Title: All AdS7 solutions of type II supergravity

Date: Oct 18, 2013 11:00 AM

URL: http://pirsa.org/13100108

Abstract: In M-theory, the only AdS7 supersymmetric solutions are AdS7 Ã— S4 and its orbifolds. In this talk, I will describe a classification of AdS7 supersymmetric solutions in type II supergravity. While in IIB none exist, in IIA with Romans mass (which does not lift to M-theory) there are many new ones. The classification starts from a pure spinor approach reminiscent of generalized complex geometry. Without the need for any Ansatz, the method determines uniquely the form of the metric and fluxes, up to solving a system of ODEs. Namely, the metric on M3 is that of an S2 fibered over an interval; this is consistent with the Sp(1) R-symmetry of the holographically dual (1,0) theory. One can obtain numerically many solutions, with D8 and/or D6 brane sources; topologically, the internal manifold M3 = S^3.

Introduction

Several reasons to be interested in 6d superconformal field theories

Introduction

Several reasons to be interested in 6d superconformal field theories

- $\mathcal{N} = (2,0)$ SCFT lives on M5-brane

Introduction

Several reasons to be interested in 6d superconformal field theories

- $\mathcal{N} = (2,0)$ SCFT lives on M5-brane

- existence of higher-dimensional CFTs is interesting problem in its own right

[e.g. a gauge theory gets strongly coupled in the UV]

Introduction

Several reasons to be interested in 6d superconformal field theories

- $\mathcal{N} = (2,0)$ SCFT lives on M5-brane
- existence of higher-dimensional CFTs is interesting problem in its own right

  [e.g. a gauge theory gets strongly coupled in the UV]
- they can be used to generate interesting classes of 4d and 3d theories

  [preaching to the pope...]

Introduction

Several reasons to be interested in 6d superconformal field theories

- $\mathcal{N} = (2,0)$ SCFT lives on M5-brane
- existence of higher-dimensional CFTs is interesting problem in its own right

  [e.g. a gauge theory gets strongly coupled in the UV]
- they can be used to generate interesting classes of 4d and 3d theories

  [preaching to the pope...]

It would be interesting to have a classification.

Introduction

Several reasons to be interested in 6d superconformal field theories

- $\mathcal{N} = (2,0)$ SCFT lives on M5-brane
- existence of higher-dimensional CFTs is interesting problem in its own right

  [e.g. a gauge theory gets strongly coupled in the UV]
- they can be used to generate interesting classes of 4d and 3d theories

  [preaching to the pope...]

It would be interesting to have a classification.

$(2,0)$ theory is unique, but how about $(1,0)$?

In this talk, we are going to attack the problem holographically:

In this talk, we are going to attack
the problem holographically:

We will classify supersymmetric AdS_7 solutions in type II theories

- in 11d sugra: $\mathrm{AdS}_7 \times M_4$

In this talk, we are going to attack the problem holographically:

We will classify supersymmetric AdS_7 solutions in type II theories

- in 11d sugra: $\mathrm{AdS}_7 \times M_4$

$\mathrm{SO}(6,2)$ symmetry $\Rightarrow$ only flux: $G_4 \propto \mathrm{vol}_4$ [Freund–Rubin]

In this talk, we are going to attack the problem holographically:

We will classify supersymmetric AdS_7 solutions in type II theories

- in 11d sugra: $\mathrm{AdS}_7 \times M_4$

$\mathrm{SO}(6,2)$ symmetry $\Rightarrow$ only flux: $G_4 \propto \mathrm{vol}_4$ [Freund–Rubin] $\Rightarrow$ cone over M_4 should have reduced holonomy

In this talk, we are going to attack the problem holographically:

We will classify supersymmetric AdS_7 solutions in type II theories

- in 11d sugra: $\mathrm{AdS}_7 \times M_4$

$\mathrm{SO}(6,2)$ symmetry $\Rightarrow$ only flux: $G_4 \propto \mathrm{vol}_4$ [Freund–Rubin] $\Rightarrow$ cone over M_4 should have reduced holonomy $\Rightarrow$ $M_4 = S^4/\mathbb{Z}_k$

In this talk, we are going to attack the problem holographically:

We will classify supersymmetric AdS_7 solutions in type II theories

- in 11d sugra: $\mathrm{AdS}_7 \times M_4$

$\mathrm{SO}(6,2)$ symmetry $\Rightarrow$ only flux: $G_4 \propto \mathrm{vol}_4$ [Freund–Rubin] $\Rightarrow$ cone over M_4 should have reduced holonomy $\Rightarrow$ $M_4 = S^4/\mathbb{Z}_k$

nothing new here!

- we will show that IIB susy solutions also $\nexists$

- However, in massive IIA we will show that there are many new solutions:

- However, in massive IIA we will show that there are many new solutions:

$$\mathrm{AdS}_7 \times M_3$$

- However, in massive IIA we will show that there are many new solutions:

$$\mathrm{AdS}_7 \times \underbrace{M_3}_{\parallel}$$

S^2-fibration over interval, topologically $\cong S^3$

'distorted S^3s'

SU(2) isometry:
R-symmetry

- However, in massive IIA we will show that there are many new solutions:

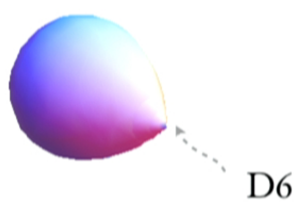
$$\mathrm{AdS}_7 \times \underbrace{M_3}_{=}$$

S^2-fibration over interval, topologically $\cong S^3$

'distorted S^3s'

SU(2) isometry: R-symmetry

for example, we will see:



- However, in massive IIA we will show that there are many new solutions:

$$\mathrm{AdS}_7 \times \underbrace{M_3}$$

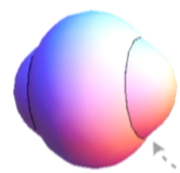
S^2-fibration over interval, topologically $\cong S^3$

'distorted S^3s'

SU(2) isometry: R-symmetry

for example, we will see:

D6



D8-D6 bound state [stabilized by flux]

Plan

1. Strategy: pure spinors
2. General classification

Plan

1. Strategy: pure spinors
2. General classification
3. Explicit solutions

I. Pure spinors

'Pure spinor' approach to susy solutions in type II: working on $T \oplus T^*$

susy parameters $\epsilon_{1,2}$ define

- two ordinary G-structures

I. Pure spinors

'Pure spinor' approach to susy solutions in type II: working on $T \oplus T^*$

susy parameters $\epsilon_{1,2}$ define

- two ordinary G-structures

$\Downarrow$

many possible cases
depending on $G(\epsilon_1) \cap G(\epsilon_2)$

or

- one G-structure on $T \oplus T^*$

I. Pure spinors

'Pure spinor' approach to susy solutions in type II: working on $T \oplus T^*$

susy parameters $\epsilon_{1,2}$ define

- two ordinary G-structures

$\Downarrow$

many possible cases
depending on $G(\epsilon_1) \cap G(\epsilon_2)$

or

- one G-structure on $T \oplus T^*$

nicer equations; easier classifications

I. Pure spinors

'Pure spinor' approach to susy solutions in type II: working on $T \oplus T^*$

susy parameters $\epsilon_{1,2}$ define

• two ordinary G-structures

$\Downarrow$

many possible cases
depending on $G(\epsilon_1) \cap G(\epsilon_2)$

or

• one G-structure on $T \oplus T^*$

described by forms
obeying algebraic constraints:
often 'pure spinors'

nicer equations; easier classifications

original example

$$\left.\begin{array}{l}\mathrm{Mink}_4\\ \mathrm{AdS}_4\end{array}\right\} \times M_6$$

[Graña, Minasian, Petrini, AT '05]

$SU(3)\times SU(3)$ structure

nice differential equations

original example

$$\left.\begin{matrix}\text{Mink}_4\\ \text{AdS}_4\end{matrix}\right\} \times M_6$$

[Graña, Minasian, Petrini, AT '05]

$\mathrm{SU}(3)\times\mathrm{SU}(3)$ structure

nice differential equations

[AT '11]

any M_{10}:

$(\mathrm{Spin}(7) \ltimes \mathbb{R}^8)^2$ structure*

*simplifying the story a bit...

original example

$$\left.\begin{matrix}\mathrm{Mink}_4 \\ \mathrm{AdS}_4\end{matrix}\right\} \times M_6$$

[Graña, Minasian, Petrini, AT '05]

