Non-Abelian T-duality and Holography

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1. Introduction & motivation

T-duality has been widely used in holography to generate new AdS solutions, which

- Can be free of singularities
- Have a more transparent brane set-up
- Better describe certain properties of the dual CFT
- Are the basis of new classifications

On the basis that T-duality is a String Theory symmetry, and therefore:

T-dual backgrounds are equivalent and define the same dual CFT

An extension of T-duality is known since the 90's, which has not been proved to be a String Theory symmetry:

Non-Abelian T-duality

- Not so attractive in ST (recently integrability..)
- Useful as a solution generating technique in SUGRA
- It can generate backgrounds with different holographic dual CFTs

Conversely, using holography it is possible to shed new light onto some of the unknown properties of non-Abelian T-duality in ST

Non-Abelian T-duality and holography

Non-Abelian T-duality (NATD) has proved to be very useful as a solution generating technique in AdS/CFT

Many interesting AdS backgrounds (some of which evading existing classifications) have been constructed

It has prompted new classification efforts

What NATD does to the CFT remains less understood

Examples so far show that NATD may change the CFT dual to the AdS backgrounds in which it is applied

In this talk we will discuss different examples for which the CFT realization of NATD has been studied

In all of them the NATD background will be associated to QFT living on (Dp,NS5) Hanany-Witten brane set-ups

Based on works with Carlos Núñez, Niall Macpherson, Georgios Itsios, Jesús Montero and Anayeli Ramírez

Outline:

1. Introduction and motivation: NATD in AdS/CFT
2. Basics of NATD: NATD vs Abelian T-duality
3. The NATD of $AdS_5 \times S^5$
4. The NATD of Klebanov-Witten
5. The $AdS_6 \times S^2$ example
6. Recent progress in AdS_3
7. Conclusions

2. Basics of NATD: NATD vs Abelian T-duality

Using the string sigma-model Rocek and Verlinde proved that Abelian T-duality is a symmetry to all orders in g_s and α'

(Buscher'88; Rocek, Verlinde'92)

The extension to arbitrary wordsheets determines the global properties of the dual variable:

$$\theta \in [0, 2\pi] \quad \xrightarrow{\text{T}} \quad \tilde{\theta} \in [0, 2\pi]$$

In the non-Abelian case neither proof works

Variables living in a group manifold are substituted by variables living in its Lie algebra

$$g \in SU(2) \quad \xrightarrow{\text{NAT}} \quad \chi \in \mathbb{R}^3$$

In the absence of global information the new variables remain non-compact

Still, NATD has been proved to be a very useful solution generating technique (Sfetsos and Thompson (2010))

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Some examples:

- New AdS_6 background in IIB

  (Y.L., O Colgain, Rodriguez-Gomez, Sfetsos, PRL (2013))

  Candidate for the holographic description of a 5d fixed point theory

  Motivated classifications of IIB AdS_6 solutions that culminated with the work of D'Hoker, Gutperle, (Karch,) Uhlemann'16,17

- New AdS_3 M-theory solution beyond existing classifications

  Only explicit example in KKK with SU(2) structure

  (Y.L., Macpherson, Montero, O Colgain'15)

In holography:

- What is the CFT dual of the AdS solutions generated through NATD? Is there a general pattern?
- How do we interpret the non-compact directions?
- Can we use the CFT to *inform* the geometry?

3. The NATD of $AdS_5 \times S^5$

$$\begin{array}{ccc} AdS_5 \times S^5 & & \text{N=2} \quad AdS_5 \times S^2 \in \text{GM} \\ \updownarrow & \xleftrightarrow{\text{NATD}} & \updownarrow \\ \text{N=4 SYM} & & \text{N=2 SCFT} \end{array}$$

(Sfetsos, Thompson'10) (Y.L., Nunez, '16)

- Gaiotto-Maldacena geometries encode the information about the dual CFT
- Useful example to study the CFT realization of NATD

- Take the $AdS_5 \times S^5$ background

$$ds^2 = ds^2_{AdS_5} + L^2\Big(d\alpha^2 + \sin^2\alpha d\beta^2 + \cos^2\alpha ds^2(S^3)\Big)$$

$$F_5 = 8L^4 \sin\alpha\cos^3\alpha d\alpha \wedge d\beta \wedge \mathrm{Vol}(S^3)$$ + Hodge dual

- Dualize it w.r.t. one of the $SU(2)$ symmetries

In spherical coordinates adapted to the remaining $SU(2)$:

$$ds^2 = ds^2_{AdS_5} + L^2\Big(d\alpha^2 + \sin^2\alpha d\beta^2\Big) + \frac{d\rho^2}{L^2\cos^2\alpha} + \frac{L^2\cos^2\alpha\rho^2}{\rho^2 + L^4\cos^4\alpha} ds^2(S^2)$$

$$B_2 = \frac{\rho^3}{\rho^2 + L^4\cos^4\alpha}\mathrm{Vol}(S^2)\,, \qquad e^{-2\phi} = L^2\cos^2\alpha(L^4\cos^4\alpha + \rho^2)$$

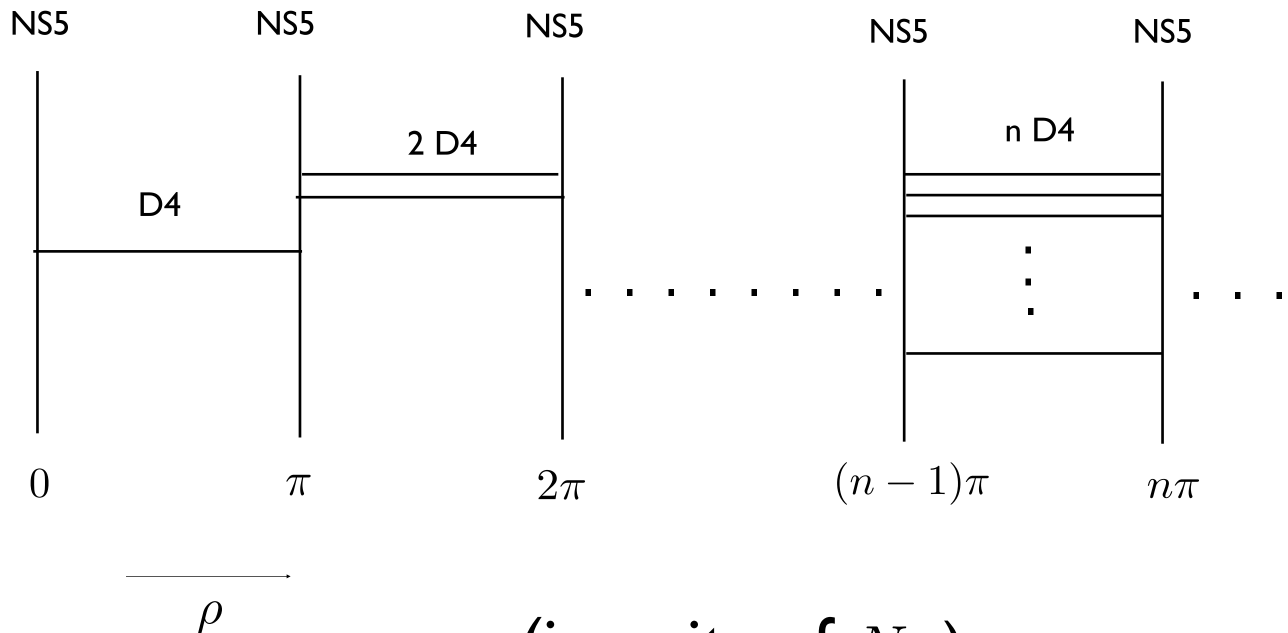
$$F_2 = L^4\sin\alpha\cos^3\alpha d\alpha \wedge d\beta, \qquad F_4 = B_2 \wedge F_2$$

