All AdS_7 solutions of type II supergravity

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- Classification of **AdS_7 supersymmetric solutions** of type II
  - no vacua in IIB
  - in massless IIA, only one solution:

    reduction of 11d $AdS_7 \times S^4$ ($/ \Gamma_{ADE}$)
  - in massive IIA, many new ones!

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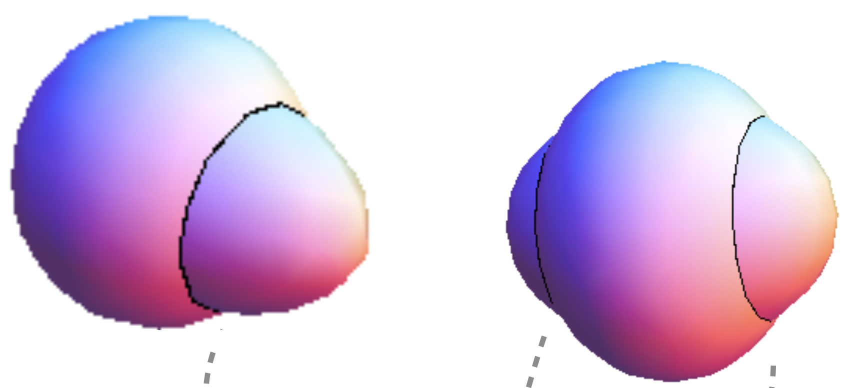

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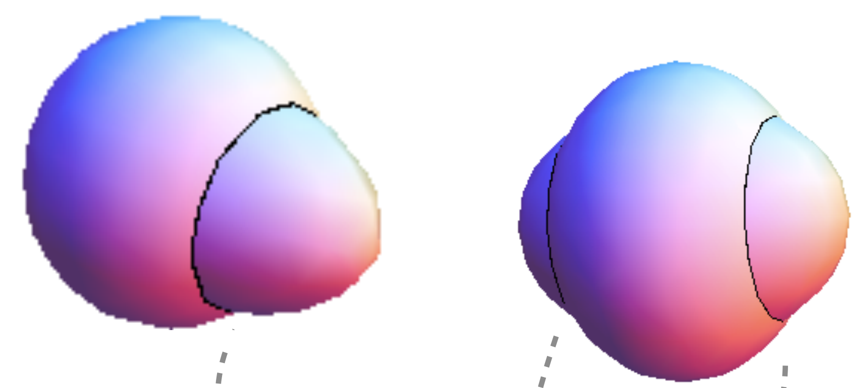

D8-D6 bound states
(stabilized by flux)

- Novel physical features
  - **smearing** the branes breaks susy
  - **NO** lower-dim. gauged sugra description

Plan

1. Methods: pure spinors

2. Classification of AdS_7 solutions

3. Physical implications

1. Pure spinors

Pure spinor approach to susy vacua in type II: working on $T \oplus T^*$

M_{10} = Mink or AdS x M_{int}

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

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[Hitchin '02, Gualtieri '04]

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forms obeying algebraic constraints
(often pure spinors)

nicer equations,
easier classification

(BPS eqs. + Bianchi ids.
notoriously hard to solve)

original example 4d + 6d: $AdS_4 \times$ / $Mink_4 \times$ } M_6 → SU(3) x SU(3) structure

[Graña, Minasian, Petrini, Tomasiello '05]

6d + 4d: $AdS_6 \times M_4$:
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[Apruzzi, MF, Passias, Rosa, Tomasiello '14] original example 4d + 6d: $\left.\begin{array}{l}AdS_4 \times \\ Mink_4 \times\end{array}\right\} M_6$ [Graña, Minasian, Petrini, Tomasiello '05]

SU(3) x SU(3) structure

on any M_{10}
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|| [Tomasiello '11]

