the Lifshitz Chern-Simons theory to the (n, m) element of the KdV hierarchy. Furthermore we showed that the map and hence the conserved charges are independent of z. We derived these result from the Drinfeld-Sokolov formalism of integrable systems.

2. Supergravity one-loop corrections on AdS_7 and AdS_3, higher spins and AdS/CFT [2]

As is well known, one-loop correction in 10d supergravity on $AdS_5 \times S^5$ corresponds to the contributions to the vacuum energy and boundary 4d conformal anomaly which are minus the values for one $N = 4$ Maxwell supermultiplet, thus reproducing the subleading term in their $N^2 - 1$ coefficient in the dual $SU(N)$ SYM theory. In the paper [2], we performed similar one-loop computations in 11d supergravity on $AdS_7 \times S^4$ and 10d supergravity on $AdS_3 \times S^3 \times eT^4$. 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 presented the expressions for the 6d anomaly a-coefficient and vacuum energy for a general-symmetry higher spin field in AdS_7 and considered their application to tests of vectorial AdS/CFT with the boundary conformal 6d theory represented by free scalars, spinors or rank 2 antisymmetric tensors.

3. Partition functions of higher spin gauge theories[3]

In [3], we started from the remark that the partition function of the set of all free massless higher spins $s = 0, 1, 2, 3, \ldots$ in flat space is equal to one: the ghost determinants cancel against the "physical" ones or, equivalently, the (regularized) total number of degrees of freedom vanishes. This feature reflects large underlying gauge symmetry and suggests analogy with supersymmetric or topological theory. The $Z = 1$ property extends also to the AdS background, i.e. the 1-loop vacuum partition function of Vasiliev theory is equal to 1 (assuming a particular regularization of the sum over spins); this was noticed earlier by us as a consistency requirement for the vectorial AdS/CFT duality. We find that the relation $Z = 1$ is also true in the conformal higher spin theory (with higher-derivative ∂^{2s} kinetic terms) expanded near flat or conformally flat S^4 background. We also considered the partition function of free conformal theory of symmetric traceless rank s tensor field which has 2-derivative kinetic term but only scalar gauge invariance in flat 4d space. This non-unitary theory has a Weyl-invariant action in curved background and corresponds to "partially massless" field in AdS_5. We discussed in detail the special case of s=2 (or "conformal graviton"), computed the corresponding conformal anomaly coefficients and compared them with previously found expressions for generic representations of conformal group in 4 dimensions.

4. Conformal a-anomaly of 6d superconformal theories [4]

In [4], we computed the conformal anomaly a-coefficient for some non-unitary (higher derivative or non-gauge-invariant) 6d conformal fields and their supermultiplets. We use the method based on a connection between 6d determinants on S^6 and 7d determinants on AdS$_7$. We found, in particular, that (1,0) supermultiplet containing 4-derivative gauge-invariant conformal vector has precisely the value of a-anomaly as attributed in arXiv:1506.03807 (on the basis of R-symmetry and gravitational 't Hooft matching) to the standard (1,0) vector multiplet. We also showed that higher derivative (2,0) 6d conformal supergravity coupled to exactly 26 (2,0) tensor multiplets has vanishing a-anomaly. This is the 6d counterpart of the known fact of cancellation of the conformal anomaly in the 4d system of N=4 conformal supergravity coupled to 4 vector N=4 multiplets. In the case when 5 of tensor multiplets are chosen to be ghost-like and the conformal symmetry is spontaneously broken by a quadratic scalar constraint the resulting IR theory may be identified with (2,0) Poincare supergravity coupled to 21=26-5 tensor multiplets. The latter theory is known to be special: it is gravitational anomaly free and results upon compactification of 10d type IIB supergravity on K3.

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