SU(3)×SU(3) structure
nice differential equations

[AT '11] any M_{10}:
$(\mathrm{Spin}(7) \ltimes \mathbb{R}^8)^2$ structure*

$$\boxed{(d + H\wedge)\Phi = (\iota_K + \tilde{K}\wedge)F}$$

+ extra equations, almost never important

*simplifying the story a bit...

original example

$$\left.\begin{array}{l}\mathrm{Mink}_4\\ \mathrm{AdS}_4\end{array}\right\} \times M_6$$

[Graña, Minasian, Petrini, AT '05]

SU(3)×SU(3) structure

nice differential equations

[AT '11]

any M_{10}:

$(\mathrm{Spin}(7) \ltimes \mathbb{R}^8)^2$ structure*

NS 3-form

defined by Φ

$$\boxed{(d + H\wedge)\Phi = (\iota_K + \tilde{K}\wedge)F}$$

total RR flux

+ extra equations, almost never important

*simplifying the story a bit...

original example

$$\left.\begin{matrix}\text{Mink}_4\\ \text{AdS}_4\end{matrix}\right\} \times M_6$$

[Graña, Minasian, Petrini, AT '05]

SU(3)×SU(3) structure

nice differential equations

[AT '11]

any M_{10}:

$(\text{Spin}(7) \ltimes \mathbb{R}^8)^2$ structure*

NS 3-form

defined by Φ

$$\boxed{(d + H\wedge)\Phi = (\iota_K + \tilde{K}\wedge)F}$$

total RR flux

+ extra equations, almost never important

system for $\text{AdS}_7 \times M_3$

Id×Id structure

*simplifying the story a bit...

original example

$$\left.\begin{matrix}\mathrm{Mink}_4\\ \mathrm{AdS}_4\end{matrix}\right\} \times M_6$$

[Graña, Minasian, Petrini, AT '05]

$SU(3)\times SU(3)$ structure

nice differential equations

[AT '11]

any M_{10}:

$(\mathrm{Spin}(7)\ltimes\mathbb{R}^8)^2$ structure*

NS 3-form

defined by Φ

$$(d + H\wedge)\Phi = (\iota_K + \tilde{K}\wedge)F$$

total RR flux

+ extra equations, almost never important

system for $\mathrm{AdS}_7 \times M_3$

$\mathrm{Id}\times\mathrm{Id}$ structure

$\mathrm{Mink}_6 \times M_4$

$SU(2)\times SU(2)$ structure

[Patalong, Lüst, Tsimpis'05]

*simplifying the story a bit...

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

origin: 3d part $\chi_{1,2}$ of susy parameters $\epsilon_{1,2}$

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

origin: 3d part $\chi_{1,2}$ of susy parameters $\epsilon_{1,2}$

both define a vielbein (= Id structure) for the internal metric

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

origin: 3d part $\chi_{1,2}$ of susy parameters $\epsilon_{1,2}$

both define a vielbein (= Id structure) for the internal metric

$$\psi^1 = \chi_1 \otimes \chi_2^\dagger$$
$$\psi^2 = \chi_1 \otimes \overline{\chi_2}$$

bispinors

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

origin: 3d part $\chi_{1,2}$ of susy parameters $\epsilon_{1,2}$

both define a vielbein (= Id structure)
for the internal metric

$$\psi^1 = \chi_1 \otimes \chi_2^\dagger$$
$$\psi^2 = \chi_1 \otimes \overline{\chi_2}$$

bispinors $\cong$ forms

$$\left[\begin{array}{c} \gamma^{i_1 \ldots i_k} \\ \wr\| \\ dx^{i_1} \wedge \ldots \wedge dx^{i_k} \end{array}\right]$$

system for $\mathrm{AdS}_7 \times M_3$

$\mathrm{Id}\times\mathrm{Id}$ structure

origin: 3d part $\chi_{1,2}$ of susy parameters $\epsilon_{1,2}$

both define a vielbein (= Id structure)
for the internal metric

$$\psi^1 = \chi_1 \otimes \chi_2^\dagger$$
$$\psi^2 = \chi_1 \otimes \overline{\chi_2}$$

bispinors $\cong$ forms

$$\left[\begin{array}{c} \gamma^{i_1\ldots i_k} \\ \wr\Vert \\ dx^{i_1}\wedge\ldots\wedge dx^{i_k} \end{array}\right]$$

better parameterization:
one vielbein $\{e_i\}$
and three angles: θ_1, θ_2, ψ

[sorry: don't confuse angle ψ with forms $\psi^{1,2}$!]

system for $\mathrm{AdS}_7 \times M_3$

Id×Id structure

origin: 3d part $\chi_{1,2}$ of susy parameters $\epsilon_{1,2}$

both define a vielbein (= Id structure)
for the internal metric

$$\psi^1 = \chi_1 \otimes \chi_2^\dagger$$
$$\psi^2 = \chi_1 \otimes \overline{\chi_2}$$

bispinors $\cong$ forms

$$\left[\begin{array}{c} \gamma^{i_1 \ldots i_k} \\ \wr\!\| \\ dx^{i_1} \wedge \ldots \wedge dx^{i_k} \end{array}\right]$$

better parameterization:
one vielbein $\{e_i\}$
and three angles: θ_1, θ_2, ψ

[sorry: don't confuse angle ψ with forms $\psi^{1,2}$!]

for example:

$$\psi^1_+ = e^{i\theta_1}\left[\cos(\psi) + e_1 \wedge (-ie_2 + \sin(\psi) e_3)\right]$$

[+ = even part]

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

The differential system reads*

$$
\begin{aligned}
d_H \mathrm{Im}\psi^1_{\pm} &= -2\mathrm{Re}\psi^1_{\mp} \\
d_H \mathrm{Re}\psi^1_{\pm} &= 4\mathrm{Im}\psi^1_{\mp} \\
d_H \psi^2_{\pm} &= -4i\psi^2_{\mp} \\
\pm *_3 F &= dA \wedge \mathrm{Im}\psi^1_{\pm} + \mathrm{Re}\psi^1_{\mp} \\
dA \wedge \mathrm{Re}\psi^1_{\mp} &= 0
\end{aligned}
$$

*up to factors of dilaton and warping

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

The differential system reads*

$$
\begin{aligned}
d_H \mathrm{Im}\psi^1_\pm &= -2\mathrm{Re}\psi^1_\mp \\
d_H \mathrm{Re}\psi^1_\pm &= 4\mathrm{Im}\psi^1_\mp \\
d_H \psi^2_\pm &= -4i\psi^2_\mp \\
\pm *_3 F &= dA \wedge \mathrm{Im}\psi^1_\pm + \mathrm{Re}\psi^1_\mp \\
dA \wedge \mathrm{Re}\psi^1_\mp &= 0
\end{aligned}
$$

total
RR flux

*up to factors of dilaton and warping

system for $\mathrm{AdS}_7 \times M_3$

Id$\times$Id structure

The differential system reads*

$$d_H \mathrm{Im}\psi^1_\pm = -2\mathrm{Re}\psi^1_\mp$$
$$d_H \mathrm{Re}\psi^1_\pm = 4\mathrm{Im}\psi^1_\mp$$
$$d_H \psi^2_\pm = -4i\psi^2_\mp$$
$$\pm *_3 F = dA \wedge \mathrm{Im}\psi^1_\pm + \mathrm{Re}\psi^1_\mp$$
$$dA \wedge \mathrm{Re}\psi^1_\mp = 0$$

total RR flux

$d_H \equiv d - H\wedge$

$A =$ warping

upper sign: IIA

lower sign: IIB

*up to factors of dilaton and warping

II. Classification

Let us start from the IIB case

$$d_H \text{Im}\psi^1_- = -2\text{Re}\psi^1_+$$
$$d_H \text{Re}\psi^1_- = 4\text{Im}\psi^1_+$$
$$d_H \psi^2_- = -4i\psi^2_+$$

zero-form part:

$$0 = \cos(\psi)\cos(\theta_1) = 0$$
$$0 = \cos(\psi)\sin(\theta_1)$$
$$0 = \sin(\psi)e^{i\theta_2} = 0$$