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

NS flux

total RR flux

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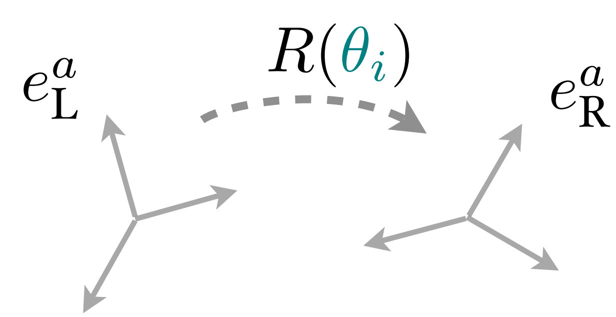

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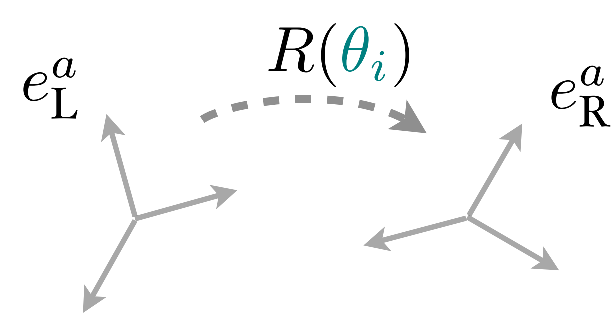
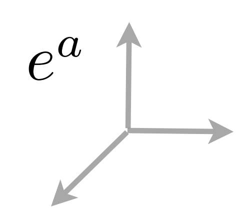


prefer working with one "average" Vielbein



1 Vielbein = metric
+ some angles θ_i
(local coords. on M_3)

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coming from Φ

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$e^a \sim f(\theta_i) d\theta_i$ $\Rightarrow$ local form of the metric $\Rightarrow$ S^2 fibration over interval $\cong S^3$

$$ds^2 \sim dr^2 + v^2(r) ds^2_{S^2}$$

no Ansatz necessary!

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rest of system determines fluxes: H, F_0, F_2
(Bianchi and EoM automatically satisfied)

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warping

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

dilaton

we are left with 3 ODEs:
we have **local solutions**
provided we solve them

(vacuum solution: all fields depend only on M_3)

✤ warm-up: $F_0 = 0$

AdS$_7$ x M_4 in 11d sugra
SO(6,2) and $G_4 \propto \mathrm{vol}(M_4)$

⇒

cone over M_4 should have reduced holonomy
(in 5d, only $\mathbb{R}^5 / \Gamma_{ADE}$)

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$M_4 = S^4 / \Gamma_{ADE}$

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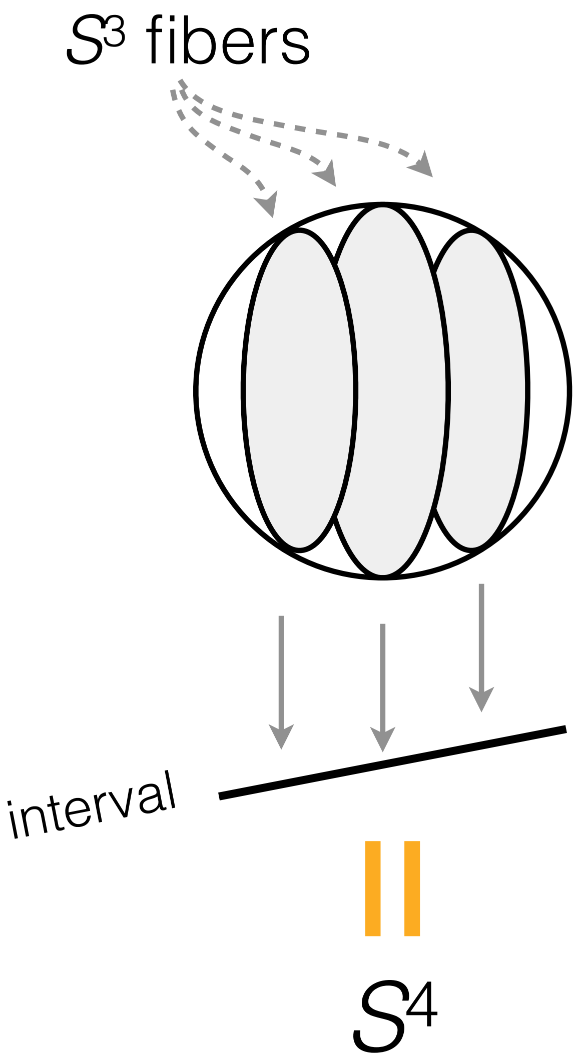

