The gravity duals of SO/USp superconformal quivers

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M5 on Σ_g

M5 wrapping a Riemann surface [Gaiotto '09]

Σ_g

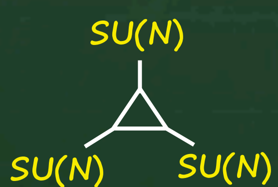
- N M5-branes on $\Sigma_g \times R^4$

  d=4, N=2 SCFT

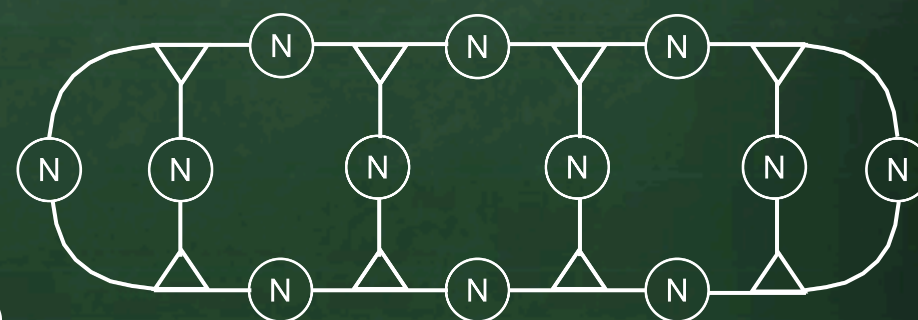
  ↓

- SU(N) generalized quivers

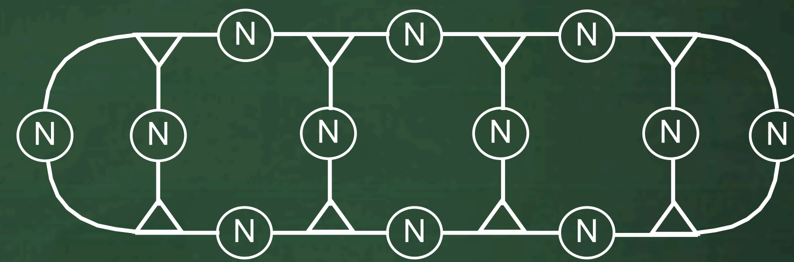
: SU(N) gauge group



: T_N theory
($SU(N)^3$ flavor sym)



M5 on Σ_g



Gravity duals [Gaiotto-Maldacena '09]

The near horizon geometry of M5 on Σ_g:

$$AdS_5 \times \Sigma_g \times S^4$$

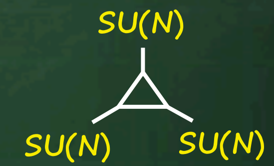
Here S^4 is non-trivially fibered over Σ_g, and the geometry has the symmetry

$$SU(2) \times U(1)$$

The conformal anomaly matches the field theory calculation:

gravity side: $c = \dfrac{\pi R^3_{AdS_5}}{8G^5_{\mathrm{N}}} = \dfrac{N^3}{3}(g-1),$

field theory side: $c = \dfrac{2n_v + n_h}{12} = \left(\dfrac{N^3}{3} - \dfrac{N}{6} - \dfrac{1}{6}\right)(g-1)$



$$n_v = \frac{2N^3}{3} - \frac{3N^2}{2} - \frac{N}{6} + 1$$

$$n_h = \frac{2N^3}{3} - \frac{2N}{3}$$

Q: What is its SO/USp counterpart?

M5 on Σ_g with orbifolding

<u>SO/USp generalized quivers</u> [Tachikawa '09]

	0 ~ 3	R^5/Z_2	6	10
M5	o	x	o	o

(Σ_g spans columns 6 and 10)