II. Classification

Let us start from the IIB case

$$d_H \mathrm{Im}\psi^1_- = -2\mathrm{Re}\psi^1_+$$
$$d_H \mathrm{Re}\psi^1_- = 4\mathrm{Im}\psi^1_+$$
$$d_H \psi^2_- = -4i\psi^2_+$$

zero-form part:

$$0 = \cos(\psi)\cos(\theta_1) = 0$$
$$0 = \cos(\psi)\sin(\theta_1) \quad \Rightarrow \quad \text{no solutions}$$
$$0 = \sin(\psi)e^{i\theta_2} = 0$$

Maybe we'll have better luck with IIA

$$d_H \mathrm{Im}\psi^1_+ = -2\mathrm{Re}\psi^1_-$$
$$d_H \mathrm{Re}\psi^1_+ = 4\mathrm{Im}\psi^1_-$$
$$d_H \psi^2_+ = -4i\psi^2_-$$

Maybe we'll have better luck with IIA

$$d_H \mathrm{Im}\psi^1_+ = -2\mathrm{Re}\psi^1_-$$
$$d_H \mathrm{Re}\psi^1_+ = 4\mathrm{Im}\psi^1_-$$
$$d_H \psi^2_+ = -4i\psi^2_-$$

- one-form part:

Maybe we'll have better luck with IIA

$$
\begin{aligned}
d_H \mathrm{Im}\psi_+^1 &= -2\mathrm{Re}\psi_-^1 \\
d_H \mathrm{Re}\psi_+^1 &= 4\mathrm{Im}\psi_-^1 \\
d_H \psi_+^2 &= -4i\psi_-^2
\end{aligned}
$$

- one-form part:

$e_i = d(\text{angles})$ $\Rightarrow$ local form of the metric:

Maybe we'll have better luck with IIA

$$d_H \mathrm{Im}\psi_+^1 = -2\mathrm{Re}\psi_-^1$$
$$d_H \mathrm{Re}\psi_+^1 = 4\mathrm{Im}\psi_-^1$$
$$d_H \psi_+^2 = -4i\psi_-^2$$

- one-form part:

$e_i = d(\text{angles})$ ⇨ local form of the metric:

θ_1, θ_2, ψ

change of variables

$r, \underbrace{\theta, \varphi}_{S^2}$

Maybe we'll have better luck with IIA

$$d_H \mathrm{Im}\psi^1_+ = -2\mathrm{Re}\psi^1_-$$
$$d_H \mathrm{Re}\psi^1_+ = 4\mathrm{Im}\psi^1_-$$
$$d_H \psi^2_+ = -4i\psi^2_-$$

- one-form part:

$e_i = d(\text{angles})$ ⇨ local form of the metric:

θ_1, θ_2, ψ

change of variables

$r, \underbrace{\theta, \varphi}_{S^2}$

S^2-fibration over interval

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

Maybe we'll have better luck with IIA

$$d_H \mathrm{Im}\psi^1_+ = -2\mathrm{Re}\psi^1_-$$
$$d_H \mathrm{Re}\psi^1_+ = 4\mathrm{Im}\psi^1_-$$
$$d_H \psi^2_+ = -4i\psi^2_-$$

- one-form part:

$e_i = d(\text{angles})$ $\Rightarrow$ local form of the metric:

θ_1, θ_2, ψ

change of variables

$r, \underbrace{\theta, \varphi}_{S^2}$

S^2-fibration over interval

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

This S^2 realizes the SU(2) R-symmetry of a $(1,0)$ 6d theory.

$$
\begin{aligned}
d_H \mathrm{Im}\psi_+^1 &= -2\mathrm{Re}\psi_-^1 \\
d_H \mathrm{Re}\psi_+^1 &= 4\mathrm{Im}\psi_-^1 \\
d_H \psi_+^2 &= -4i\psi_-^2
\end{aligned}
$$

- three-form part: determines H

$$d_H \mathrm{Im}\psi^1_+ = -2\mathrm{Re}\psi^1_-$$
$$d_H \mathrm{Re}\psi^1_+ = 4\mathrm{Im}\psi^1_-$$
$$d_H \psi^2_+ = -4i\psi^2_-$$

- three-form part: determines H
- we had two more equations:

$$dA \wedge \mathrm{Re}\psi^1_- = 0 \quad \Rightarrow \quad \underset{\text{dilaton}}{\phi} = \phi(r)$$

$$*_3 F = dA \wedge \mathrm{Im}\psi^1_+ + \mathrm{Re}\psi^1_-\text{: determines } F_0,\ F_2$$

$$d_H \mathrm{Im}\psi^1_+ = -2\mathrm{Re}\psi^1_-$$
$$d_H \mathrm{Re}\psi^1_+ = 4\mathrm{Im}\psi^1_-$$
$$d_H \psi^2_+ = -4i\psi^2_-$$

- three-form part: determines H
- we had two more equations:

$$dA \wedge \mathrm{Re}\psi^1_- = 0 \quad \Rightarrow \quad \underbrace{\phi}_{\text{dilaton}} = \phi(r)$$

$$*_3 F = dA \wedge \mathrm{Im}\psi^1_+ + \mathrm{Re}\psi^1_-\text{: determines } F_0,\ F_2$$

Bianchi for F_2 automatically satisfied

When the dust settles:
we have a local solution
provided we solve a system of 3 ODEs

$$\begin{cases} \partial_r A = \dots \\ \partial_r x = \dots \\ \partial_r \phi = \dots \end{cases}$$

When the dust settles:
we have a local solution
provided we solve a system of 3 ODEs

$$\begin{cases} \partial_r A = \dots \\ \partial_r x = \dots \\ \partial_r \phi = \dots \end{cases}$$

Can we now make M_3 compact?

$$ds^2 \sim dr^2 + (1 - x^2(r)) ds^2_{S^2}$$

When the dust settles:
we have a local solution
provided we solve a system of 3 ODEs

$$\begin{cases} \partial_r A = \dots \\ \partial_r x = \dots \\ \partial_r \phi = \dots \end{cases}$$

Can we now make M_3 compact?

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

Two possibilities:

- making r periodic, so that $M_3 \cong S^1 \times S^2$

When the dust settles:
we have a local solution
provided we solve a system of 3 ODEs

$$\begin{cases} \partial_r A = \dots \\ \partial_r x = \dots \\ \partial_r \phi = \dots \end{cases}$$

Can we now make M_3 compact?

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

Two possibilities:

- making r periodic, so that $M_3 \cong S^1 \times S^2$

  we showed that this is incompatible with the ODEs ✗

- making $(1 - x^2)$ shrink for two values of r, so that $M_3 \cong S^3$

When the dust settles:
we have a local solution
provided we solve a system of 3 ODEs

$$\begin{cases} \partial_r A = \dots \\ \partial_r x = \dots \\ \partial_r \phi = \dots \end{cases}$$

Can we now make M_3 compact?

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

Two possibilities:

- making r periodic, so that $M_3 \cong S^1 \times S^2$

  we showed that this is incompatible with the ODEs ✗

- making $(1 - x^2)$ shrink for two values of r,
  so that $M_3 \cong S^3$

  This works! ✓

  ...if one includes brane sources

III. Explicit examples

- Warm-up: $F_0 = 0$

  reduce $\mathrm{AdS}_7 \times S^4$ to IIA

III. Explicit examples

- Warm-up: $F_0 = 0$

reduce $\mathrm{AdS}_7 \times S^4$ to IIA

$\exists$ vector field that preserves susy:
simultaneous rotation in 12 and 34 plane in $\mathbb{R}^5 \supset S^4$

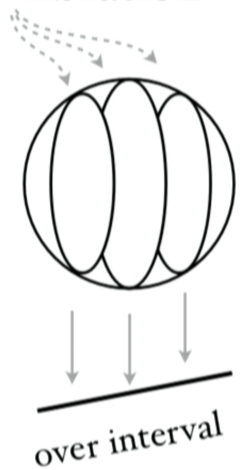
III. Explicit examples

- Warm-up: $F_0 = 0$

reduce $\mathrm{AdS}_7 \times S^4$ to IIA

$\exists$ vector field that preserves susy:
simultaneous rotation in 12 and 34 plane in $\mathbb{R}^5 \supset S^4$