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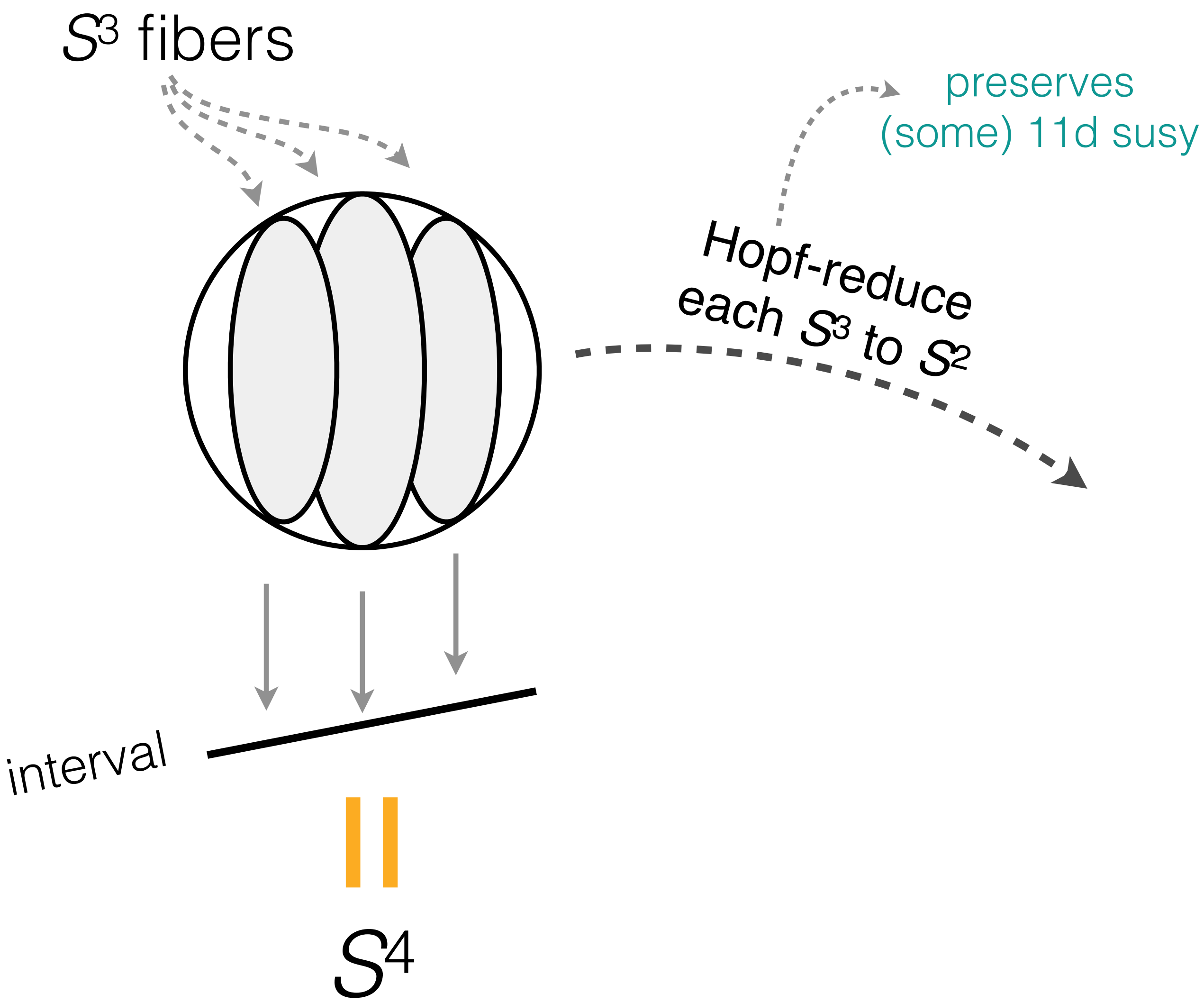