- New Gaiotto-Maldacena geometry
- What about ρ ?
  - Background perfectly smooth for all $\rho \in \mathbb{R}^+$
  - No global properties inferred from the NATD
  - How do we interpret the running of ρ to infinity in the CFT?
- Singular at $\alpha = \pi/2$ where the original S^3 shrinks (due to the presence of NS5-branes)

  This is the tip of a cone with S^2 boundary $\rightarrow$ We have to care about large gauge transformations
- Large gauge transformations modify the quantized charges such that $N_4 = nN_6$ in each $[n\pi, (n+1)\pi]$ interval

We have also NS5 charge, such that every time we cross a π interval one NS5 is created

This is compatible with a D4/NS5 brane set-up:



(in units of N_6)

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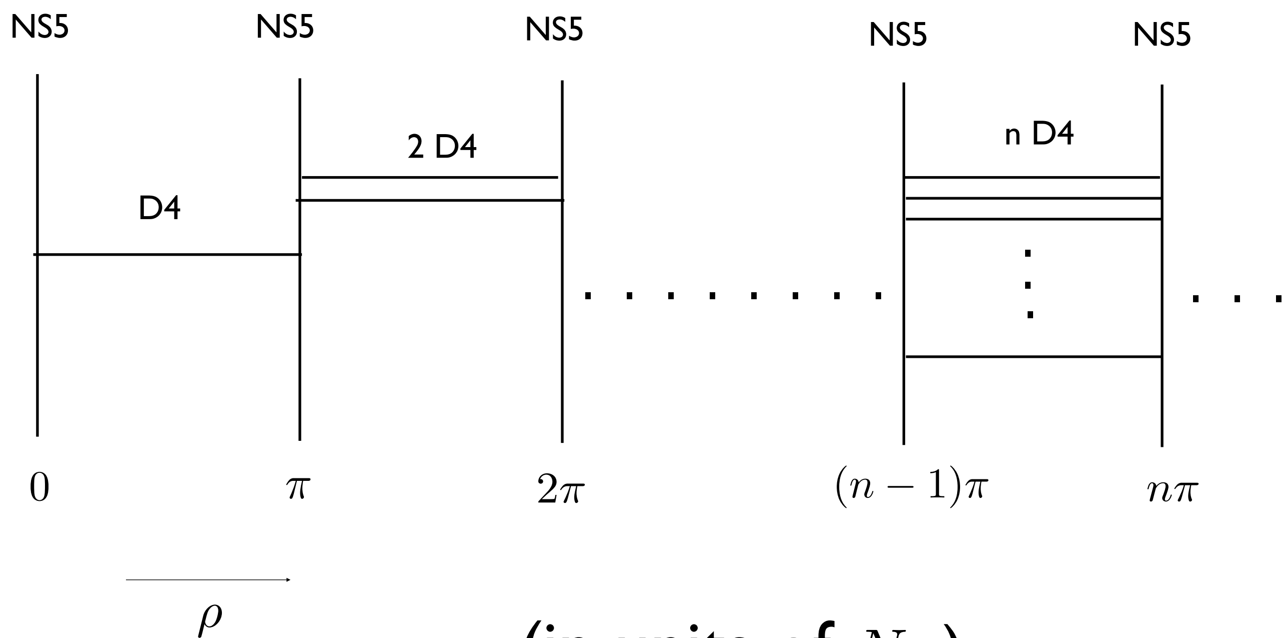


(in units of N_6)

These D4/NS5 brane set-ups realize 4d $\mathcal{N}=2$ field theories with gauge groups connected by bifundamentals (Witten'97)

Having the D4 finite extension in the r direction, the field theory living in them is 4d at low energies, with effective gauge coupling:

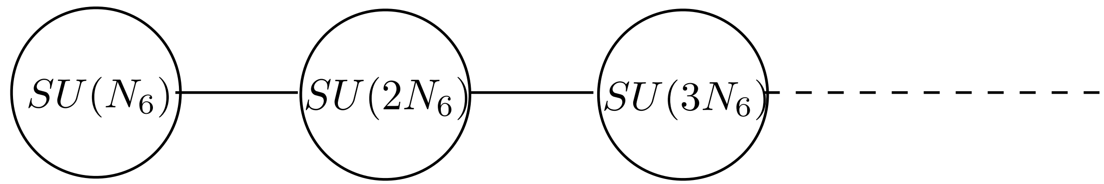
$$\frac{1}{g_4^2} \sim r_{n+1} - r_n$$

Open strings connecting D4's stretched between different NS5 represent bifundamental matter

Strings connecting the D4 to D6 or semi-infinite D4 represent fundamental matter

For l_n D4-branes in $[r_n, r_{n+1}]$ the gauge group is $SU(l_n)$ and there are (l_{n-1}, l_n) and (l_n, l_{n+1}) hypermultiplets.

Our case corresponds to an infinite linear quiver:



which satisfies the conditions for conformal invariance:

The bifundamentals contribute to the $SU(l_n)$ beta function as $l_{n-1} + l_{n+1}$ flavors.

The beta function thus vanishes at each interval if

$$2l_n = l_{n+1} + l_{n-1}$$

Gaiotto-Maldacena geometries were built to study the CFTs associated to these brane set-ups (Gaiotto, Maldacena'09)

We will now see that, as a GM geometry, the dual quiver associated to the NATD solution is the same above

This brane intersection has also been recently confirmed by the analysis in Terrise, Tsimpis, Whiting'18

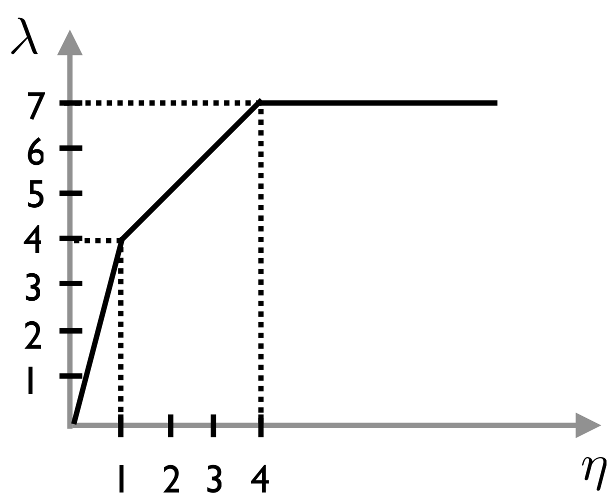
The NATD and GM geometries

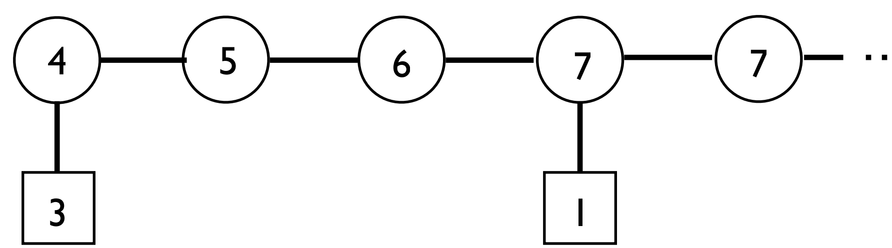
GM geometries are generic backgrounds dual to 4d N=2 CFTs.

They are described in terms of a function $V(\sigma,\eta)$ solving a Laplace eq. with a given charge density $\lambda(\eta)$ at $\sigma=0$

Regularity and quantization of charges impose strong constraints on the allowed form of $\lambda(\eta)$, which encodes the information of the dual CFT.