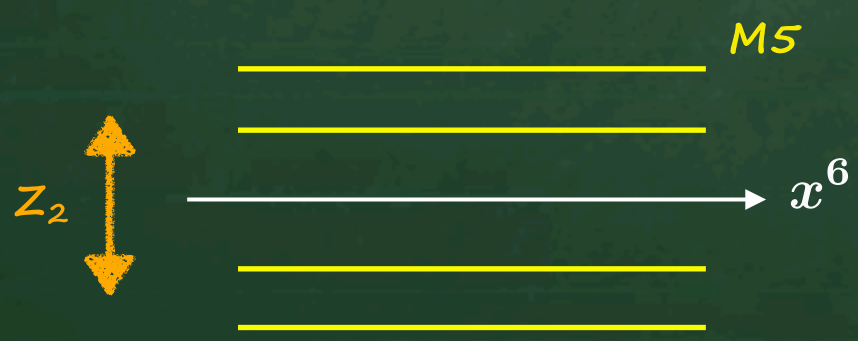
2N M5 on top of R^5/Z_2

↓

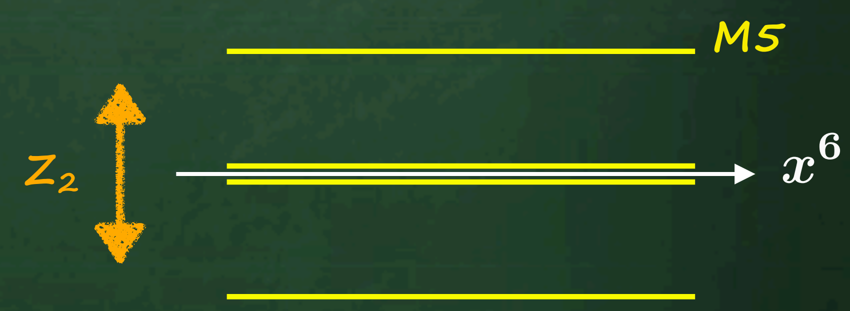
$\left\{ \begin{array}{c} SO(2N) \\ USp(2N-2) \end{array} \right\}$ gauge groups in 4dim

For USp(2N−2), two M5 are localized at the Z_2 fixed plane.

[Hori '98]



SO(4)



USp(2)

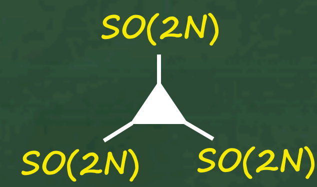
M5 on Σ_g with orbifolding

<u>SO/USp counterparts of T_N theory</u>

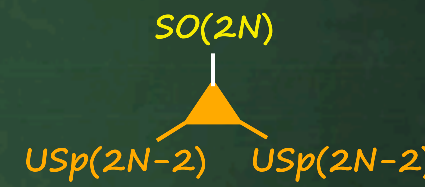
[Tachikawa '09]

There are **two** counterparts. →

T_{SO} theory

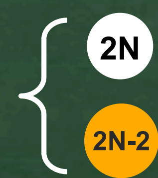


$\tilde{T}_{SO}$ theory



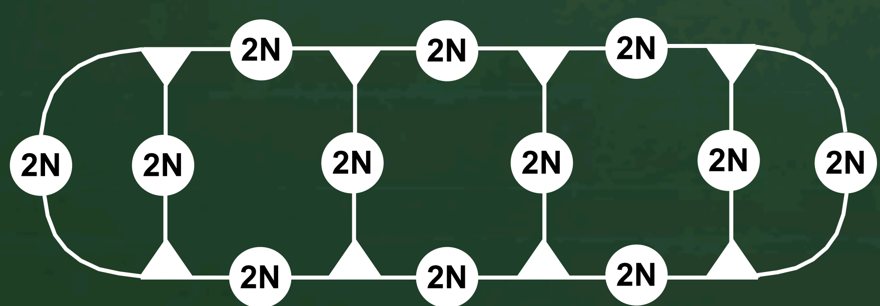
[Their anomaly contributions n_v and n_h are read off via S-duality.]

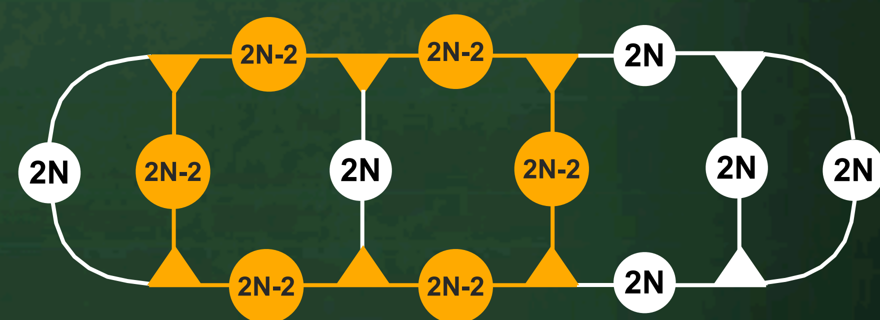
There are several quivers sharing **the same Σ_g.**



: SO(2N) gauge group

: USp(2N−2) gauge group





M5 on Σ_g with orbifolding

Gravity duals

The difference between SO and USp is subleading in large N.