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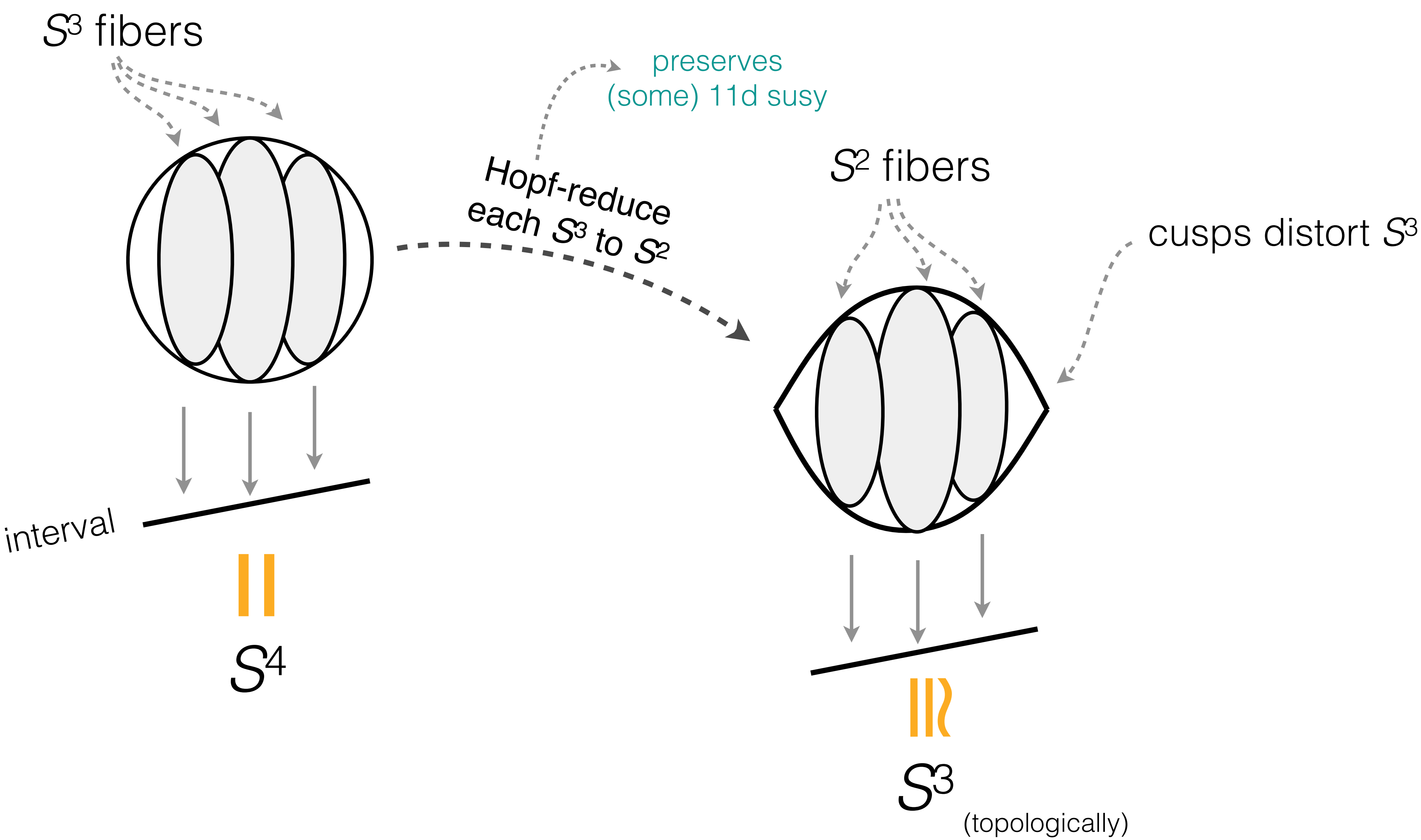