S^4 is S^3-fibration



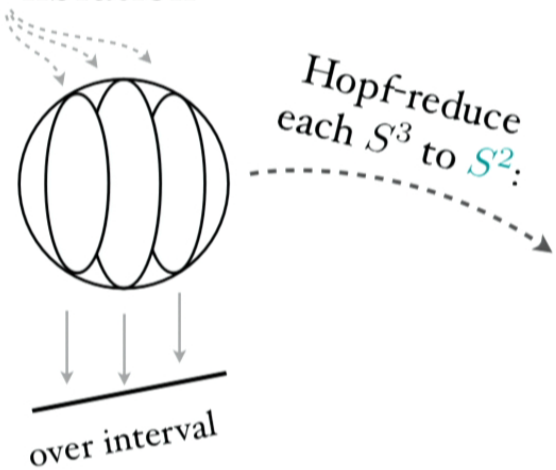
III. Explicit examples

- Warm-up: $F_0 = 0$

reduce $\mathrm{AdS}_7 \times S^4$ to IIA

$\exists$ vector field that preserves susy:
simultaneous rotation in 12 and 34 plane in $\mathbb{R}^5 \supset S^4$

S^4 is S^3-fibration



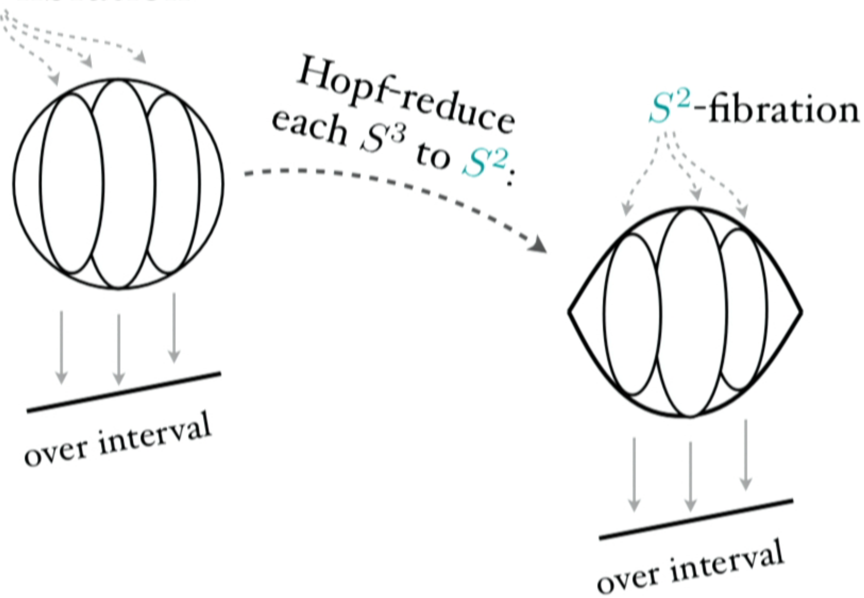
III. Explicit examples

- Warm-up: $F_0 = 0$

reduce $\mathrm{AdS}_7 \times S^4$ to IIA

$\exists$ vector field that preserves susy:
simultaneous rotation in 12 and 34 plane in $\mathbb{R}^5 \supset S^4$

S^4 is S^3-fibration



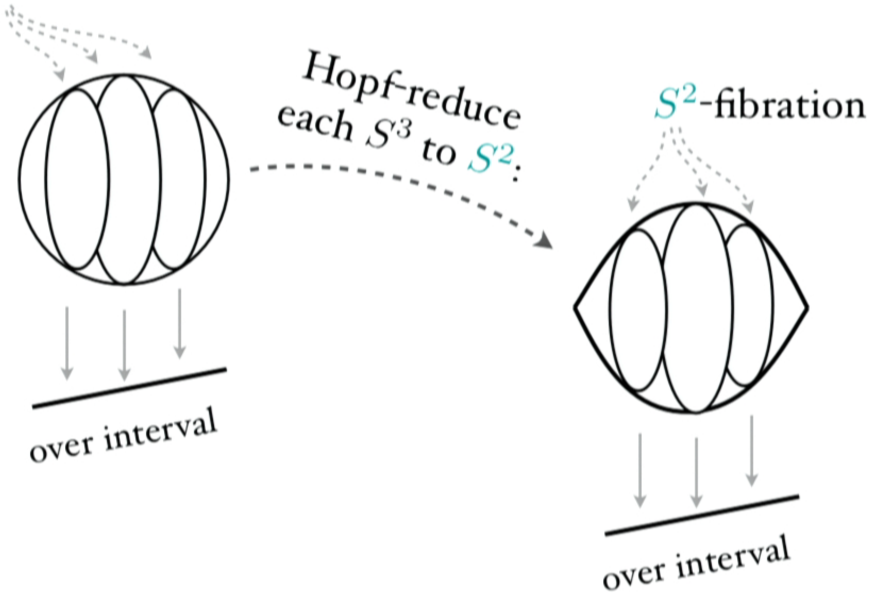
III. Explicit examples

- Warm-up: $F_0 = 0$

reduce $\mathrm{AdS}_7 \times S^4$ to IIA

$\exists$ vector field that preserves susy:
simultaneous rotation in 12 and 34 plane in $\mathbb{R}^5 \supset S^4$

S^4 is S^3-fibration



M_3 is now topologically $\cong S^3$

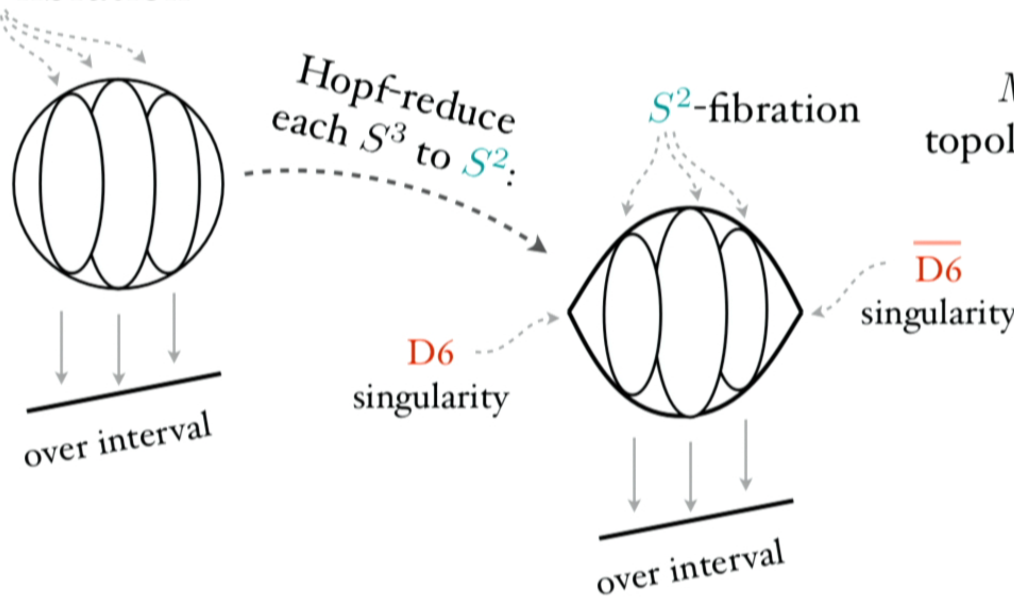
III. Explicit examples

- Warm-up: $F_0 = 0$

reduce $\mathrm{AdS}_7 \times S^4$ to IIA

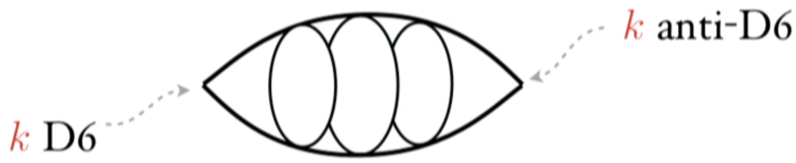
$\exists$ vector field that preserves susy:
simultaneous rotation in 12 and 34 plane in $\mathbb{R}^5 \supset S^4$

S^4 is S^3-fibration

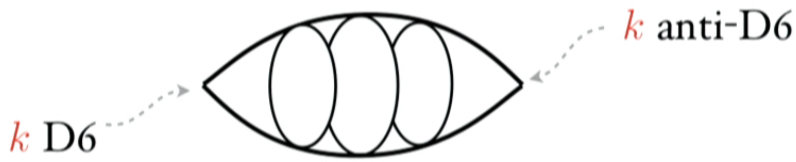


M_3 is now topologically $\cong S^3$

Incidentally, we might as well reduce $\mathrm{AdS}_7 \times S^4/\mathbb{Z}_k$



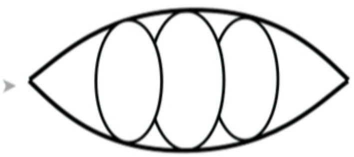
Incidentally, we might as well reduce $\mathrm{AdS}_7 \times S^4/\mathbb{Z}_k$



in a sense this is an analogue of ABJM

[giving up some susy gives us one more parameter to play with]