⟶ The dual geometry is determined by Σ_g as

$$AdS_5 \times \Sigma_g \times RP^4$$

(In comparison with SU-quivers, S^4 is replaced by RP^4)

M5 on Σ_g with orbifolding

Gravity duals

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→ The dual geometry is determined by Σ_g as

$$AdS_5 \times \Sigma_g \times RP^4$$

(In comparison with SU-quivers, S^4 is replaced by RP^4)

→ The holographic conformal anomaly

$$c = \frac{\pi R^3_{AdS_5}}{8 G^5_{\mathrm{N}}} = \frac{4N^3}{3}(g-1)$$

is determined by the genus g of Σ_g and independent of the choice of SO or USp.

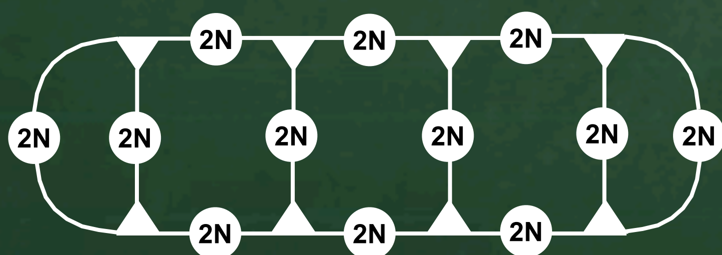
M5 on Σ_g with orbifolding

In fact, in the field theory side, we can show that n_v and n_h are equal between theories with the same Σ_g, by using the facts that

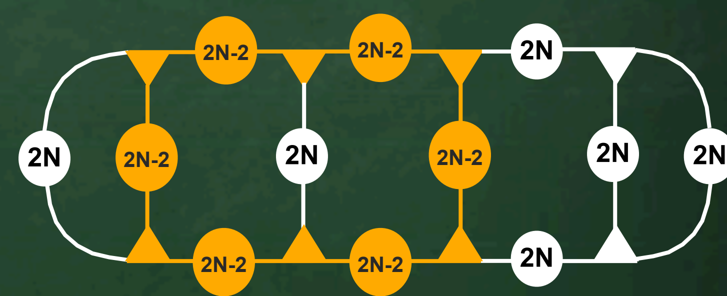
$$n_v = \frac{8N^3}{3} - 7N^2 + \frac{10N}{3}$$
$$n_h = \frac{8N^3}{3} - 4N^2 + \frac{4N}{3}$$

$$n_v = \frac{8N^3}{3} - 7N^2 + \frac{16N}{3} - 1$$
$$n_h = \frac{8N^3}{3} - 4N^2 + \frac{4N}{3}$$

For example, both



and



have

$$c = \frac{2n_v + n_h}{12} = \left(\frac{4N^3}{3} - 2N^2 + \frac{5N}{6}\right)(g-1)$$

M5 on Σ_g with orbifolding

Torsion part of G-flux [Hori '98]

The topology of the 3-form potential is measured by

$$H^4(\mathrm{RP}^4 \times S^1, \widetilde{\mathbf{Z}}) \simeq \mathbf{Z} \oplus \mathbf{Z}_2$$

($\widetilde{\mathbf{Z}}$: integers twisted by the orientation bundle)

Torsion part

$$\mathbf{Z}_2 \ni \vartheta \equiv \int_{S^1 \times \mathbf{RP}^3} [G_4/2\pi]$$

$$= \begin{cases} 0 \cdots\cdots SO(2N) \\ 1 \cdots\cdots USp(2N-2) \end{cases}$$

