Chiral theories of class S_Γ

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Introduction

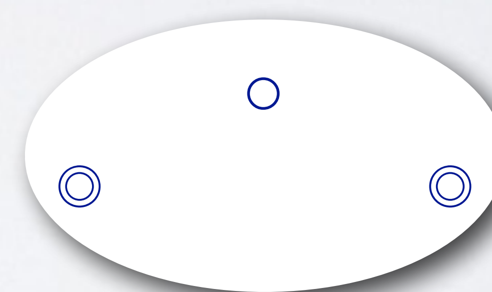
Recently, it has been found that **a large class of 4d N=2 gauge theories** is obtained from 6d (2,0) theory compactified on a Riemann surface, which is called "class S" **[Gaiotto]**

One of the most remarkable features of the construction is that it includes various SCFTs, which are used as building blocks of the class of N=2 gauge theories.

puncture with SU(N) flavor symmetry

Non-trivial SCFT called T_N theory

$$a, c \sim N^3$$



free bifundamental hypermultiplets

$$a, c \sim N^2$$

6d (2,0) theories are classified by ADE group……

It is known that there are various theories in 6d with (1,0) supersymmetry.

[Blum-Intriligator, Hanany-Zaffaroni]

[Del Zotto-Heckman-Tomasiello-Vafa, Heckman-Morrison-Vafa…]

What kind of theories is obtained by compactification to 4d?

We consider here simpler examples: **orbifold of A_{N-1} (2,0) theory (a world volume theory on M5-branes proving the C^2/Γ singularity)**

- ➢ N=1 in 4d, chiral
- ➢ SCFTs with chiral nature?

Non-trivial SCFT

$$a, c \sim |\Gamma|^2 N^3$$

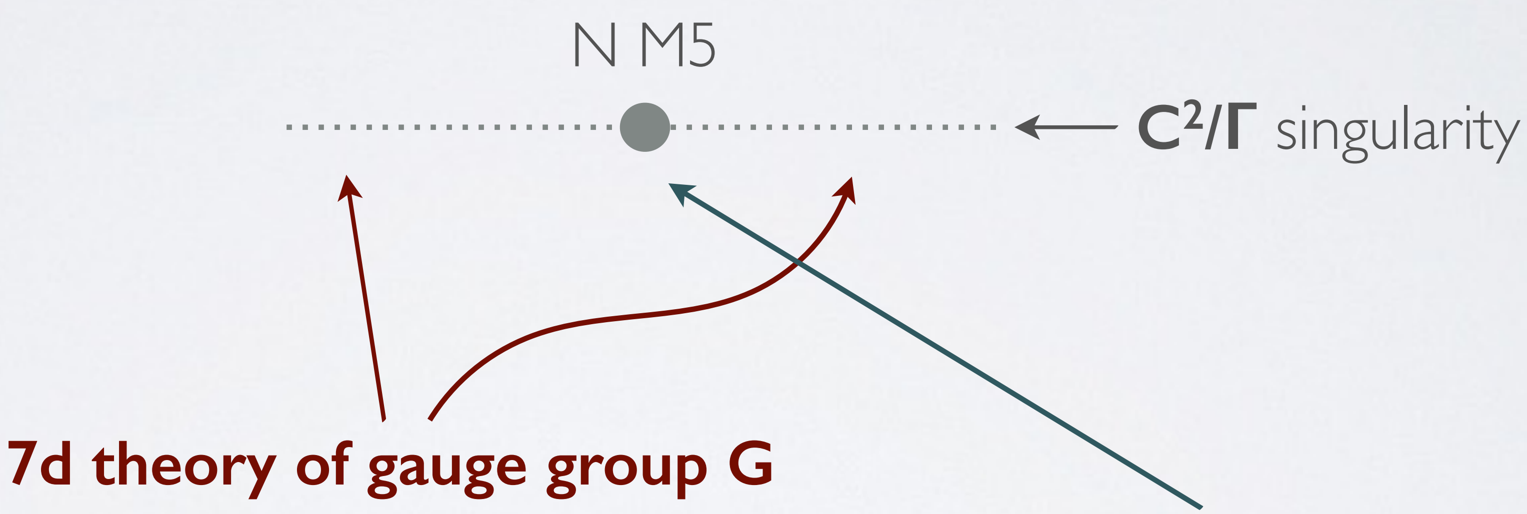
More generally we can consider the orbifold of (2,0) theory of type G: (1,0) theory (G,G')