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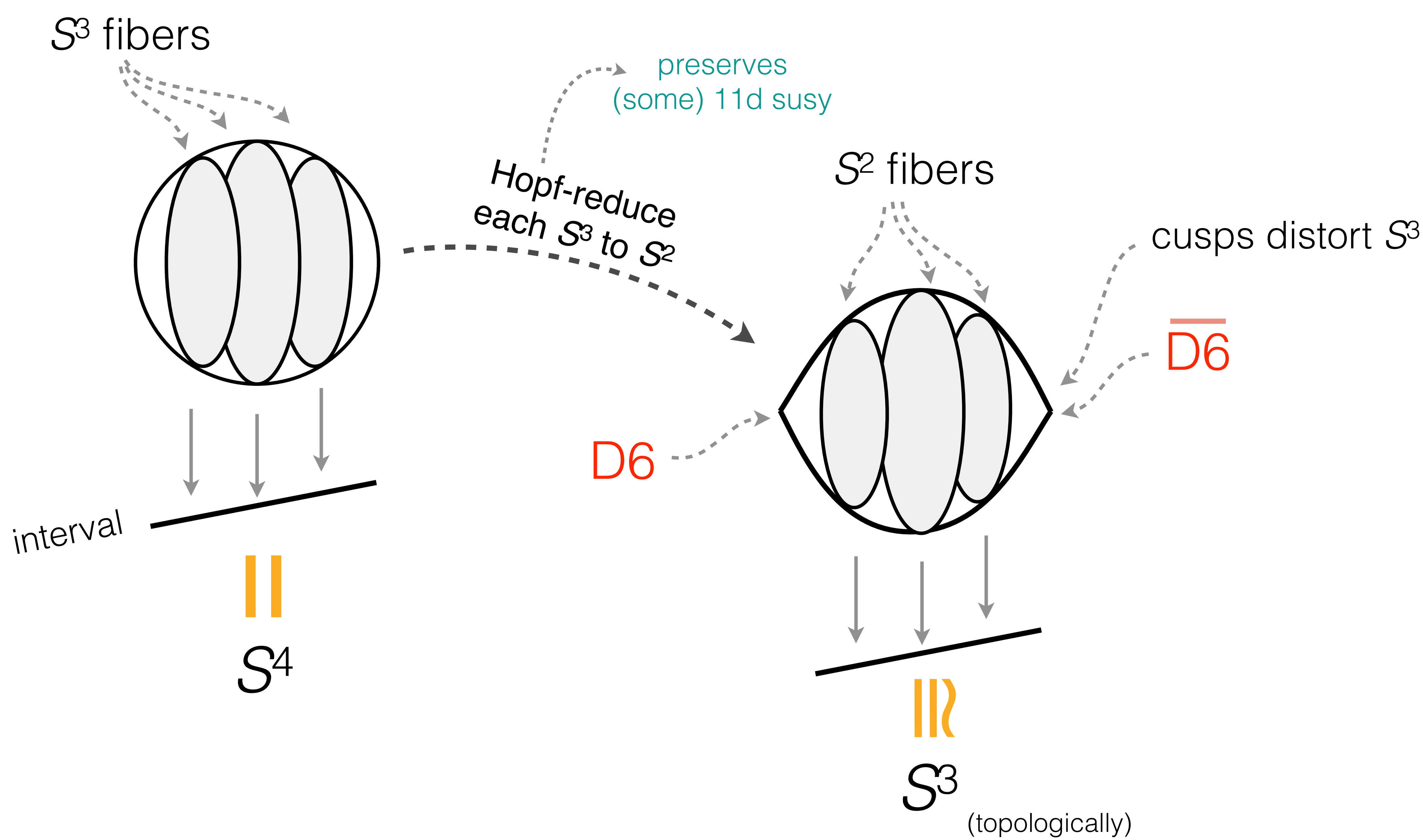