M5 on Σ_g with orbifolding

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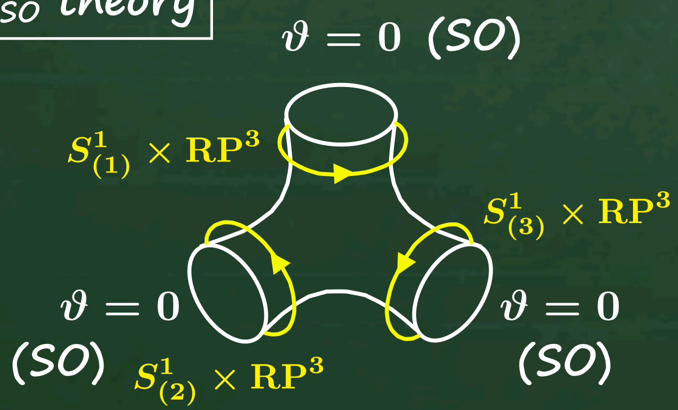
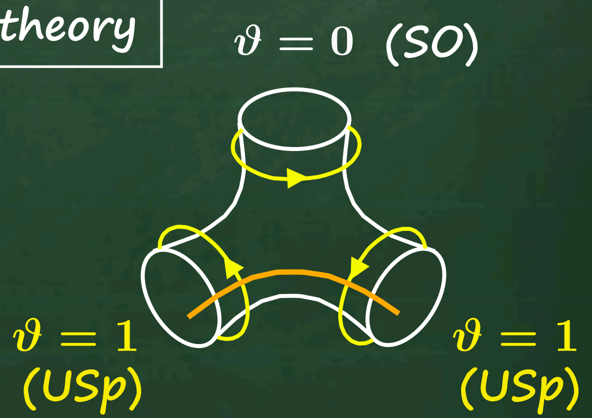
T_{SO} theory

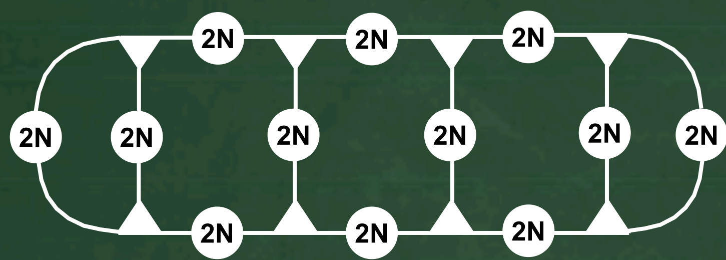


$\widetilde{T}_{SO}$ theory

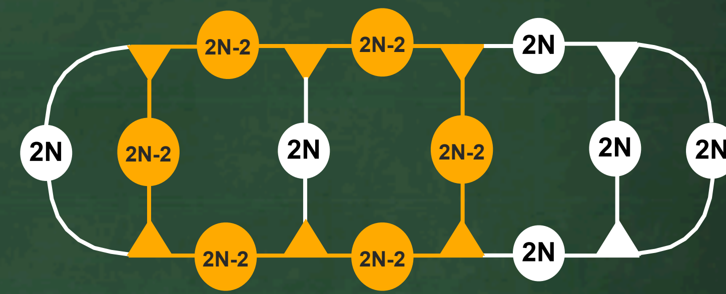


M5 on Σ_g with orbifolding

For example, for



and



the dual gravities are distinguished by the **torsion part of G-flux** along the "B-cycles" of Σ_g:

Summary

- We studied the gravity duals of SO/USp superconformal quivers, which are constructed by wrapped M5-brane on a Riemann surface together with the Z_2 orbifold.

- For a Riemann surface Σ_g without punctures, the gravity duals are characterized by the genus g of Σ_g and the torsion part of the four-form flux.

- The conformal anomalies of the theory is determined by the genus g of Σ_g.

- In the paper, we also studied the gravity duals of SO/USp tails. So, if you could take a look at it, I would be very happy!!

That‘s all for my presentation.

Thank you very much.

M5 on Σ_g

Gravity dual

[Gaiotto-Maldacena]

$$ds^2 = (\pi N l_p^3)^{\frac{2}{3}} \frac{W^{\frac{1}{3}}}{2} \left\{ 4ds^2_{AdS_5} + 2\left[4\frac{dr^2 + r^2 d\beta^2}{(1-r^2)^2} \right] + 2d\theta^2 + \frac{2}{W}\cos^2\theta (d\psi^2 + \sin^2\psi d\phi^2) + \frac{4}{W}\sin^2\theta \left(d\chi + \frac{2r^2 d\beta}{1-r^2} \right)^2 \right\}$$

$$W \equiv 1 + \cos^2\theta$$