Gauged Supergravities

in

Nine Dimensions

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Motivation

Gauging

$$\left(\partial_\mu \rightarrow D_\mu = \partial_\mu + g A_\mu \right)$$

$$\Downarrow$$

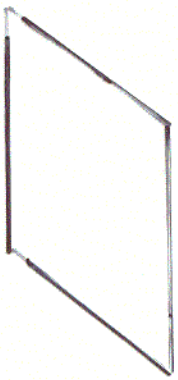
Scalar Potential

$$\left(\sqrt{-g} R \rightarrow \sqrt{-g} R + \sqrt{-g}\, m^2 V(\varphi) \right)$$

SUSY: $\boxed{g = m}$

Scalar Potential

① AdS/dS spacetime

② Domain Wall m_1  m_2

(A) Randall-Sundrum brane world
($D=5$)

(B) AdS/CFT $\rightarrow$ DW/QFT

Higher Dimensions

D = 11 : no cosmological constant

Nicolai, Townsend, v. Nieuwenhuizen

D = 10

IIA ⟨ m_R Romans — no gauging
D8-brane (Polchinski)

m_{11} Howe, Lambert, West
Lavrinenko, Lu, Pope — no action
string theory?

IIB : no massive deformation

Goal : D = 9 (3 scalars)

Gauging from Dimensional Reduction

Kaluza-Klein

$$\hat{\phi}(x,z) = \underbrace{\phi(x) + \text{massive modes}}_{\text{harmonic expansion}}$$

$$\Downarrow$$

Scherk-Schwarz II

$$\hat{\phi}(x,z) = \phi(x, mz) + \text{massive modes}$$

$$\Uparrow$$

governed by internal symmetry

Example

$\sqrt{-g}\,(\partial\phi)^2$ $\qquad$ $\phi \to \phi + c$: $SO(1,1)$

$\hat{\phi}(x,z) = \phi(x) + mz$

$\sqrt{-g}\,(\partial\phi)^2 \longrightarrow \sqrt{-g}\,\left((D\phi)^2 + m^2\right)$

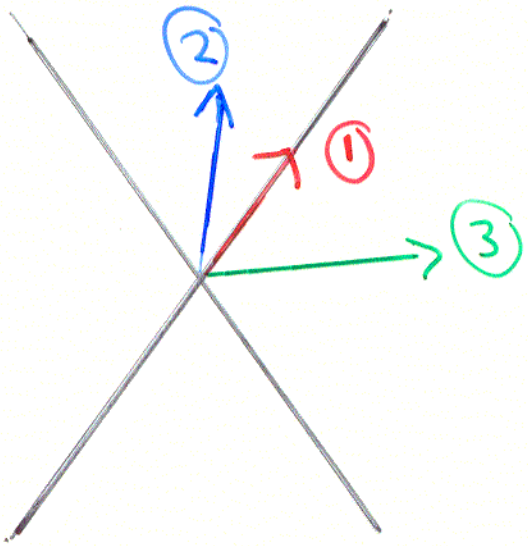
$D_\mu \phi = \partial_\mu \phi - m A_\mu$ $\qquad$ $\delta\phi = m\lambda$