For example:





The NATD solution has $\lambda(\eta) = \eta$, $\eta \sim \rho$, which corresponds to an infinite linear quiver with gauge groups of increasing rank, as predicted by the brane set-up

This brings strong evidence to the brane set-up predicted from the solution

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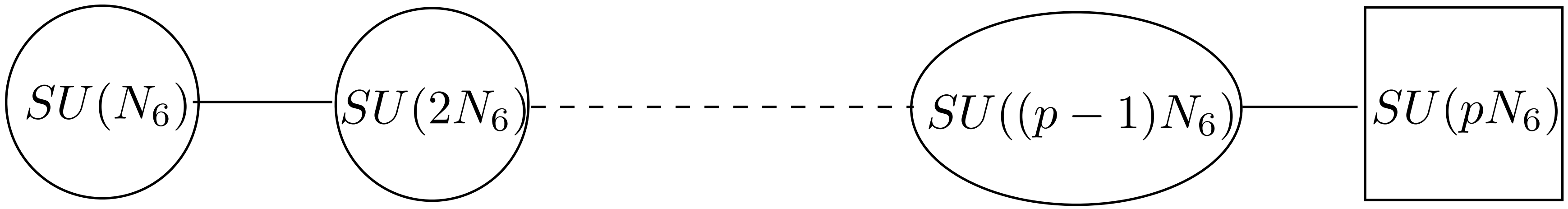
However, the associated CFT is *infinite*.

We will see next that we can complete the quiver to produce a well-defined 4d CFT, and, using holography, complete the geometry

A natural way to complete the quiver is by adding fundamentals:



This completion reproduces correctly the value of the holographic central charge:

From the geometry:

$$c_{NATD} \sim \int_0^{\eta_*} f(\eta) d\eta = \frac{N_6^2 N_5^3}{12}$$

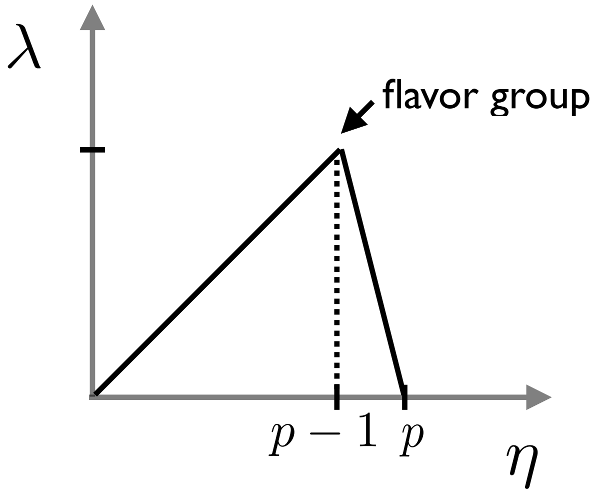
(Klebanov, Kutasov, Murugan'08)

In the field theory we can use: $c = \frac{1}{12}(2n_v + n_h)$ (Shapere, Tachikawa'08)

This gives

$$c = \frac{N_6^2 p^3}{12}\left[1 - \frac{1}{p} - \frac{2}{p^2 N_6^2} + \frac{2}{N_6^2 p^3}\right] \approx \frac{N_6^2 p^3}{12}$$

In the geometry, the completed quiver corresponds to



$$\frac{\lambda(\eta)}{N_6} = \begin{cases} \eta & 0 \leq \eta \leq p-1 \\ (1-p)\eta + (p^2 - p) & (p-1) \leq \eta \leq p \end{cases}$$

The solution to the Laplace equation that gives rise to this charge density *completes* the non-Abelian T-dual geometry, and resolves its singularity

Close to the kink the behaviour of the completed geometry is that of D6-branes

The NATD solution arises when zooming-in away from the kink

This idea also works in other examples

4. The NATD of Klebanov-Witten

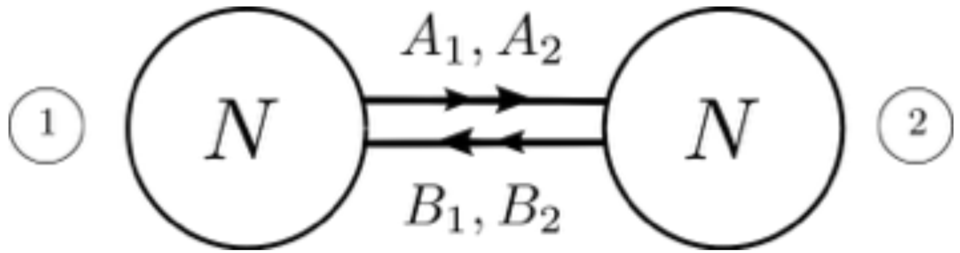
$$\begin{tikzcd} AdS_5 \times T^{1,1} \arrow[d, leftrightarrow] \arrow[r, leftrightarrow, "\text{NATD}"] & \text{N=1 } AdS_5 \in \text{GMSW} \arrow[d, leftrightarrow] \\ \text{N=1 KW} & \text{N=1 SCFT} \end{tikzcd}$$

(Itsios, Nunez, Sfetsos, Thompson'13) (Itsios, Y.L., Montero, Nunez, '17)

- GMSW geometries do not encode the information about the dual CFT
- Still, we can extract useful information using the relation with GM

The Klebanov-Witten theory:

$\mathcal{N}=1$ $SU(N)\times SU(N)$ gauge theory with bifundamental matter fields transforming in the $(N,\bar{N})$ and $(\bar{N},N)$ representations of $SU(N)$



Dual to $AdS_5\times T^{1,1}$:

$$ds^2_{T^{1,1}}=\frac{1}{6}(ds^2(S^2_1)+ds^2(S^2_2))+\frac{1}{9}(d\psi+\cos\theta_1 d\phi_1+\cos\theta_2 d\phi_2)^2$$

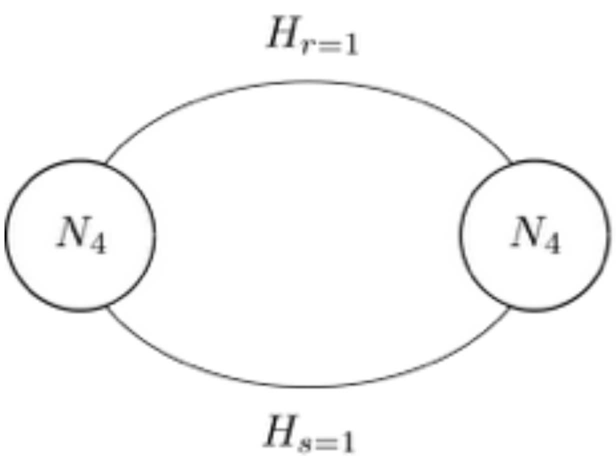
$$F_5=\frac{4}{L}\Big(\mathrm{Vol}(AdS_5)-L^5\mathrm{Vol}(T^{1,1})\Big)$$

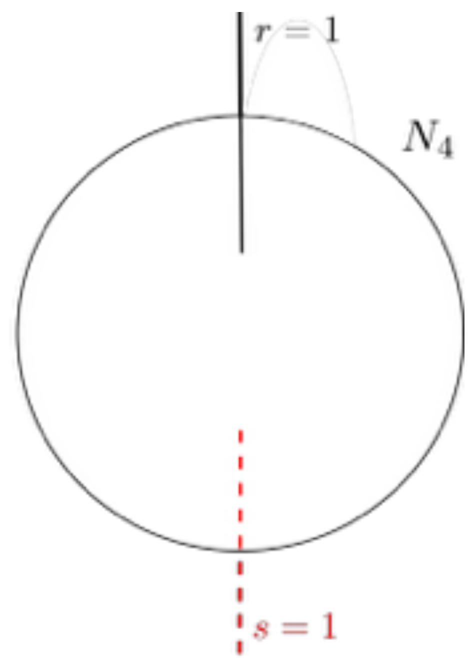
Abelian T-dual realization: (Dasgupta, Mukhi'98; Uranga'98)