Incidentally, we might as well reduce $\mathrm{AdS}_7 \times S^4/\mathbb{Z}_k$

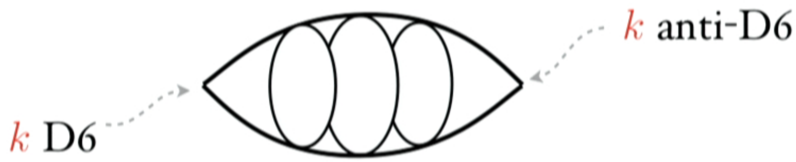


in a sense this is an analogue of ABJM

[giving up some susy gives us one more parameter to play with]

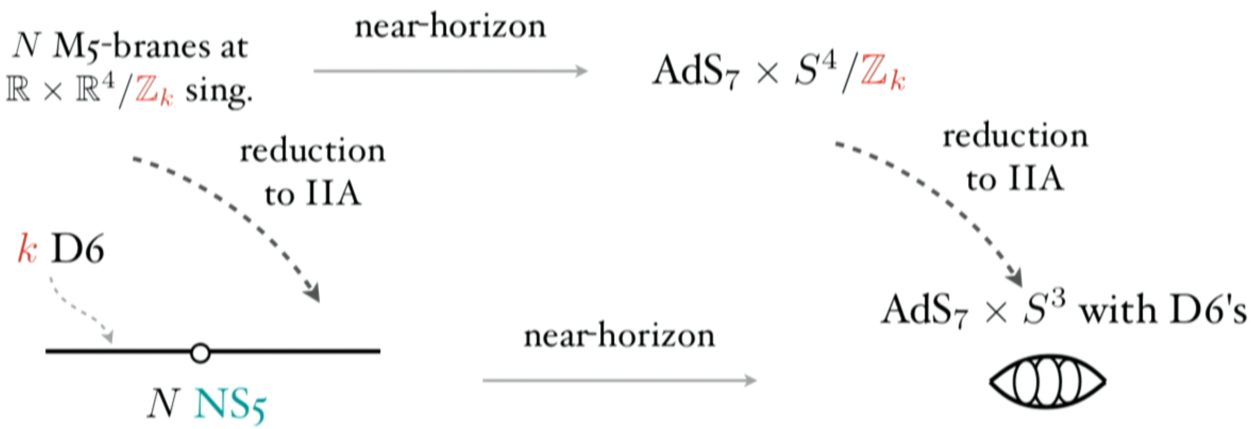
N M5-branes at $\mathbb{R} \times \mathbb{R}^4/\mathbb{Z}_k$ sing. $\xrightarrow{\text{near-horizon}}$ $\mathrm{AdS}_7 \times S^4/\mathbb{Z}_k$

Incidentally, we might as well reduce $\mathrm{AdS}_7 \times S^4/\mathbb{Z}_k$

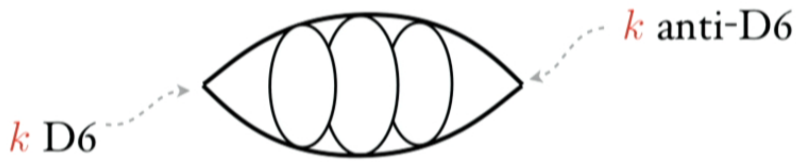


in a sense this is an analogue of ABJM

[giving up some susy gives us one more parameter to play with]

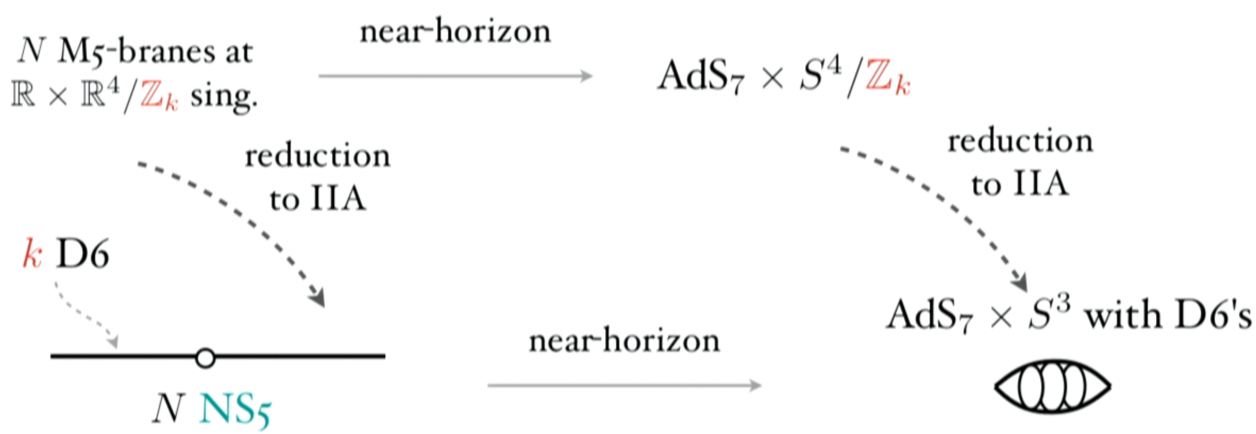


Incidentally, we might as well reduce $\mathrm{AdS}_7 \times S^4/\mathbb{Z}_k$



in a sense this is an analogue of ABJM

[giving up some susy gives us one more parameter to play with]

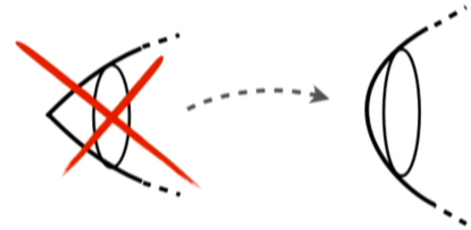


But: field theory still hard.

- Let us now introduce $F_0 \neq 0$

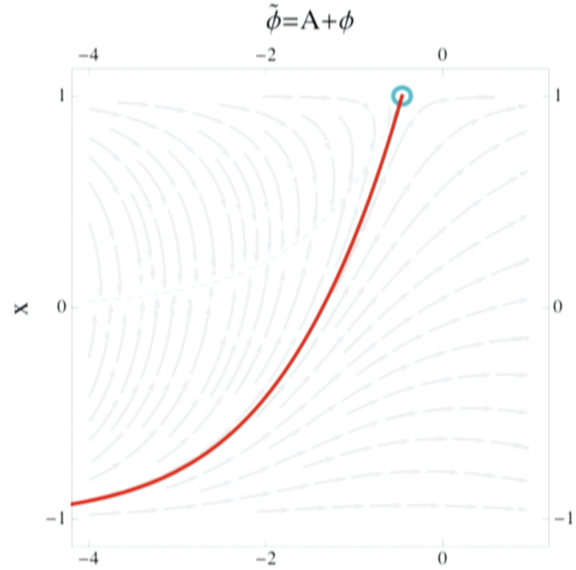
- Let us now introduce $F_0 \neq 0$

  Let's try to avoid singularities.