(A, A): **[Gaiotto-Razamat, Franco-Hayashi-Uranga, Hanany-KM]**

(D, A): **[Kanno's poster]**

6d (1,0) theories of type Γ

is the world volume theory on **N M5-branes proving the orbifold singularity $\mathbb{C}^2/\Gamma_G$**, where Γ_G is the orbifold of type G = SU(k), SO(2k), E_6, E_7 and E_8



domain wall in 7d theory:
from 6d point of view on this domain wall,
the theory has G x G flavor symmetry

Global symmetry:

$SU(2)_R \times G^2$ (x U(1) only for A-type)

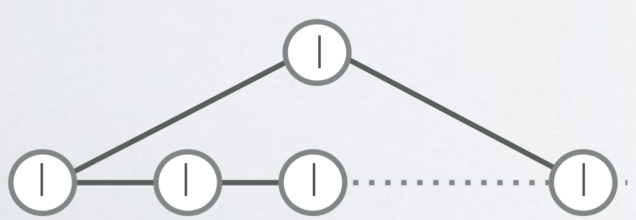
Compactification on T^2

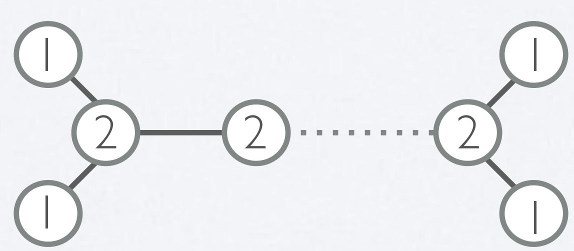
By taking $x^{6,10}$ direction as T^2 and reducing x^{10} to type IIA, we get N D4-branes on C^2/Γ_G

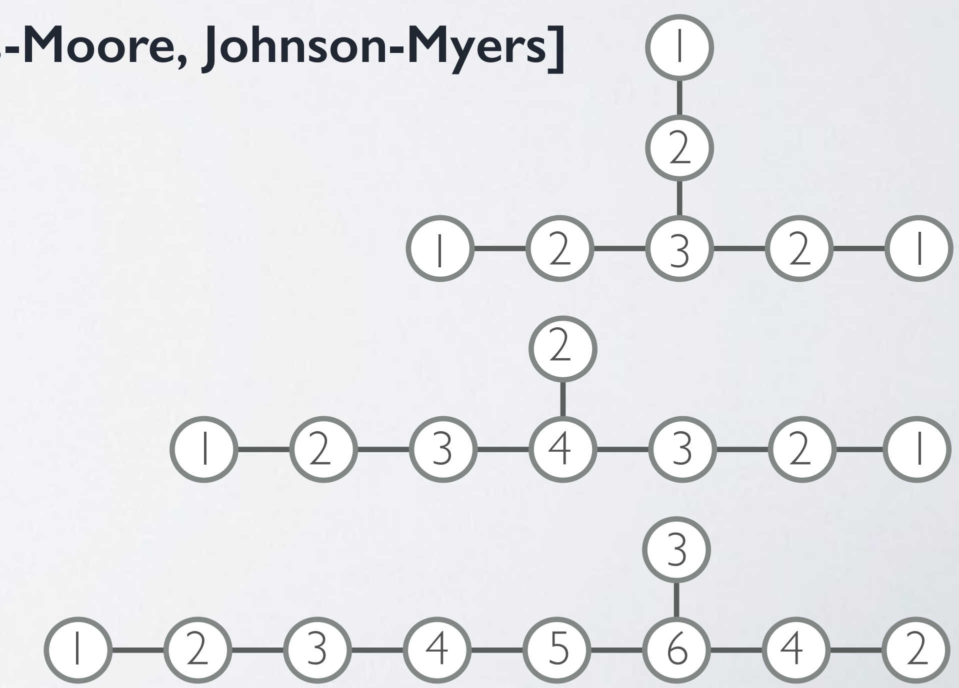
	0123	45	6	78	9	10
N M5	——		—			—
C^2/Γ	——		—		—	—