IIA background with B_2, F_4 fluxes $\leftrightarrow$ NS5, D4 branes

Two types of, orthogonal, NS5-branes

Mutual rotation equivalent to a mass deformation in the CFT breaking $\mathcal{N}=2$ to $\mathcal{N}=1$



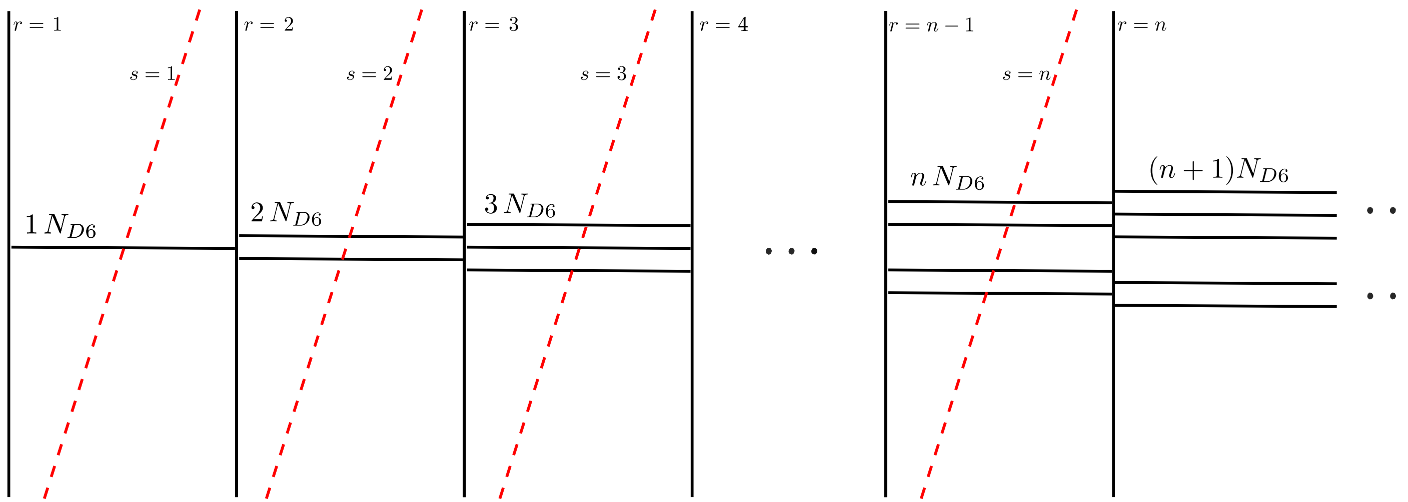


The non-Abelian T-dual solution

IIA background with $B_2\,, F_2\,, F_4 = B_2 \wedge F_2$ fluxes

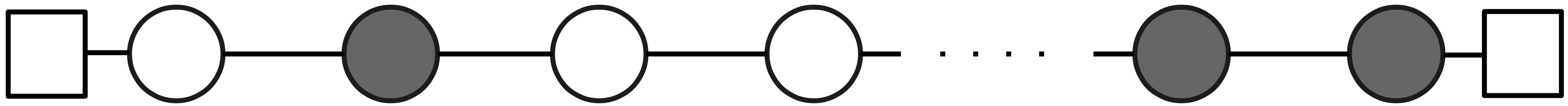
Two types of, orthogonal, NS5 and NS5' branes

Brane set-up:



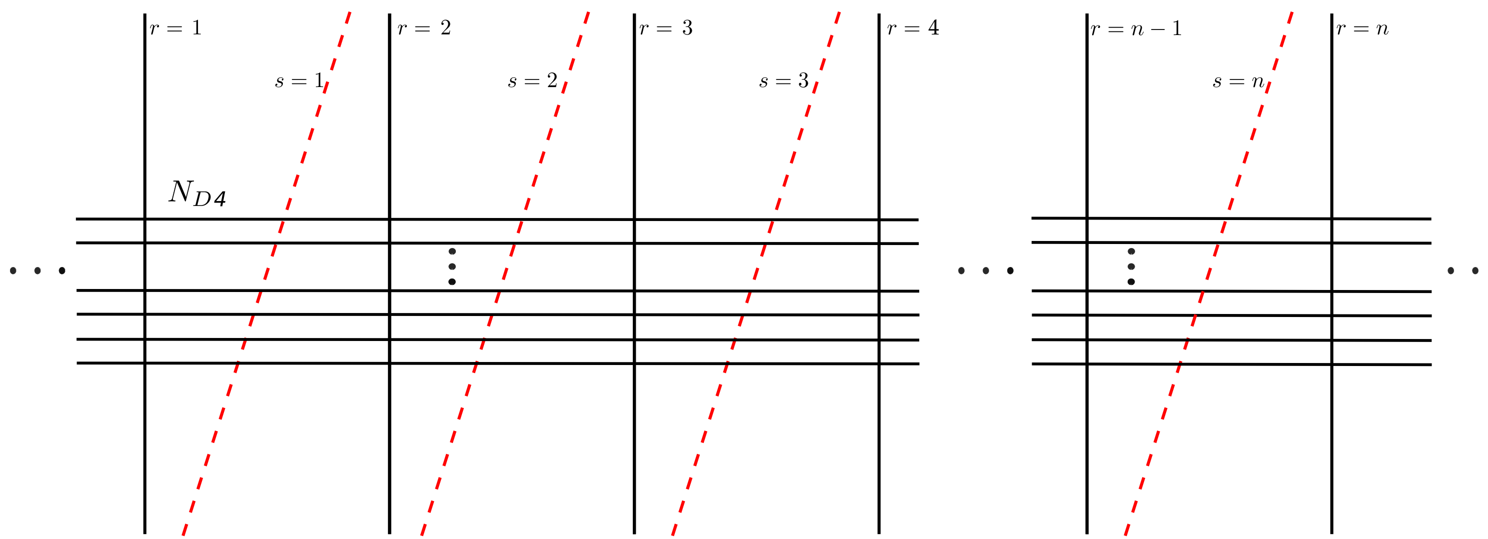
It generalizes the brane set-ups describing the linear quiver gauge theories of Bah-Bobev (Bah, Bobev'13)

Bah-Bobev linear quivers:



$\mathcal{N}=1$ and $\mathcal{N}=2$ $SU(N)$ vector multiplets plus bifundamental matter fields

Realized in brane set-ups with orthogonal NS5 and NS5' branes:



Flow to interacting 4d $\mathcal{N}=1$ CFT in the IR

In the CFT fixed point the central charges can be determined from the 't Hooft anomalies associated to the R-symmetry (Anselmi, Freedman, Grisaru, Johansen'97) :

$$a = \frac{3}{32}(3\mathrm{Tr}\, R^3 - \mathrm{Tr}\, R) \ , \qquad c = \frac{1}{32}(9\mathrm{Tr}\, R^3 - 5\mathrm{Tr}\, R)$$

where R is the R-symmetry, $R = R_0 + \frac{1}{2}\epsilon\mathcal{F}$, determined by a-maximization (Intriligator, Wecht'03)