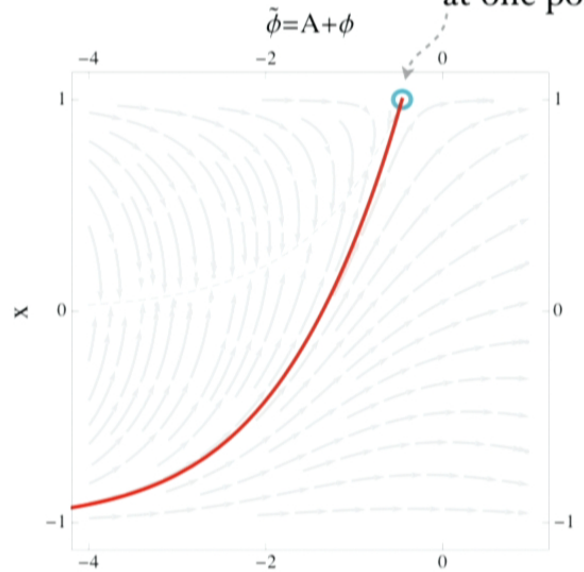
system can be
represented as a flow:

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$



system can be represented as a flow:

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

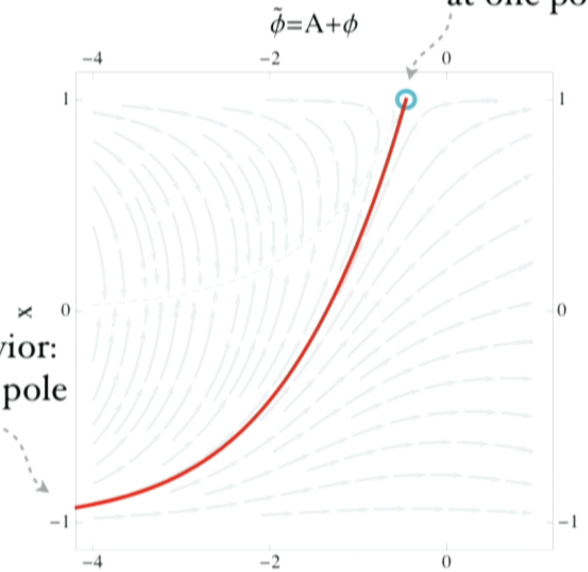


system can be
represented as a flow:

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

we end up with runaway behavior:
it represents anti-D6s at other pole

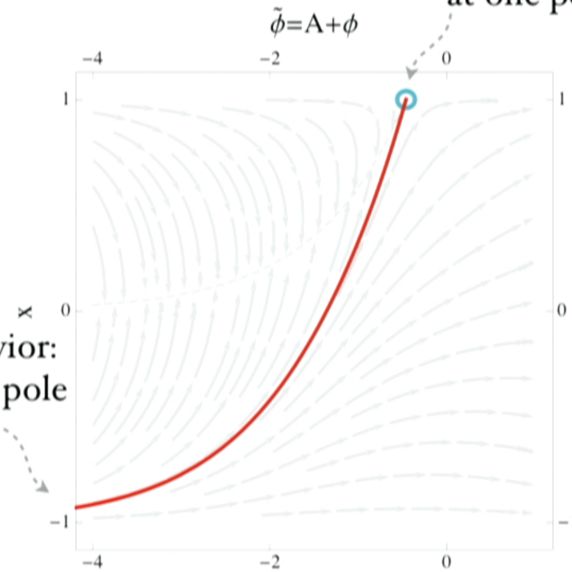
we start from here
at one pole



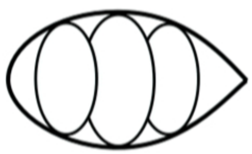
system can be
represented as a flow:

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

we start from here
at one pole



we end up with runaway behavior:
it represents anti-D6s at other pole

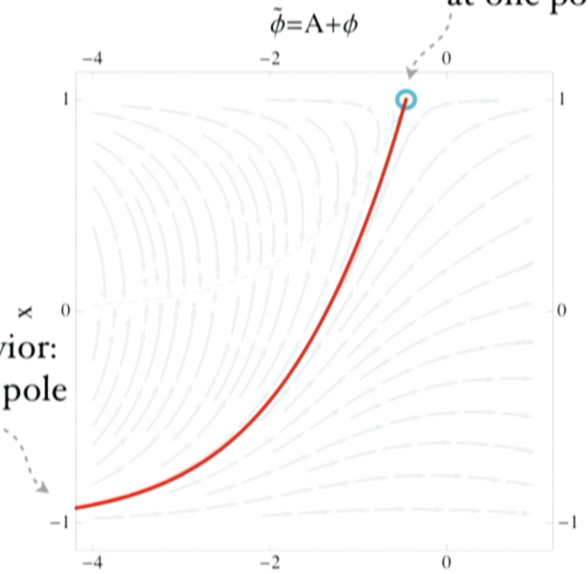


k anti-D6

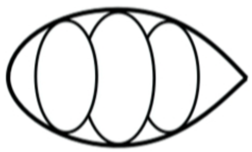
system can be
represented as a flow:

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

we start from here
at one pole



we end up with runaway behavior:
it represents anti-D6s at other pole

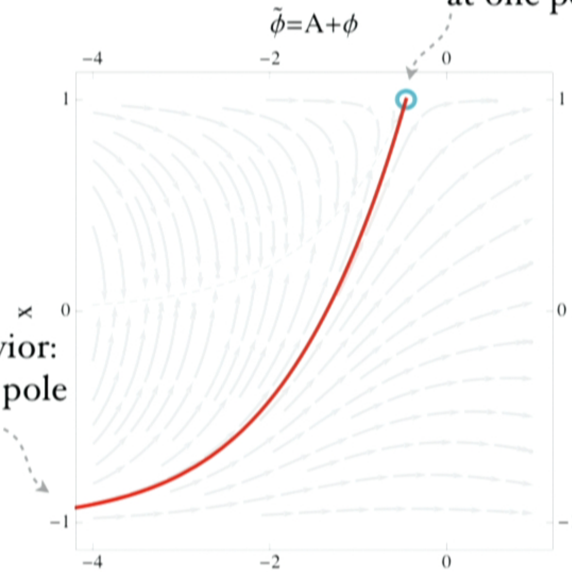


k anti-D6

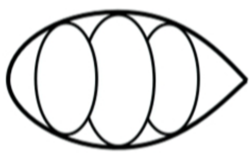
system can be
represented as a flow:

$$ds^2 \sim dr^2 + (1 - x^2(r))ds^2_{S^2}$$

we start from here
at one pole



we end up with runaway behavior:
it represents anti-D6s at other pole



k anti-D6

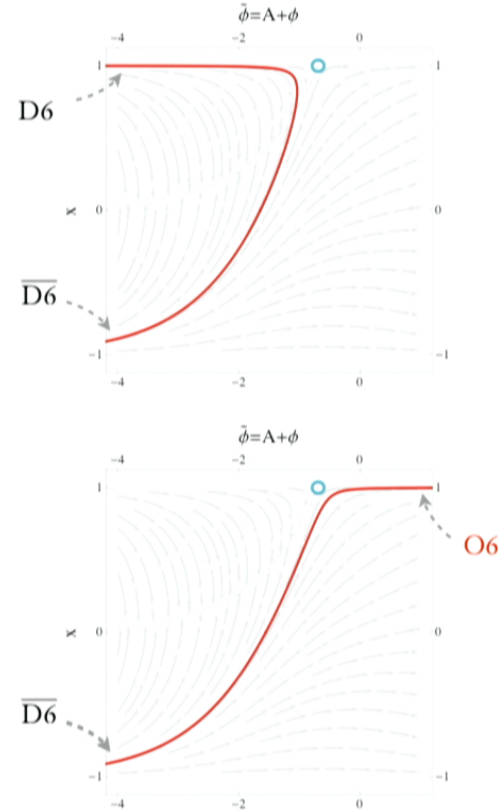
no contradiction with Bianchi:

$$dF_2 - HF_0 = k\delta_{\mathrm{D6}}$$

$$\Downarrow$$

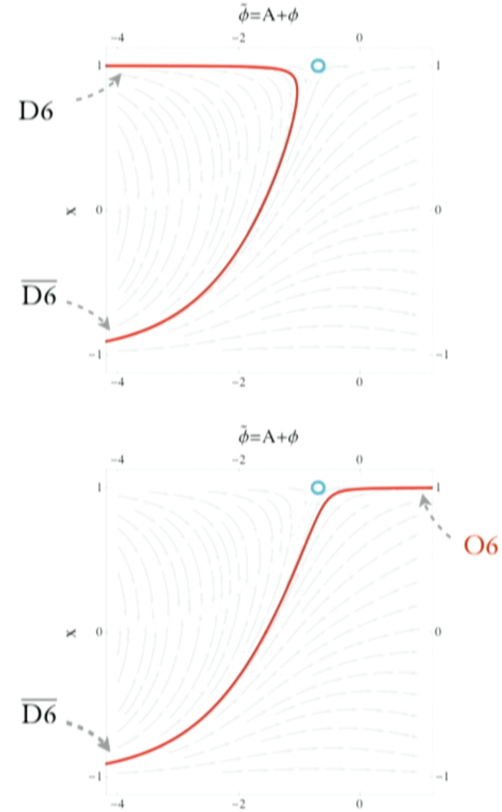
$$-F_0 \int H = k$$

- if one ‘misses’ the regular point, one can have D6s or an O6 at the other pole



- if one ‘misses’ the regular point, one can have D6s or an O6 at the other pole

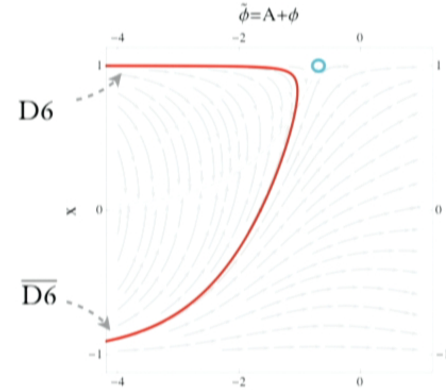
behavior near singularity:
same as for $F_0 = 0$