$\delta A_\mu = \partial_\mu \lambda$

A_μ

KK - vector

$SL(2,\mathbb{R})$

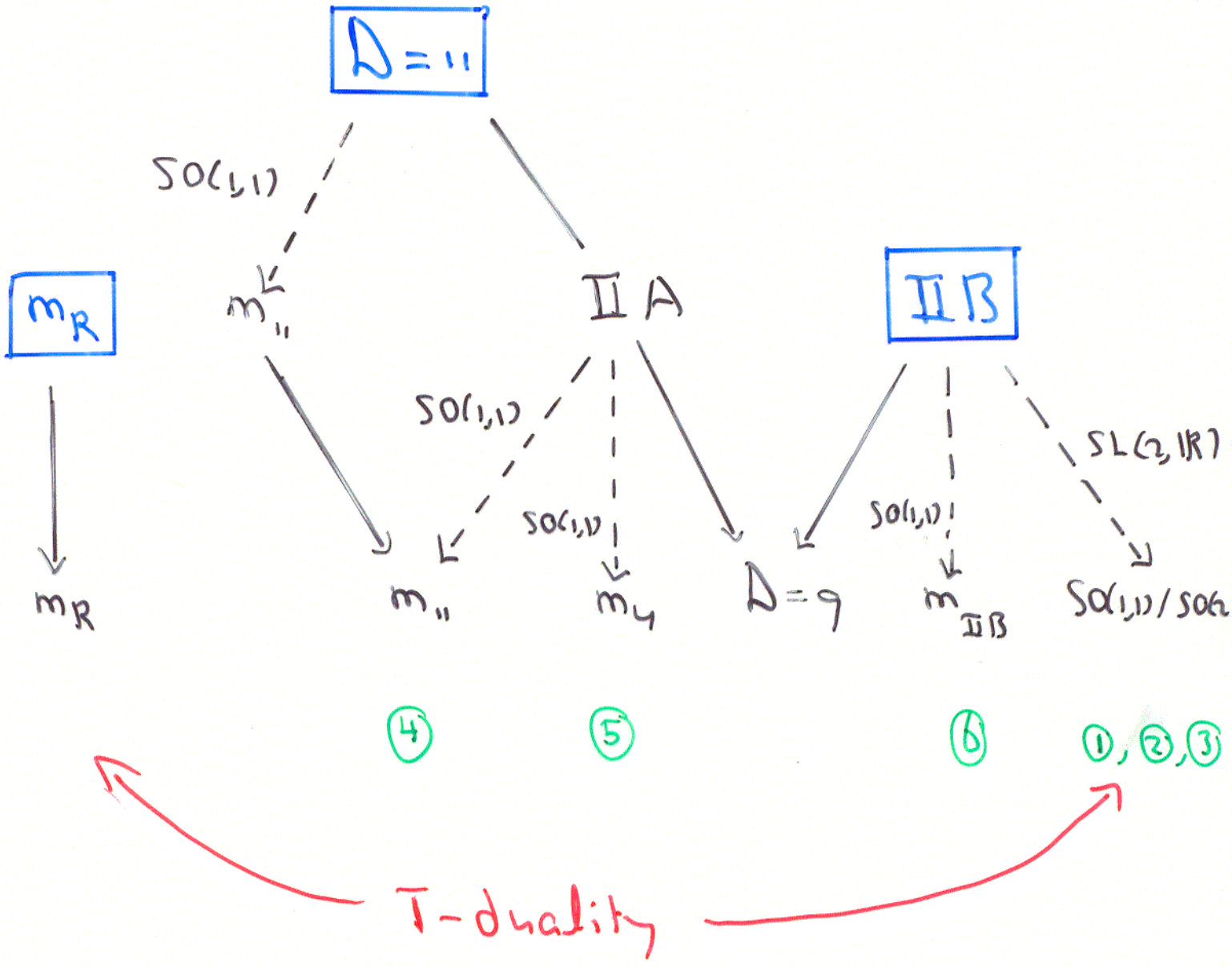


① $SO(1,1)_p$ $\quad \Omega = \begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$ $\quad \mathrm{Tr}\,\Omega = 2$

② $SO(1,1)_h$ $\quad \Omega = \begin{pmatrix} e^{\gamma} & 0 \\ 0 & e^{-\gamma} \end{pmatrix}$ $\quad \mathrm{Tr}\,\Omega > 2$

③ $SO(2)_e$ $\quad \Omega = \begin{pmatrix} \cos\vartheta & \sin\vartheta \\ -\sin\vartheta & \cos\vartheta \end{pmatrix}$ $\quad \mathrm{Tr}\,\Omega < 2$

Summary



- Six D=9 Gauged SUGRAS !

- String theory / M-theory ?

Solutions

(A) Half-SUSY Domain Walls

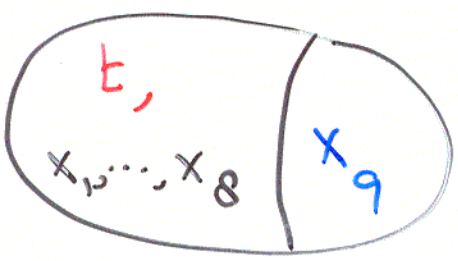
$SL(2,\mathbb{R})$ (see hep-th/0203202)

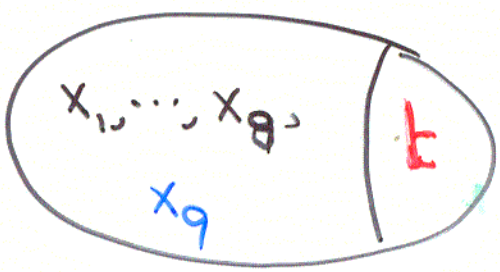
$D=9$ DW $\Longleftrightarrow$ $D=10$ IIB 7-brane