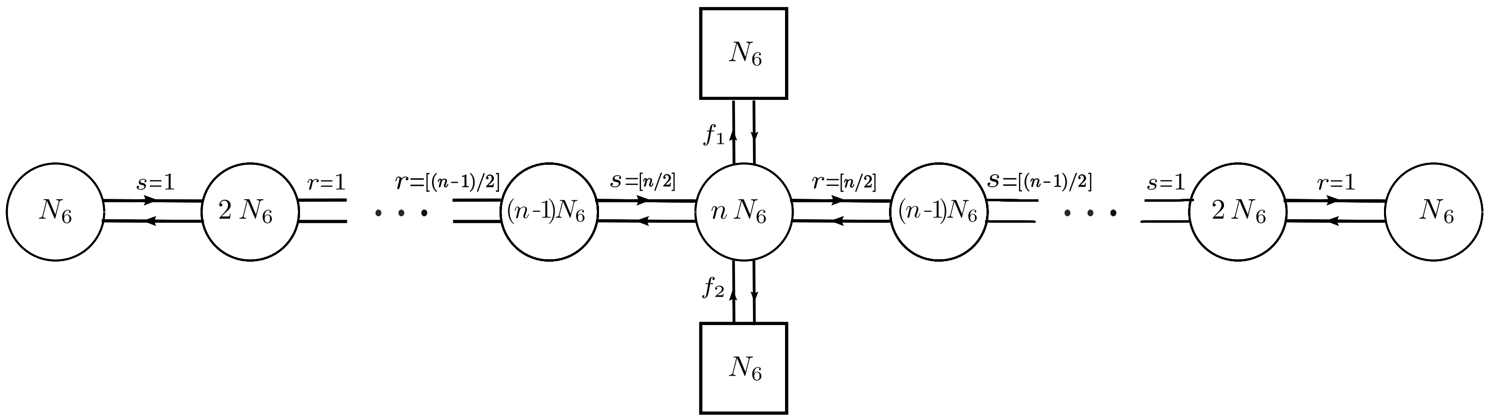
CFT dual to the NATD solution

Infinite linear quiver $\rightarrow$ Complete it, such that:

- Vanishing beta functions and R-symmetry anomalies
- Self-dual under $N_c \rightarrow N_f - N_c$
- Mass deformation of the $\mathcal{N}=2$ quiver dual to the NATD of $AdS_5 \times S^5/\mathbb{Z}_2$:

$$\begin{tikzcd}
AdS_5 \times S^5/\mathbb{Z}_2 \arrow[r] \arrow[d, "\text{mass}"] & \text{NATD of } AdS_5 \times S^5/\mathbb{Z}_2 \arrow[d, "\text{mass}"] \\
AdS_5 \times T^{1,1} \arrow[r] & \text{NATD of } AdS_5 \times T^{1,1}
\end{tikzcd}$$

Our proposed *completed* quiver is:



It is obtained by modding out by $\mathbb{Z}_2$ the $\mathcal{N}=2$ *completed* quiver dual to the NATD of $AdS_5 \times S^5$ and mass deforming it

A non-trivial check is that the central charges satisfy the Tachikawa-Wecht UV/IR relations:

$$a_{\mathcal{N}=1} = \frac{9}{32}(4\,a_{\mathcal{N}=2} - c_{\mathcal{N}=2})\,, \qquad c_{\mathcal{N}=1} = \frac{1}{32}(-12\,a_{\mathcal{N}=2} + 39\,c_{\mathcal{N}=2})$$

(Tachikawa, Wecht'09)

In the large number of nodes limit: $c_{\mathcal{N}=1} \sim a_{\mathcal{N}=1}$ and

$$c_{\mathcal{N}=1} = \frac{27}{32} c_{\mathcal{N}=2}$$ (Tachikawa, Wecht'09)

It reproduces the holographic central charge

5. The $AdS_6 \times S^2$ example

(Y.L., Macpherson, Montero '18)

AdS6 solutions are quite unique

This is largely due to the fact that in 5d there is a unique super-conformal algebra, $F(4)$

5d fixed point theories can however be engineered in string theory for specific gauge groups and matter content (Seiberg'96, Intriligator, Morrison, Seiberg'97)

$\rightarrow AdS_6$ duals?

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$\to AdS_6$ duals?

The unique AdS6 solution to (massive) Type IIA is dual to the fixed point of the 5d Sp(N) gauge theory (Seiberg'96), engineered on a (D4,D8/O8) system (Brandhuber, Oz'99)

More general string theory realizations can be given in terms of (p,q) 5-brane webs in Type IIB (Aharony, Hanany'97)

$\rightarrow AdS_6$ duals?

More general string theory realizations can be given in terms of (p,q) 5-brane webs in Type IIB (Aharony, Hanany'97)

$\rightarrow AdS_6$ duals?

The first solution in IIB was constructed through NATD from the BO solution (also ATD) (Y.L., O Colgain, Rodriguez-Gomez, Sfetsos'12)

This prompted the study of classifications in IIB

Apruzzi, Fazzi, Passias, Rosa, Tomasiello'14; Kim, Kim, Suh'15; Kim, Kim'16; Gutowski, Papadopoulos'17,

which culminated with the work of

D'Hoker, Gutperle, Karch, Uhlemann'16; D'Hoker, Gutperle, Uhlemann'17,18

These works provide a complete classification of solutions to Type IIB SUGRA, which are firm candidates for the AdS6 duals of CFTs living in (p,q) 5-brane webs.

Brief review of the DGU global solutions

$AdS_6 \times S^2 \times \Sigma_2$ solutions, compatible with the $SO(2,5) \times SO(3)$ bosonic subalgebra of $F(4)$. 16 SUSYs

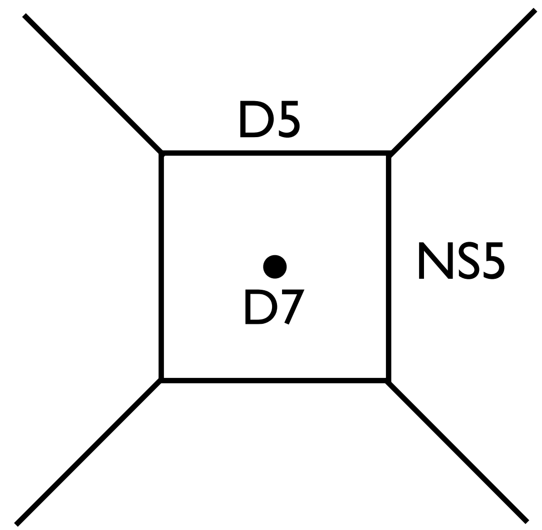
General solutions are expressed in terms of two locally holomorphic functions $\mathcal{A}_\pm$ on Σ_2

$\mathcal{A}_\pm$ were explicitly computed for the upper half plane and the annulus

The solutions for the upper half plane were shown to behave near the poles as the near brane limit of (p,q) 5-branes

The poles were interpreted as the remnants of external (p,q) 5-branes in a 5-brane web