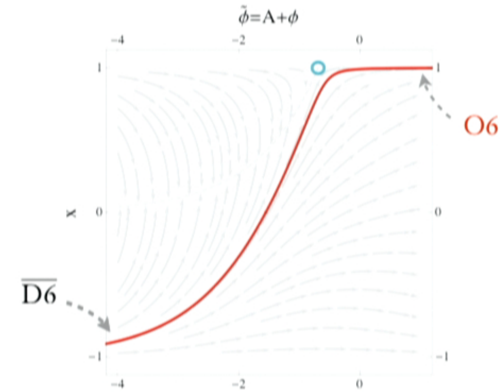


- if one 'misses' the regular point, one can have D6s or an O6 at the other pole

behavior near singularity:
same as for $F_0 = 0$

this time we don't have
M-theory to justify it;
so we're not sure these
solutions are physical



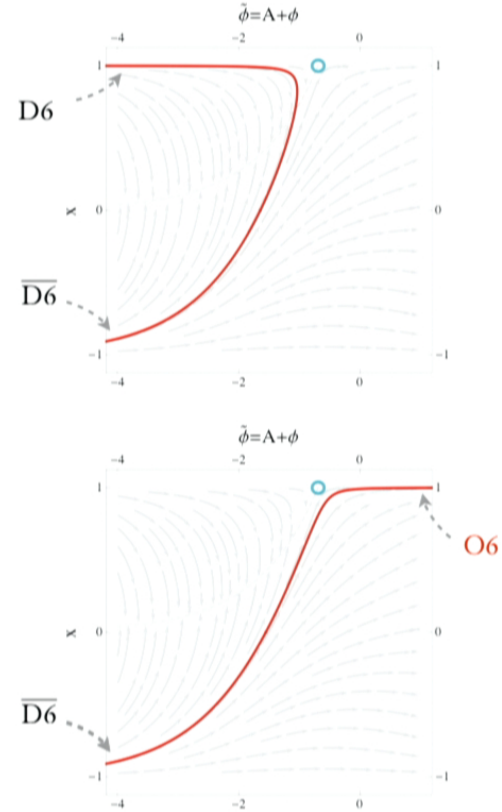


- if one ‘misses’ the regular point, one can have D6s or an O6 at the other pole

behavior near singularity:
same as for $F_0 = 0$

this time we don’t have M-theory to justify it; so we’re not sure these solutions are physical

[in a AdS_4 setup, O6 can be desingularized by F_0; not here
[Saracco, AT ’12]]



- How can we make both poles regular?

  Extra ingredient: D8s

    flow depends on F_0: a D8 changes it

- How can we make both poles regular?

Extra ingredient: D8s

flow depends on F_0: a D8 changes it

we allow them to be magnetized

⇩

induced D6 charge

- How can we make both poles regular?

Extra ingredient: D8s

flow depends on F_0: a D8 changes it

we allow them to be magnetized

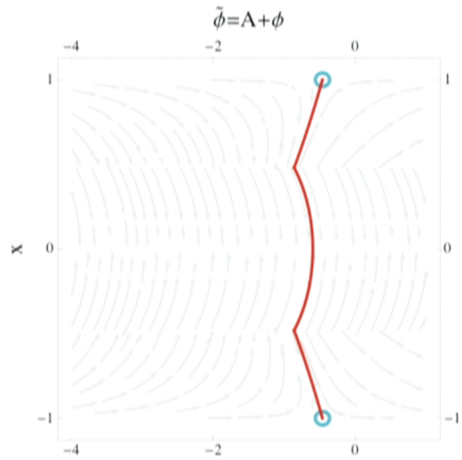
⇩

induced D6 charge

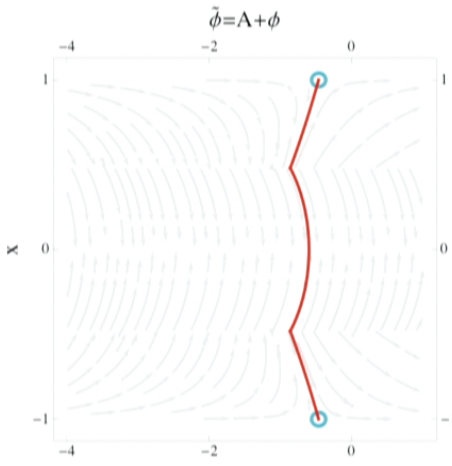
Now Bianchi for F_2 is no longer automatic

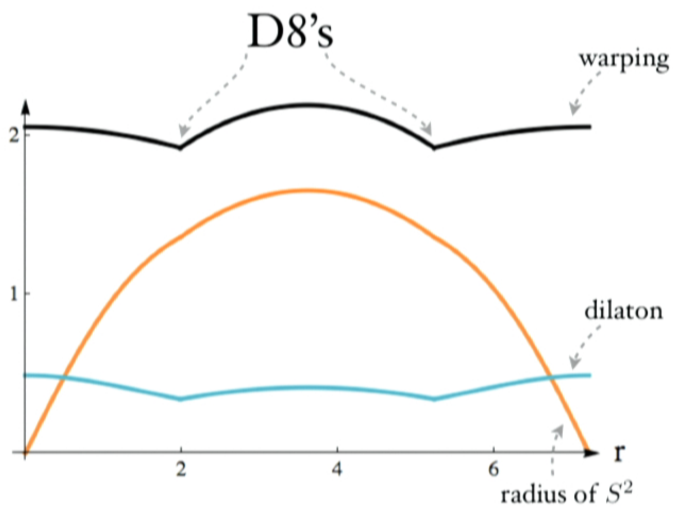
$$dF_2 - HF_0 = n_{\mathrm{D8}}\mathcal{F} \wedge dr\delta(r - r_{\mathrm{D8}})$$