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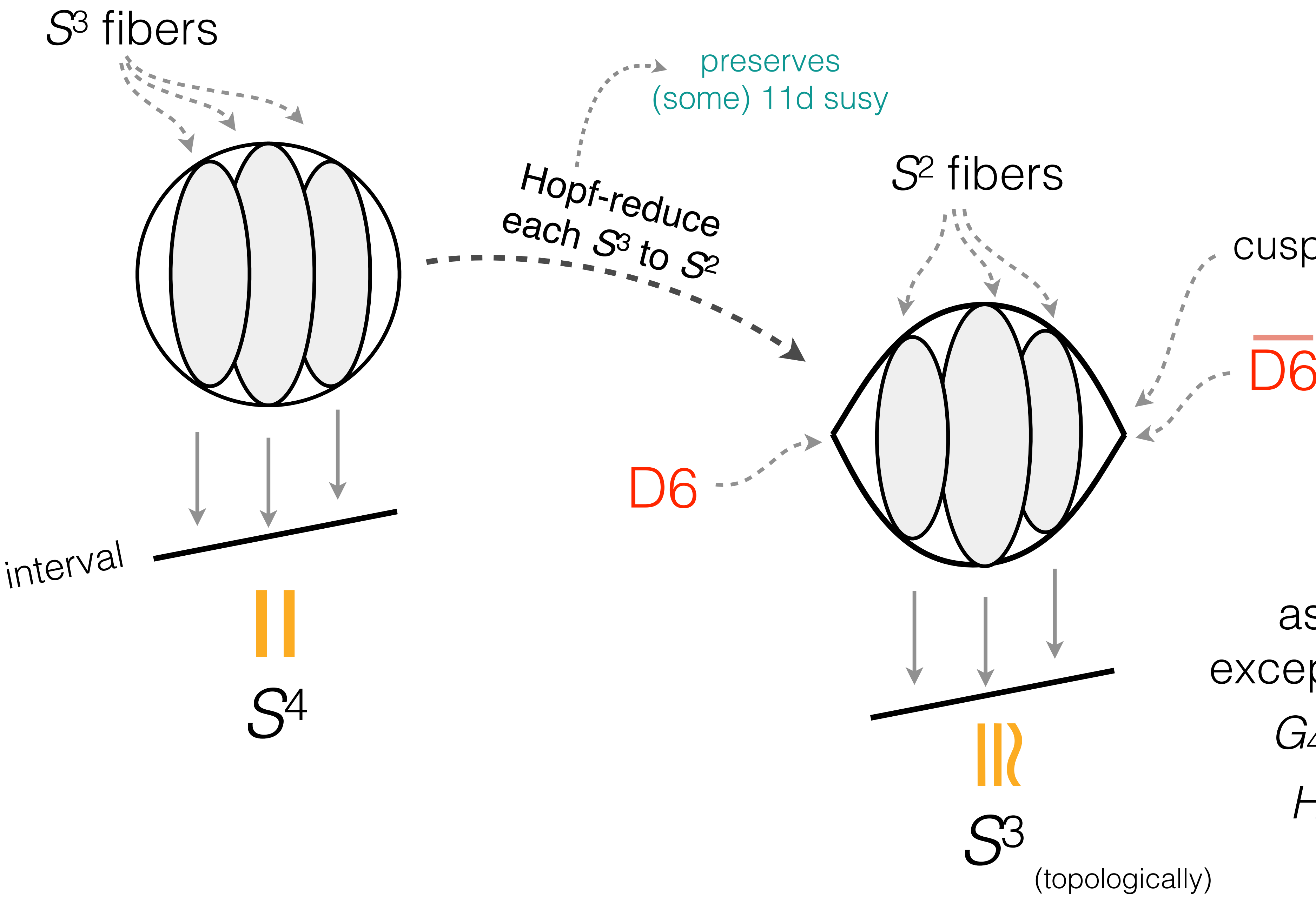