These webs are 5d realisations of Hanany-Witten brane set-ups



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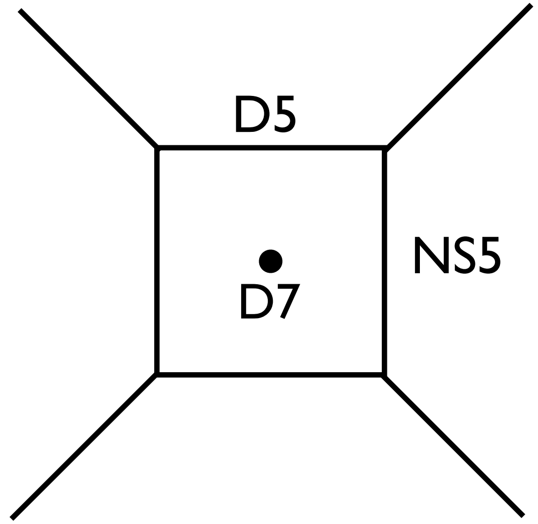
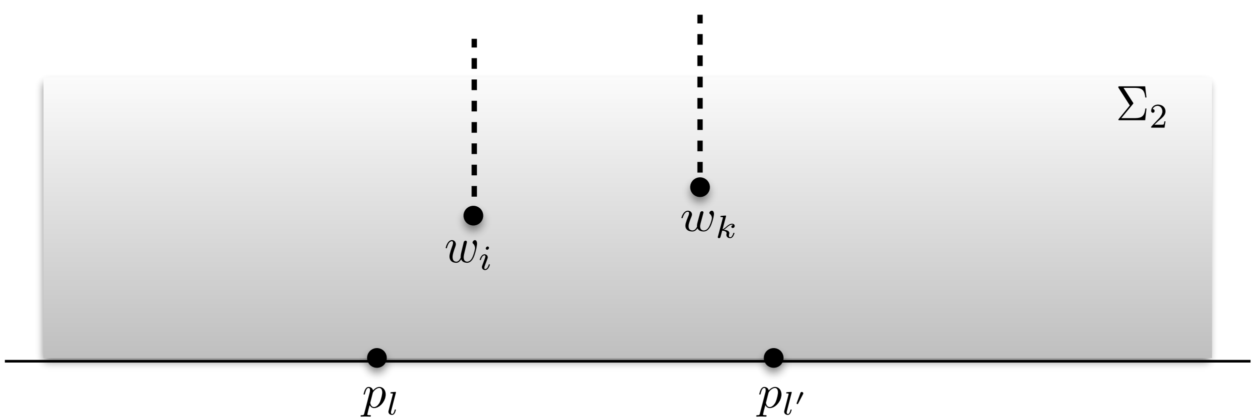
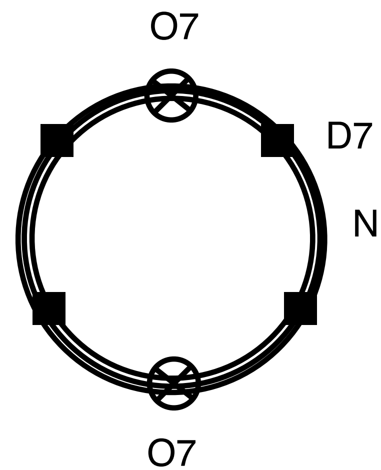


7-branes were included in a later paper, by allowing the supergravity fields to have non-trivial $SL(2,\mathbb{R})$ monodromy at isolated punctures in the interior of Σ_2

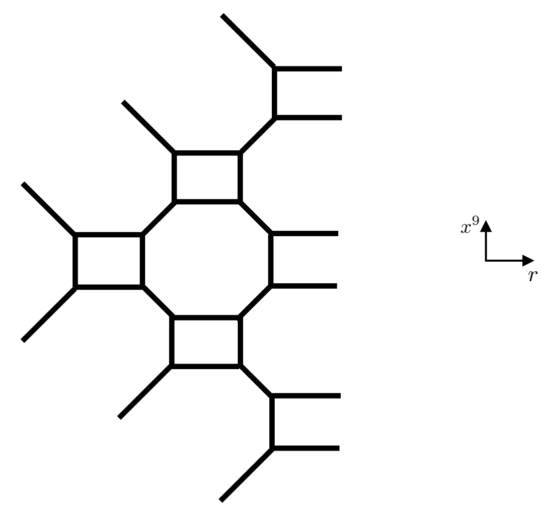


The ATD and NATD of the Brandhuber-Oz solution were shown to fit in the class of DGU (Y.L., Macpherson, Montero '18)

The ATD realises the Sp(N) fixed point theory in a D5,NS5,D7/O7 brane system:



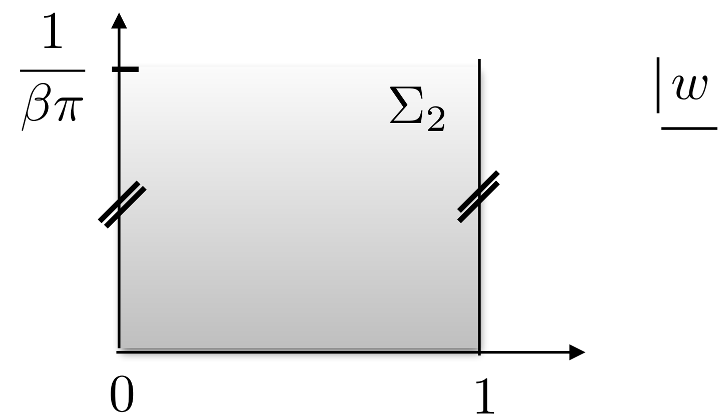
In the NATD the D5-branes are stretched between NS5-branes such that $N_{D5}=nN_{D7}$ at each $\rho\in[n\pi,(n+1)\pi]$ interval



The Abelian T-dual as a DGU global solution

The Riemann surface is an annulus:

$$w = \frac{\psi}{\pi} + \frac{i}{\beta\pi}(1 - (\cos\theta)^{2/3})$$



DGU discussed (p,q) 5-branes on the annulus. We added the D7 branes. The resulting holomorphic functions are expressed in terms of Jacobi theta-functions, that ensure the required periodicities

First known solution for the annulus

Possible to include smeared branes in the formalism of DGU

Similarly, the NATD solution is reproduced from an infinite strip:

Candidate dual CFT: $Sp(N_{D7}) \times Sp(2N_{D7}) \times \cdots \times Sp(nN_{D7}) \ldots$
fixed point theory

At each interval the condition $N_F \leq 2N + 4$ for the existence of a $Sp(N)$ UV fixed point theory is satisfied, according to the classification in Intriligator, Morrison, Seiberg'97

This is supported by the free energy and EE, which scale with $N^{5/2}$

6. Progress in AdS_3

(Y.L., Macpherson, Núñez, Ramírez'19)

2d CFTs play a prominent role in string theory, and provide the best arena to test the AdS/CFT correspondence

Canonical example: Near horizon of D1-D5 $AdS_3 \times S^3 \times CY_2$ geometry realising (4,4) superconformal symmetry. CFT dual believed to be the free symmetric product orbifold (Gaberdiel, Gopakumar, Eberhardt'18-19)

NATD: $AdS_3 \times S^2 \times CY_2$ geometry in massive IIA realising (0,4) superconformal symmetry

Classify $AdS_3 \times S^2 \times CY_2$ solutions in massive IIA!

AdS_3 solutions to massive IIA with (0,4) susy

$AdS_3 \times S^2 \times M_4 \times I$ solutions, with

- $M_4 = CY_2$: Generalisation of D4-D8 (Youm'99)
- $M_4 =$ Kähler: Generalisation of the (T-duals of the) sols obtained from F-theory on Y_3 (Couzens, Lawrie, Martelli, Schafer-Nameki, Wong'17)

Concentrate in the first class:

$$ds^2 = \frac{u}{\sqrt{h_4 h_8}}\Big(ds^2_{AdS_3} + \frac{h_8 h_4}{4h_8 h_4 + u'^2} ds^2_{S^2}\Big) + \sqrt{\frac{h_4}{h_8}} ds^2_{CY_2} + \frac{\sqrt{h_4 h_8}}{u} d\rho^2$$