now flow changes across a D8 stack

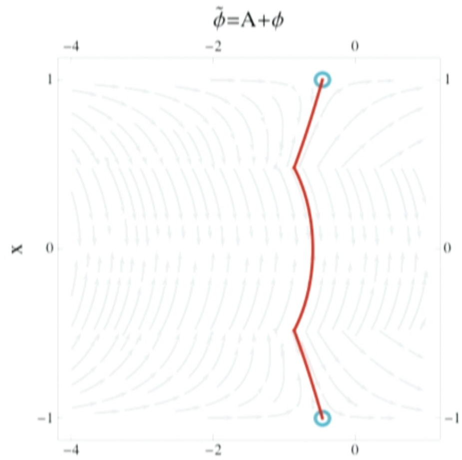


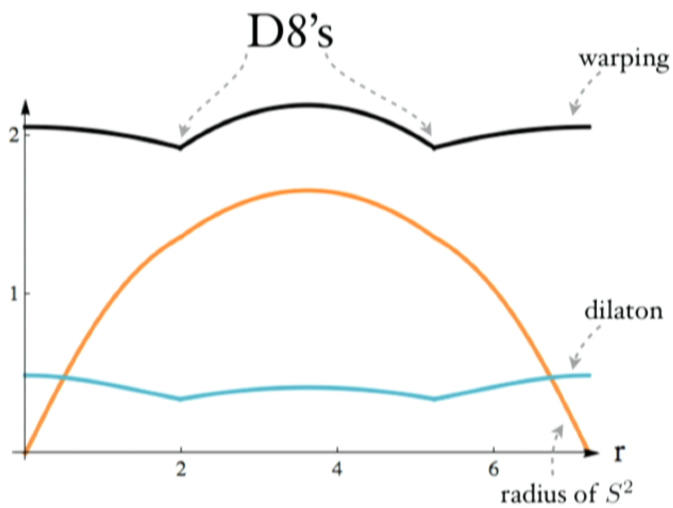
now flow changes across a D8 stack

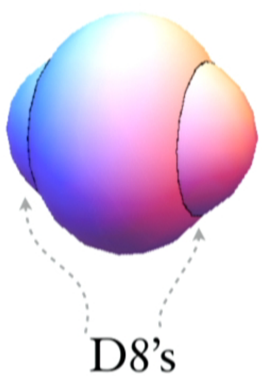




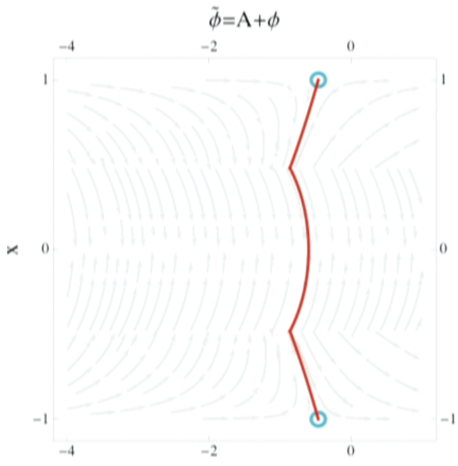
now flow changes across a D8 stack

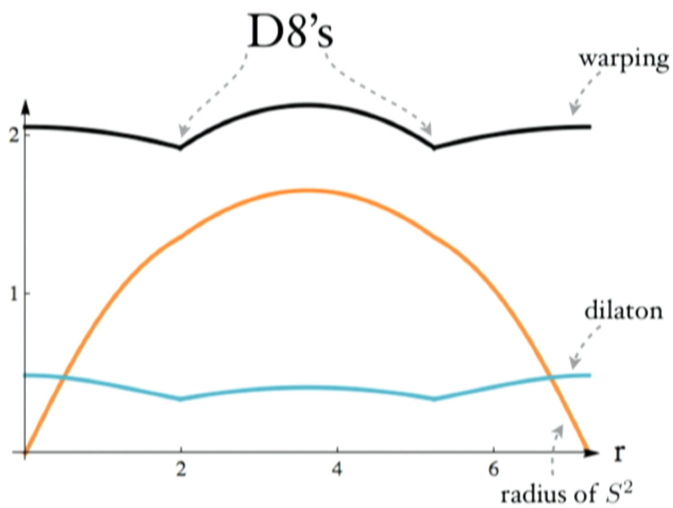




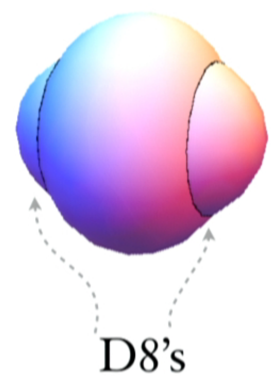


now flow changes across a D8 stack

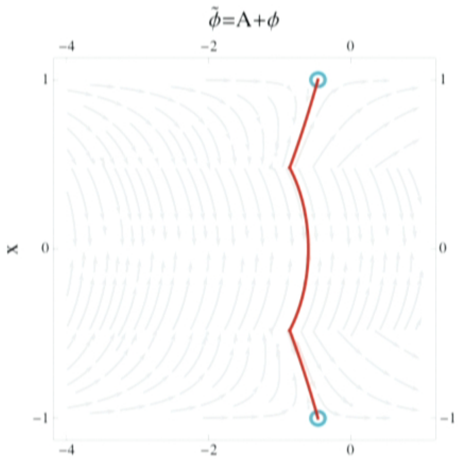


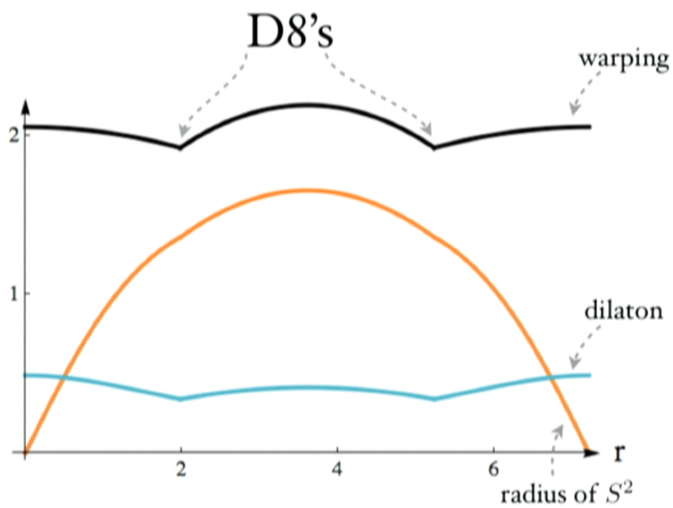


- There should be similar solutions with arbitrary number of D8's



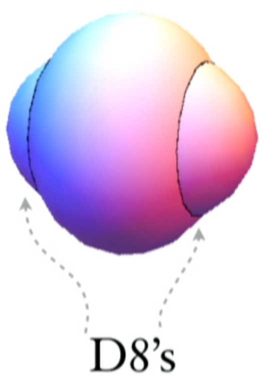
now flow changes across a D8 stack



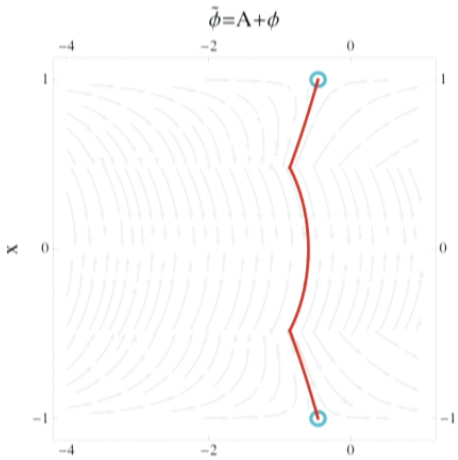


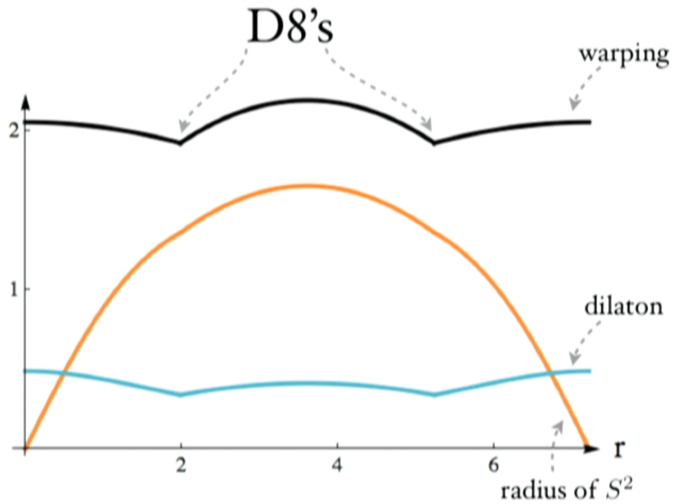
- There should be similar solutions with arbitrary number of D8's

- In the examples we found, $F_0 = 0$ in the middle region. Is it always so?



now flow changes across a D8 stack

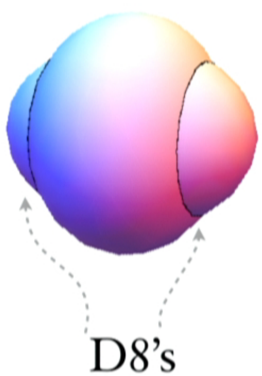




- There should be similar solutions with arbitrary number of D8's

- In the examples we found, $F_0 = 0$ in the middle region. Is it always so?

- One can also add D6's at the poles, but they are probably nonperturbatively unstable to decay to D8's



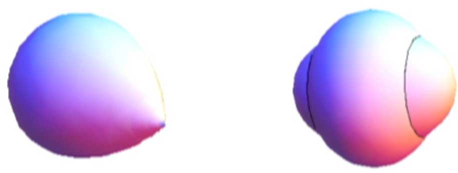
Conclusions

- Using pure spinors, we classified all susy AdS_7 solutions in type II

- No solutions in type IIB; many new ones in massive IIA

internal manifold M_3: S^2-fibration over interval, topologically $\cong S^3$

- Solutions with D6's and/or D8's



Conclusions

- Using pure spinors, we classified all susy AdS_7 solutions in type II

- No solutions in type IIB; many new ones in massive IIA

internal manifold M_3: S^2-fibration over interval, topologically $\cong S^3$

- Solutions with D6's and/or D8's