	0123	45	6	78	9
N D4	——		—		
C^2/Γ	——		—		—

It is known that theories on D4's (with nonzero B field) are **4d N=2 quiver theories with affine G shape**: **[Douglas-Moore, Johnson-Myers]**







Compactification on C_g

Since C_g has SO(2) holonomy we twist this with $U(1)_R$ in $SU(2)_R$ symmetry:

$$A_{U(1)_R} + \omega_{C_g} = 0$$

This preserves N=1 supersymmetry in 4d.

The global symmetry in 4d theory is (with B-field)

$U(1)_R \times U(1)^{2r}$ (x U(1) for A type)

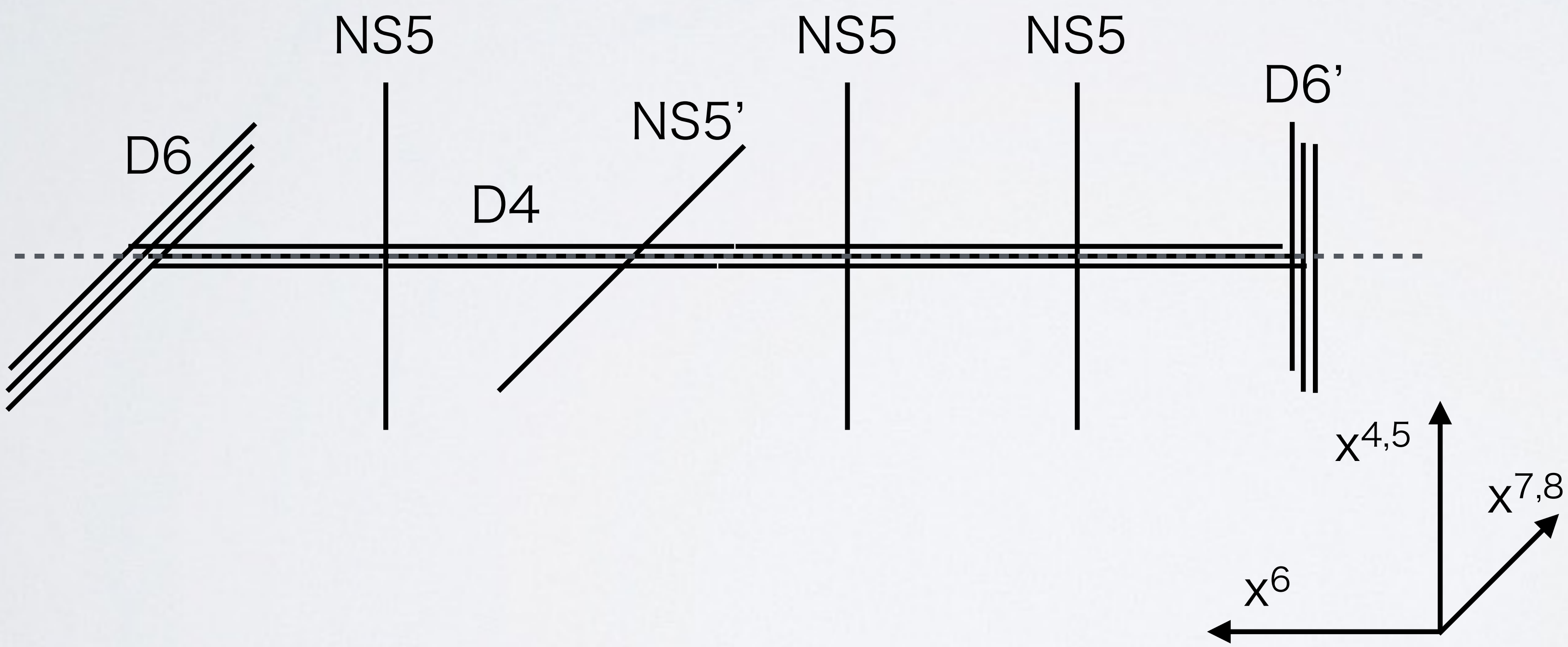
Additionally we can add nontrivial flux of global non-R symmetry. Thus the theories are classified by

