SO(9) supergravity and matrix model holography

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Introduction and context

$\rightarrow$ Context: BFSS matrix model and D0-branes distribution

$\rightarrow$ 2D maximally supersymmetric SO(9) supergravity that describes fluctuations around the S^8 compactification of type IIA supergravity.

$\rightarrow$ Content of the theory : a dilaton ρ and **128** scalar fields divided in $\mathbf{44} \oplus \mathbf{84}$.

$\rightarrow$ We use a $U(1)^4$ consistent truncation of the full $SO(9)$ gauge group of IIA to compute correlation functions in the matrix model involving the operators dual to the graviton.

$\rightarrow$ Previous work on $SO(6) \times SO(3)$ solution in the $SO(9)$ theory $\implies$ we want to generalise to $SO(p) \times SO(q)$ with $p + q = 9$.

Based on 2503.15954 together with H. Samtleben (ENS de Lyon) and D. Tsimpis (Université Lyon 1).

Generalisation to any $SO(p) \times SO(9-p)$ of $SO(9)$

Scalar description

- Here, we consider solutions that break the $SO(9)$ gauge symmetry down to $SO(p) \times SO(q)$, with $p+q=9$. Accordingly, the $SL(9)$ matrix T^{IJ} will be of diagonal form, depending on one scalar field x as

$$\mathcal{V} = T^{IJ} = \begin{bmatrix} e^{x}\, \mathbb{I}_{p\times p} & 0 \\ 0 & e^{-px/q}\, \mathbb{I}_{q\times q} \end{bmatrix} .$$

The Lagrangian reduces to

$$\mathcal{L}_{\text{sugra}} = \sqrt{-g}\Big(-\rho R + \frac{1}{2}\,\rho\, K_p\, \partial_\mu x\, \partial^\mu x - V_p(x)\Big) ,$$

$$K_p = \frac{9\,p}{2\,q} , \qquad V_p = -\frac{1}{2}\,\rho^{5/9}\left(p\,(p-2)\,e^{2x} + 2pq\,e^{x(q-p)/q} + q\,(q-2)\,e^{-2px/q}\right) ,$$

The Killing spinor equations can be solved to obtain the dilaton and 2D metric $\mathrm{d}s_2^2 = \tilde{f}(x)^2\mathrm{d}t^2 - \tilde{g}(x)^2\mathrm{d}x^2$.

Generalisation to any $SO(p) \times SO(9-p)$ of $SO(9)$

Uplift to 10D using an uplift ansatz, and then a Kaluza-Klein straightforward uplift to 11D.

11D uplift in a pp-wave form

$$\mathrm{d}s_{11}^2 = \mathrm{d}x^-\mathrm{d}x^+ - H(r_p, r_q)(\mathrm{d}x^-)^2 - \left(\mathrm{d}r_q^2 + r_q^2\mathrm{d}\Omega_{q-1}^2 + \mathrm{d}r_p^2 + r_p^2\mathrm{d}\Omega_{p-1}^2\right)$$

with $H(r_p, r_q)$ that satisfies $\Delta H = 0$.

→ New 2D solutions and their uplift to 11D;
→ We have different pp-waves solution for any $SO(p) \times SO(q)$;
→ We can interpret them as a distribution of branes: $\sigma_{9-p}(r_p) = (1 - r_p^2)^{\frac{5-p}{2}}$;
→ We can now compute the two point correlators using the holographic renormalization technique and compare with the literature $\langle O_{44}(0)O_{44}(q)\rangle \propto q^{-6/5}$ and $\langle O_{84}(0)O_{84}(q)\rangle \propto q^{4/5}$.

Plot of scalar fluctuations correlators in **44** and the **84** for $SO(6) \times SO(3)$

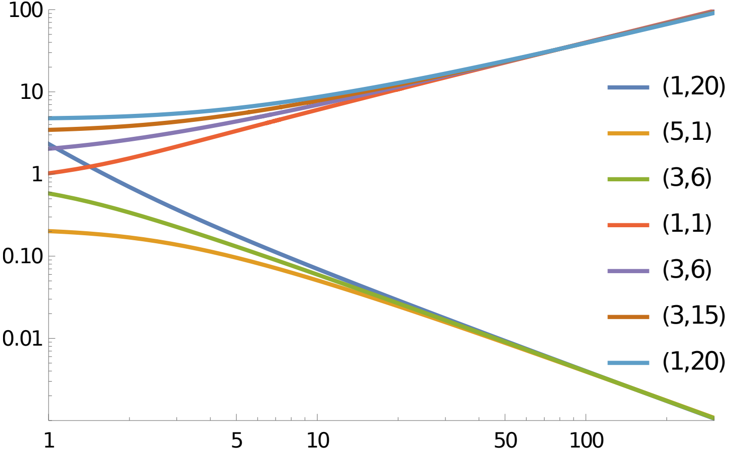

Figure: Plot of two-point correlators in both the **44** and the **84** sector. The $q \to \infty$ asymptotics reproduces the $q^{-6/5}$ and $q^{4/5}$ behavior of the undeformed model.