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

[1]Dipartimento di Matematica e Fisica, 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 in the 2013 focused on various aspects of the gauge-gravity duality, ranging from application of integrability based techniques in the $AdS_5 \times S^5 - \mathcal{N} = 4$ SYM duality to the study of some properties of black holes in higher spin gravity theories, conjectured to be dual to some 2-dimensional conformal field theories with enlarged symmetry algebras. In the following we present a brief summary of the published result:

1. On a discrete symmetry of the Bremsstrahlung function in N=4 SYM [1]

In this work we consider the quark anti-quark potential on the three sphere in planar $\mathcal{N} = 4$ SYM and the associated vacuum potential in the near BPS limit with L units of R-charge. We discuss the strong coupling limit of the Bremsstrahlung function B_L by computing it at large but finite L, providing strong support to a special symmetry of the Bremsstrahlung function under the formal discrete symmetry $L \to 1 - L$. In this context, it is the counterpart of the reciprocity invariance discovered in the past in the spectrum of various gauge invariant composite operators. The symmetry has remarkable consequences in the scaling limit where L is taken to be large with fixed ratio to the 't Hooft coupling. This limit organizes in inverse powers of the coupling and resembles the semiclassical expansion of the dual string theory which is indeed known to capture the leading classical term. We show that the various higher-order contributions to the Bremsstrahlung function obey several constraints and, in particular, the next-to-leading term, formally associated with the string one-loop correction, is completely determined by the classical contribution. The large L limit at strong coupling is also discussed.

2. On the partition functions of higher spin black holes [2]

We reconsider black hole solutions of D = 3 higher-spin gravity in the $hs[\lambda] + hs[\lambda]$ Chern-Simons formulation. A suitable generalisation of the BTZ black hole has a spin-3 chemical potential α, and non-zero values of all the conserved charges associated with the asymptotic $W^{\infty}[\lambda]$ symmetry. We extend the available perturbative expansion of the partition function to order $\mathcal{O}(\alpha^{18})$ for generic values of the λ parameter. The result matches the CFT prediction at λ =0 and at λ =1 where we provide the exact all-order expansion of the partition function. The perturbative series is then analysed in the interesting non-trivial limit $\lambda \to \infty$ and we derive the exact analytical expressions of the partition function and the spin-4 charge in closed form as functions of α. Also, the first subleading correction at large λ is shown to be simply related to the leading contribution.

3. Resummation of scalar correlator in higher spin black hole background [3]

We consider the proposal that predicts holographic duality between certain 2D minimal models at large central charge and Vasiliev 3D higher spin gravity with a single complex field. We compute the scalar correlator in the background of a higher spin black hole at order $\mathcal{O}(\alpha^5)$ in the chemical potential ? associated with the spin-3 charge. The calculation is performed at generic values of the symmetry algebra $hs[\lambda]$ parameter λ and for the scalar in three different representations. We then study the perturbative data in the large λ limit and discover remarkable regularities. This leads to formulate a closed formula for the resummation of the leading and subleading terms that scale like $\mathcal{O}(\alpha^n \lambda^{2n})$ and $\mathcal{O}(\alpha^n \lambda^{2n-1})$ respectively.

4. Analysis of higher spin black holes with spin-4 chemical potential [4]

We consider the AdS_3/CFT_2 duality between certain coset WZW theories at large central charge and Vasiliev 3D higher spin gravity with a single complex field. On the gravity side, we discuss a higher spin black hole solution with chemical potential coupled to the spin-4 charge. We compute the perturbative expansion of the higher spin charges and of the partition function at high order in the chemical potential. The result is obtained with its exact dependence on the parameter λ characterising the symmetry algebra $hs[\lambda]$. The cases of λ=0,1 are successfully compared with a CFT calculation. The special point $\lambda = \infty$, the Bergshoeff-Blencowe-Stelle limit, is also solved in terms of the exact generating function for the partition function. The thermodynamics of both the spin-4 and the usual spin-3 black holes is studied in order to discuss the λ dependence of the BTZ critical temperature $T_{BTZ}(\lambda)$. In the spin-3 case, it is shown that $T_{BTZ}(\lambda)$ converges for large λ to the critical point of the $\lambda = \infty$ known partition function previously found by the authors. In the spin-4 black hole, the picture is qualitatively similar and $T_{BTZ}(\lambda = \infty)$ is accurately determined by various numerical methods.

REFERENCES

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