$S[\Gamma_G, N, C_g; F_i]$

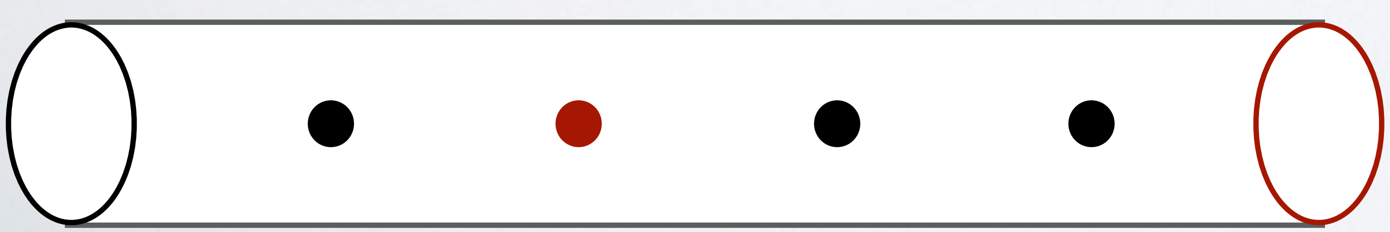
Compactification on $C_{g,n}$

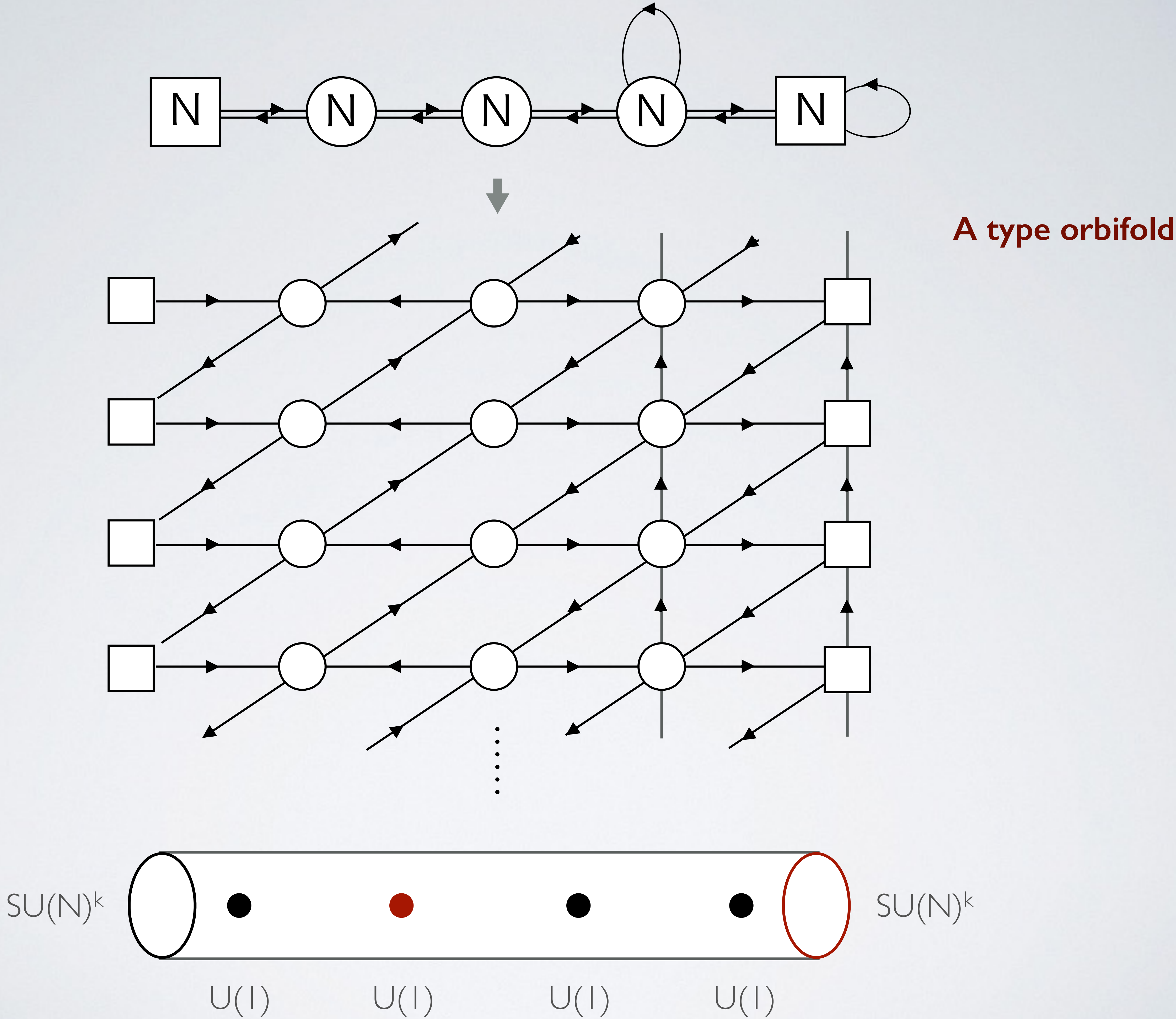
We now include punctures on Riemann surface. The classification of the punctures of this class of theories have not yet been done. Instead we here consider a simple class of punctures:

For A type, g=0



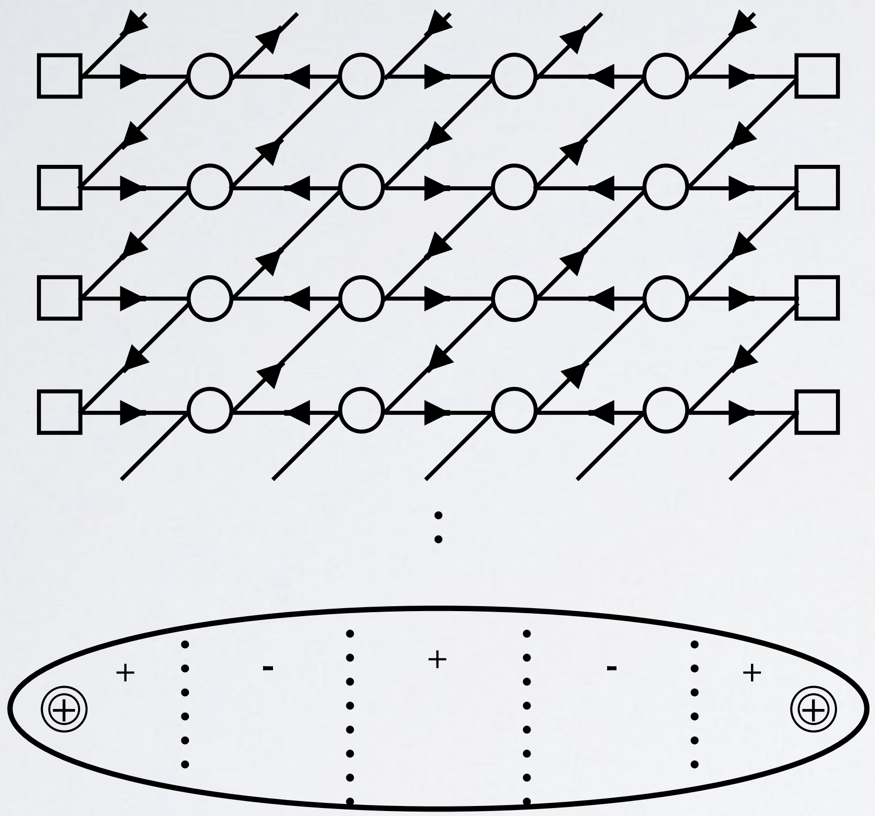
	0123	45	6	78	9
N D4	—		—		
C^2/Z_k	—		—		—
NS5	—	—			
NS5'	—			—	
D6	—			—	—
D6'	—	—			—