same behavior
as D6 in flat space,
except for diverging H flux
$G_4 \sim \exp(\phi) H \wedge e^{11}$:
$H \to \infty$ as $e^{11} \to 0$

reduction of FR agrees with our results in 10d! (ODEs are exactly solvable in massless case)

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(massive IIA does not lift to 11d)

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graphics courtesy of Alessandro

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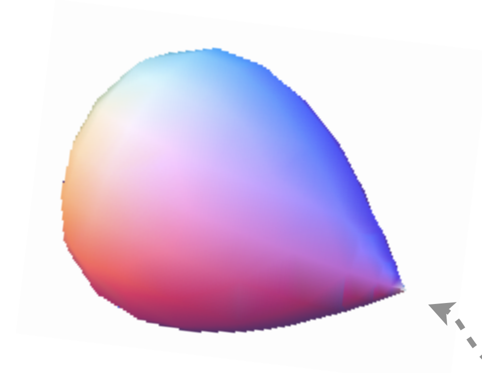

D6 stack (H divergence as in massless case)

fills AdS_7, point in S^3

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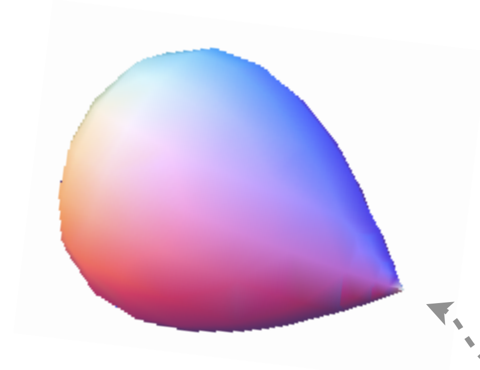

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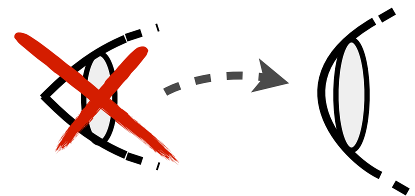

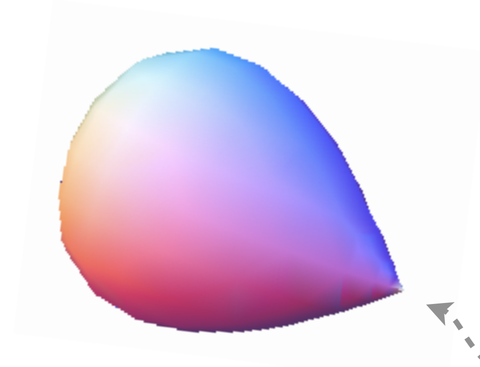

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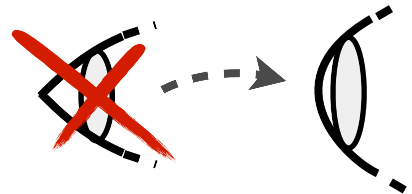

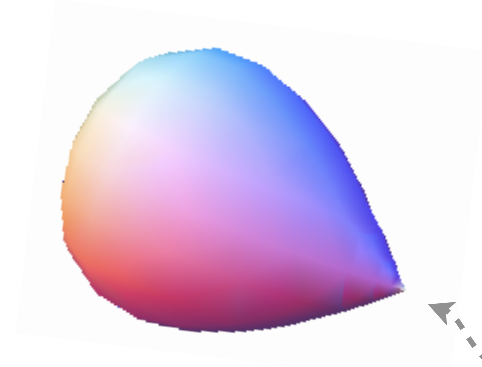

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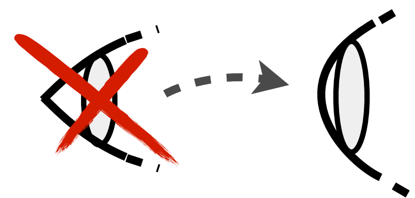