$u, h_4, h_8:$ Linear functions in ρ

B_2 -field:

$$B_2 = \frac{1}{2}\Big(-\rho + \frac{uu'}{4h_4h_8 + u'^2} + 2n\pi\Big)\mathrm{vol}(S^2)$$

for $\rho \in [\rho_n, \rho_{n+1}]$, such that $\frac{1}{4\pi^2}\int_{S^2} B_2 \in [0,1]$ and

one NS5-brane is created at each interval

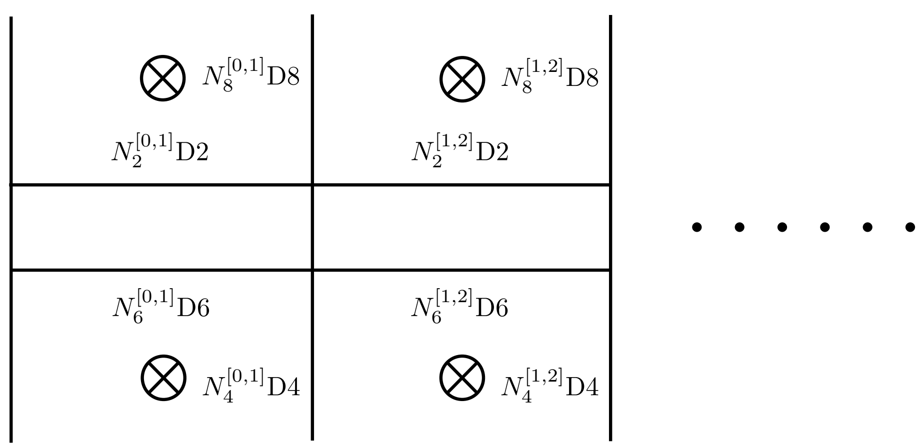
Page fluxes	Branes
$F_0 = h_8'$	D8
$\hat{F}_2 = \Big(h_8 - (\rho - 2n\pi)h_8'\Big)\mathrm{vol}_{S^2}$	D6
$\hat{F}_4 = h_4'\mathrm{vol}_{CY_2}$	D4
$\hat{F}_6 = \Big(h_4 - (\rho - 2n\pi)h_4'\Big)\mathrm{vol}_{CY_2} \wedge \mathrm{vol}_{S^2}$	D2

D2 and D6 branes are stretched among NS5-branes. They play the role of colour branes

D4 and D8 are perpendicular, and play the role of flavour branes

Supported by the analysis of Bianchi identities

Brane set-up:



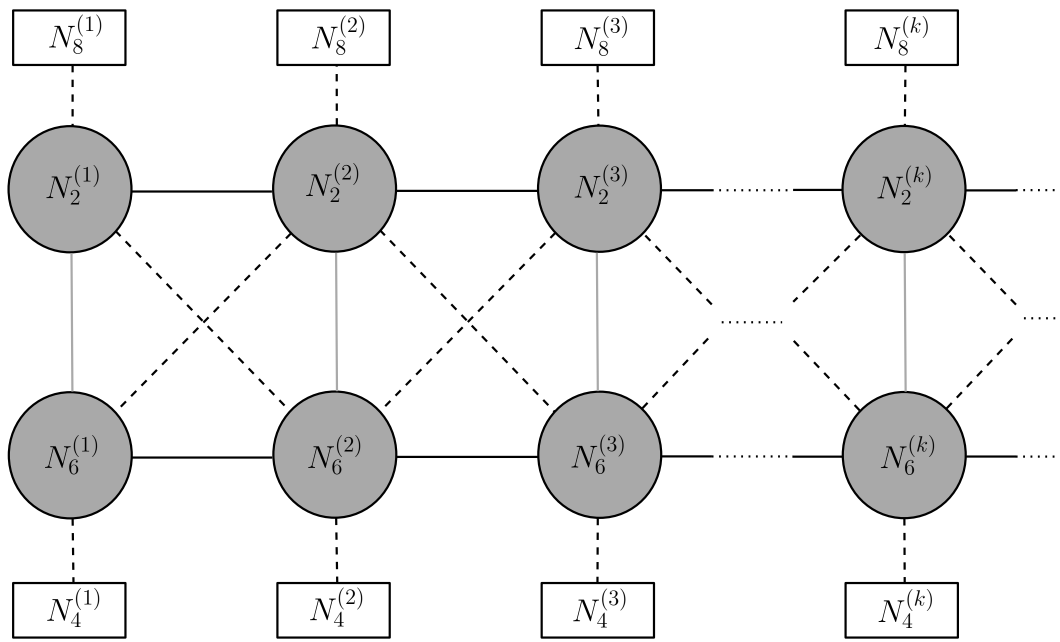
We will concentrate on solutions for which $u \sim \rho$ and h_4, h_8 are piecewise linear, with the change of slope due to the presence of D4 and D8 branes, respectively

We will also impose that $h_4(P+1) = h_8(P+1) = 0$, such that the space terminates at $\rho = P+1$ and we can have a well defined dual CFT

Our proposal: The brane set-up describes a (0,4) QFT that flows to a strongly coupled CFT in the IR, dual to our solutions

2d dual CFT

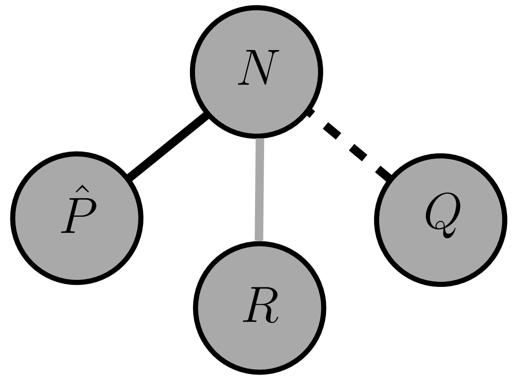
Two types of *colour* and *flavour* branes $\rightarrow$ *Planar* quiver



The resulting *planar* quiver consists on two (4,4) linear quivers coupled by (0,4) and (0,2) matter fields

The field theory is described in terms of (0,2) multiplets, that combine into (0,4) and (4,4) multiplets

It is obtained by assembling the building block:



Where:

Circles represent (4,4) vector multiplets, the black line a (4,4) hypermultiplet, the grey line a (0,4) hypermultiplet and the dashed line a (0,2) Fermi multiplet

This building block is non-anomalous if $2R = Q$

This must be satisfied at each node of our quiver

We can then compute the central charge of the CFT in the IR using that the (0,4) superconformal algebra relates the central charge with the R-symmetry anomaly:

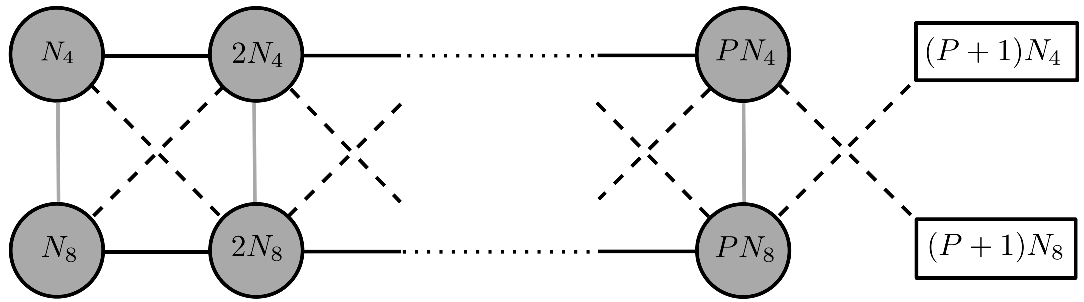
$$c = 6k = 6(n_{hyp} - n_{vec})$$ (Putrov, Song, Yan'15)

The holographic central charge, in turn, is computed from

$$c \sim V_{int} = \frac{3\pi}{2G_N} \int d\rho \, h_8 h_4$$

We have checked in various examples that these two expressions agree in the holographic limit

One of them is the *completion* of the NATD:



Gauge anomaly vanishes: $R = N_8;\ Q = 2N_8 \quad \Rightarrow 2R = Q$

$$n_{hyp} = \sum_{j=1}^{P-1} j(j+1)(N_4^2 + N_8^2) + \sum_{j=1}^{P} j^2 N_4 N_8$$

$$n_{vec} = \sum_{j=1}^{P} (j^2 N_4^2 - 1 + j^2 N_8^2 - 1)$$

$\Rightarrow \quad c \sim 2N_4N_8P^3$ to leading order in P

AdS dual:

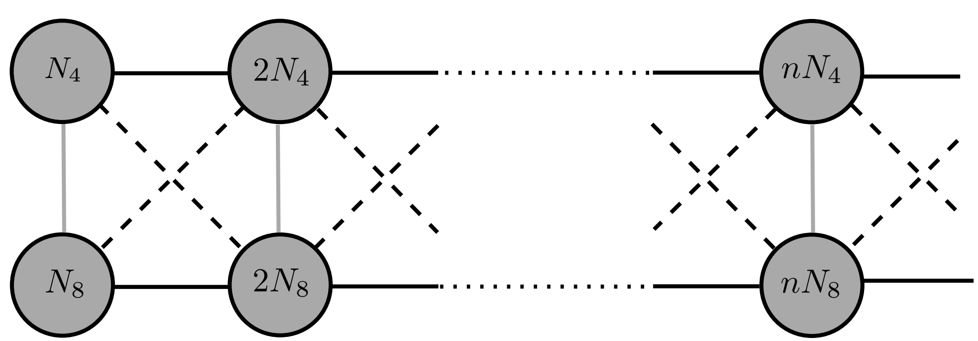
$$u = N_4 N_8\, \rho$$

$$h_8(\rho) = N_8 . \begin{cases} \rho & 0 \le \rho \le P \\ P((P+1) - \rho) & P \le \rho \le (P+1). \end{cases}$$

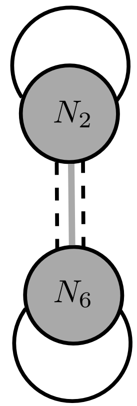
$$h_4(\rho) = N_4 . \begin{cases} \rho & 0 \le \rho \le P \\ P((P+1) - \rho) & P \le \rho \le (P+1). \end{cases}$$

For large P, $c_{hol} = 2N_4N_8P^3$, exactly as in field theory!

This solution is the *completion* of the non-Abelian T-dual of $AdS_3 \times S^3 \times CY_2$, defined by $u, h_8, h_4 \sim \rho$ and dual to:



ATD:



Enhancement to (4,4) susy

Defects in 6d (1,0) CFTs

Apruzzi, Fazzi, Rosa, Tomasiello'14: Complete classification of AdS_7 solutions in massive IIA.

General form of the solutions:

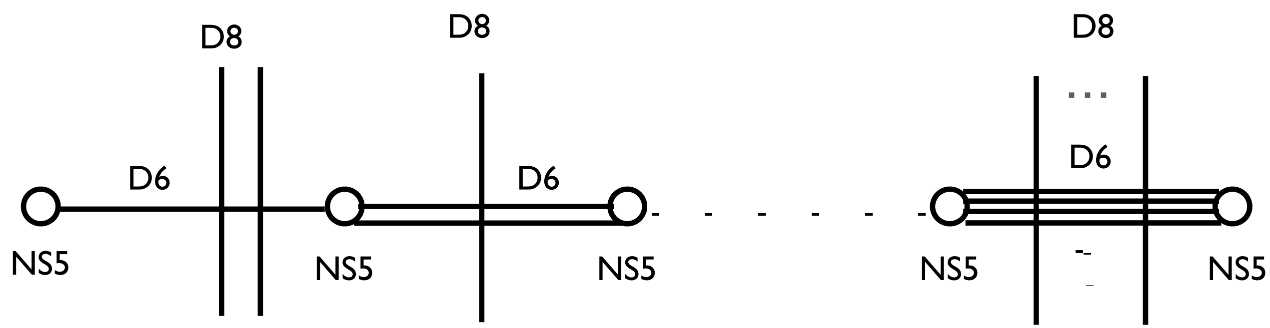
$$ds^2_{10} = \pi\sqrt{2}\left(8\sqrt{-\frac{\alpha}{\ddot{\alpha}}}ds^2_{AdS_7} + \sqrt{-\frac{\ddot{\alpha}}{\alpha}}dz^2 + \frac{\alpha^{3/2}(-\ddot{\alpha})^{1/2}}{\dot{\alpha}^2 - 2\alpha\ddot{\alpha}}ds^2_{S^2}\right)$$

$$e^{2\Phi} = 2^{5/2}\pi^5 3^8 \frac{(-\alpha/\ddot{\alpha})^{3/2}}{\dot{\alpha}^2 - 2\alpha\ddot{\alpha}}$$

$$B_2 = \pi\left(-z + \frac{\alpha\dot{\alpha}}{\dot{\alpha}^2 - 2\alpha\ddot{\alpha}}\right)\mathrm{vol}_{S^2} \qquad F_2 = \left(\frac{\ddot{\alpha}}{162\pi^2} + \frac{\pi F_0 \alpha\dot{\alpha}}{\dot{\alpha}^2 - 2\alpha\ddot{\alpha}}\right)\mathrm{vol}_{S^2}$$

They depend on $\alpha(z)$, which satisfies $\dddot{\alpha} = -162\pi^3 F_0$

$\alpha(z)$ encodes the information of the dual CFT, which is a 6d (1,0) CFT living in a D6-NS5-D8 brane system (Gaiotto, Tomasiello'15; Cremonesi, Tomasiello'15):



Apruzzi, Fazzi, Passias, Rota, Tomasiello'15: AdS_5 and AdS_4 solutions to massive IIA arise as compactifications on 2d or 3d manifolds:

$$ds^2_{AdS_{5(4)}} + ds^2_{\Sigma_{2(3)}} \leftrightarrow ds^2_{AdS_7}$$

They are related by flows to the AdS_7 solutions (Passias, Rota, Tomasiello'15)

AdS_3?

Similar mapping: $ds^2_{AdS_3} + ds^2_{CY_2} \leftrightarrow ds^2_{AdS_7}$, plus

$$\rho \leftrightarrow z$$

$$u, h_4 \leftrightarrow \alpha$$

$$h_8 \leftrightarrow -\ddot{\alpha}$$

Formal mapping that allows to go from AdS_3 to AdS_7 but not the other way around

This is due to the extra D2-D4 defect

$$F_0 = h_8' \qquad\qquad \leftrightarrow \qquad\qquad F_0 = -\ddot{\alpha}$$

$$\hat{F}_2 = \Big(h_8 - (\rho - 2n\pi)h_8'\Big)\mathrm{vol}_{S^2} \qquad \hat{F}_2 = \Big(\ddot{\alpha} + F_0(z - n\pi)\Big)\mathrm{vol}_{S^2}$$

Wrapped brane *sector:* D6-NS5-D8 wrapped on CY_2

$$\hat{F}_4 = h_4'\mathrm{vol}_{CY_2} \qquad\qquad \leftrightarrow$$

$$\hat{F}_6 = \Big(h_4 - (\rho - 2n\pi)h_4'\Big)\mathrm{vol}_{CY_2} \wedge \mathrm{vol}_{S^2}$$

Defect brane *sector:* D2-D4 branes

Reduce susy to 1/4-BPS

Are there flows that connect the solutions to AdS7?

7. Conclusions

Non-Abelian T-duality has interesting applications to Holography:

- Generation of new solutions $\rightarrow$ Extension of existing classifications, explicit examples in known classes, construction of new classes of solutions,..

- AdS solutions dual to CFTs living on (Dp,NS5) brane set-ups (so far)

Holography has interesting applications to duality in ST:

- Using holography it is possible to provide the sought for global completion of NATD geometries

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THANKS!