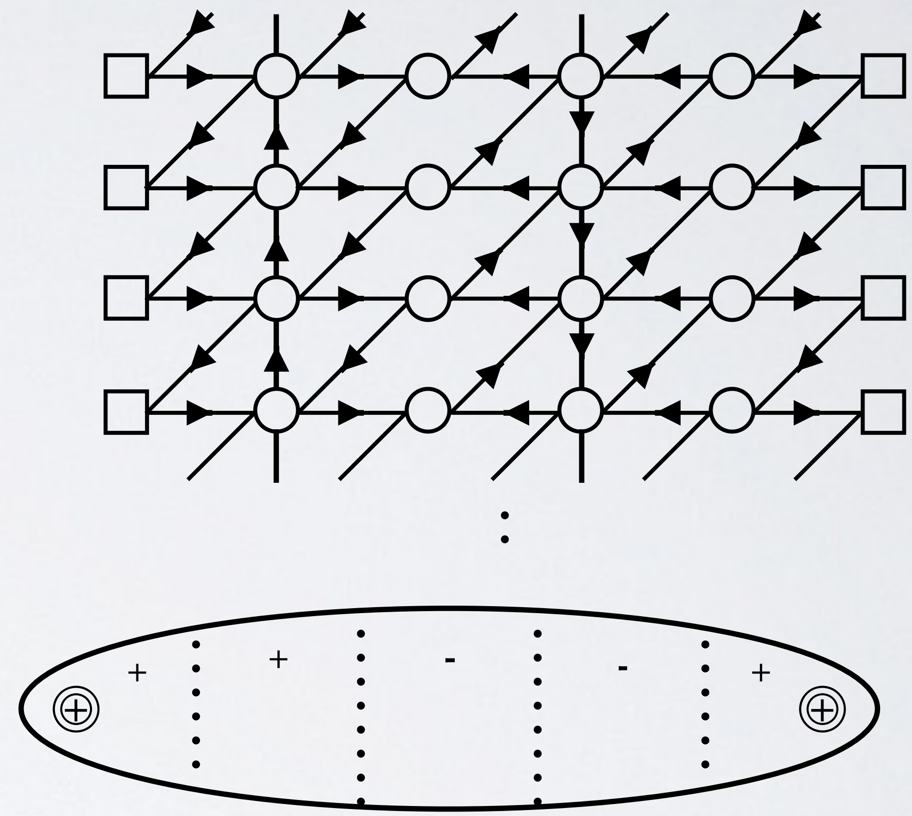



N
N
N
N
N
A type orbifold
SU(N)^k
SU(N)^k
U(1)
U(1)
U(1)
U(1)

IR property and duality

The theory flows to IR fixed point.





Exactly marginal deformations

$$\dim_{\mathbb{C}} \mathcal{M}_{C_{0,n}} = n - 3$$

$$\dim_{\mathbb{C}} \mathcal{M}_{C_{1,n}} = k + gcd(k,n) + n$$

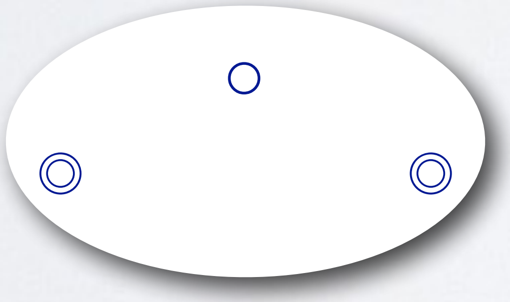
Punctures of A type theories

- **maximal puncture** (coming from D6's)

  labeled by sign σ, color n, and has flavor symmetry $SU(N)^k$
  (the sign σ is related to **D6** or **D6'**)

- other punctures can be obtained by Higgsing

  minimal puncture (coming from NS5) has a U(1) symmetry
  (the sign σ is related to **NS5** or **NS5'**)



free bifundamentals

SCFT
with $SU(N)^{3k}$

Conclusion

We considered 4d N=1 SCFT obtained from N M5-branes on C^2/Γ (but mostly Γ=A case) compactified on a Riemann surface.

Outlook

- ✪ classification of punctures?
- ✪ how can we study strongly coupled theories associated to $C_{0,3}$?
- ✪ insertion of half-BPS surface defect **[Mori's poster]**
- ✪ relation to brane-tiling, and integrable systems **[work in progress]**
- ✪ Coulomb phase and orbifolded Hitchin system?
- ✪ orbifolded version of 6=3+3 and 6=2+4 correspondences?