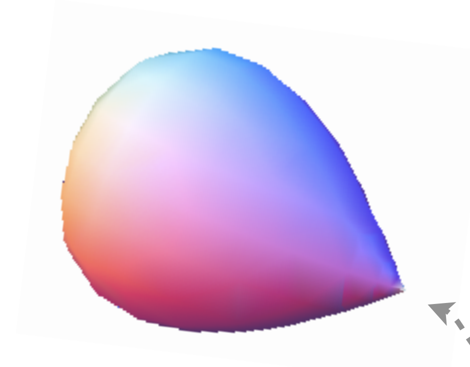

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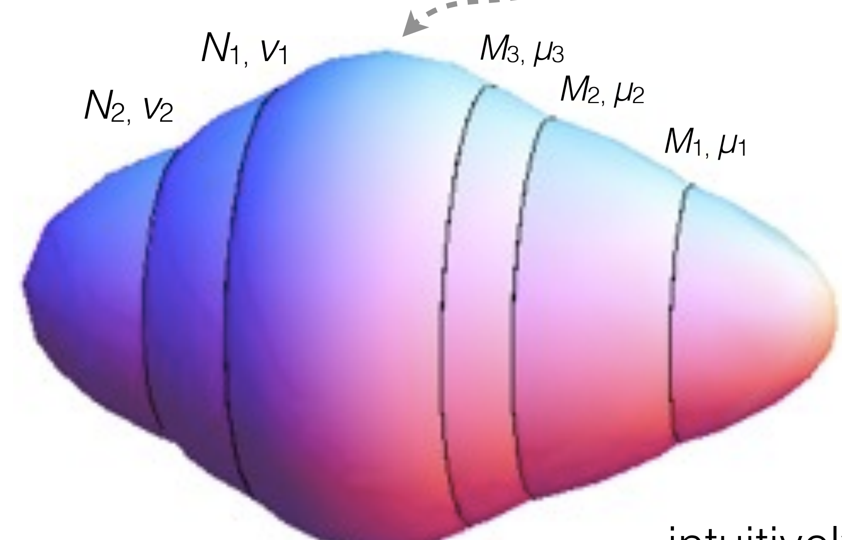
$F_0 = 0$



most general solution: many D8-D6 stacks:

- H flux integer $N \sim \int H$
- numbers N_i of D8's with D6 charges ν_i
- massless $F_0 = 0$ central region

integers subject to constraints

intuitively, D8's don't slip off because of electric attraction (branes are calibrated)

graphics courtesy of Alessandro

3. Physical implications

common lore
in flux vacua:

when calibrated sources are present,
smear the source (“warping” = 0) to perform
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[Danielsson, Dibitetto, MF, Van Riet '13]

no solution to BPS system

non-susy numerical configurations with localized D6's: [Junghans, Schmidt, Zagermann '14]
with smeared D6's, solutions to 10d EoM: [Blåbäck, Danielsson, Junghans, Van Riet, Wrase, Zagermann '11]

try to obtain **lower-dim.**
gauged sugra description

compare scalar potentials V :

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[Danielsson, Dibitetto, MF, Van Riet '13]

susy AdS_7 flux vacua in IIA

smearing sources

non-susy solutions to 10d EoM

smearing + dim. reducing

~~7d gauged sugras~~

Conclusions

Using pure spinors, we classified all supersymmetric $AdS_7 \times M_3$ vacua of type II theories, without using any Ansatz

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We proved that massive vacua with D6's do not admit a 7d gauged sugra description. Moreover, smearing the sources breaks susy

1st example of flux vacua with these highly unusual features