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# HIGHER SPIN $AdS_3$ SUPERGRAVITY AND ITS CFT DUAL*

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Gravity, itself a gauge theory of a spin 2 field, can be extended to a higher spin gauge theory on AdS spaces. Recently, Gaberdiel and Gopakumar conjectured that a large $N$ limit of a 2d minimal model is dual to a bosonic subsector of a higher spin supergravity theory on 3d AdS space. We propose and test the untruncated supersymmetric version of this conjecture where the dual CFT is a large $N$ limit of the $\mathcal{N} = 2$ $\mathbf{C}\mathrm{P}^N$ Kazama-Suzuki model.

*Keywords*: Higher spin gauge theory; AdS/CFT correspondence; $W$ symmetry.

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## 1. Background

Recently, higher spin gravity theories have attracted a lot of attention due to their application to the AdS/CFT correspondence. Higher spin gravity theories extend ordinary gravity with gauge fields having spin $s \geq 3$. On anti-de Sitter space, a higher spin gauge theory with an infinite number of spins and non-trivial interactions can be constructed, the so-called Vasiliev theory. In Ref. 1 it was proposed that a 4d Vasiliev theory is dual to the 3d O($N$) vector model. Very recently, a 3d Vasiliev theory was conjectured to be dual to a large $N$ limit of a 2d minimal model.[2] In Ref. 3, we have extended the conjecture to the case including supersymmetry.

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## 2. Minimal model holography

The higher spin gravity theory considered in Ref. 2 is given by a bosonic truncation of the higher spin $\mathcal{N} = 2$ supergravity theory in Ref. 4. The theory includes higher spin gauge fields with spin $s = 2, 3, \ldots$ and two complex massive scalar fields. It contains a single parameter $\lambda$ determining its symmetry algebra and the mass of the matter fields. The dual theory is proposed to be the $W_N$ minimal model which has the coset description

$$\frac{\mathrm{su}(N)_k \oplus \mathrm{su}(N)_1}{\mathrm{su}(N)_{k+1}} \ . \tag{1}$$

This conjecture stems from the fact that the asymptotic symmetry of the gravity theory is a large $N$ limit of the $W_N$ algebra.[5,6] In order to compare the model with the classical gravity theory, we need to take a large $N, k$ limit with the 't Hooft parameter $N/(k+N)$ kept fixed and equal to $\lambda$. By now, the conjecture is believed to be true having withstood several tests, such as the matching of the spectrum.[7]

## 3. Supersymmetric minimal model holography

It is natural to expect a duality involving the full sector of the 3d supergravity theory in Ref. 4. The untruncated theory includes both fermionic higher spin gauge fields and Dirac fermions in the matter sector, as well as more bosonic fields. Further, it enjoys $\mathcal{N} = 2$ supersymmetry. Our conjecture[3] is that the dual theory is given by the $\mathcal{N} = (2, 2)$ $\mathbb{C}\mathrm{P}^N$ Kazama-Suzuki model

$$\frac{\mathrm{su}(N+1)_k \oplus \mathrm{so}(2N)_1}{\mathrm{su}(N)_{k+1} \oplus \mathrm{u}(1)_{N(N+1)(k+N+1)}} \ . \tag{2}$$

Again, we need to take the large $N, k$ limit with finite $\lambda = N/(k+N)$. This dual theory is actually the minimal model based on the $\mathcal{N} = (2, 2)$ super $W_N$ algebra,[8] which is the asymptotic symmetry of the gravity theory.[3] The equivalence of the spectrum on the two sides of the duality has already been established,[3,9] and this strongly supports our conjecture. We are now studying correlation functions and the $\mathcal{N} = 1$ supersymmetric version of the duality. Another important future direction is to investigate $1/N$ effects since they correspond to the quantum effects of the supergravity theory.

## References

1. I. R. Klebanov and A. M. Polyakov, *Phys. Lett. B* **550**, 213 (2002).
2. M. R. Gaberdiel and R. Gopakumar, *Phys. Rev. D* **83**, 066007 (2011).
3. T. Creutzig, Y. Hikida and P. B. Ronne, *JHEP* **1202**, 109 (2012).
4. S. F. Prokushkin and M. A. Vasiliev, *Nucl. Phys. B* **545**, 385 (1999).
5. M. Henneaux and S. -J. Rey, *JHEP* **1012**, 007 (2010).
6. A. Campoleoni, S. Fredenhagen, S. Pfenninger and S. Theisen, *JHEP* **1011**, 007 (2010).
7. M. R. Gaberdiel, R. Gopakumar, T. Hartman and S. Raju, *JHEP* **1108**, 077 (2011).
8. K. Ito, *Phys. Lett. B* **259**, 73 (1991).
9. C. Candu and M. R. Gaberdiel, arXiv:1203.1939 [hep-th].