$\uparrow$ $\uparrow$

scalar potential monodromy

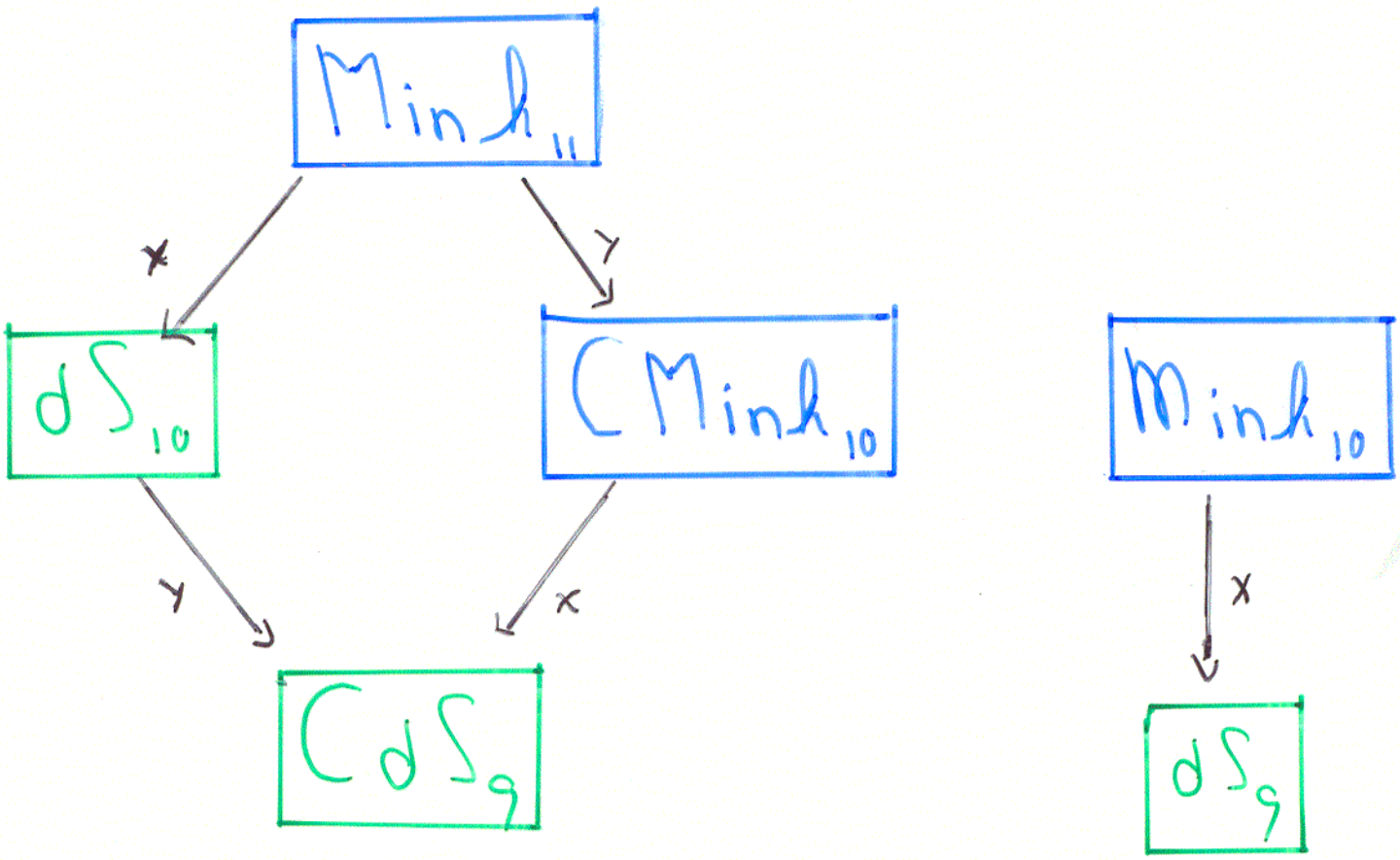
(B) Space-like branes





ⓒ non-SUSY dS solutions

$$Minkowski_{11}: \quad ds^2 = e^{2mx}\left(-dt^2 + e^{2mt}(dx_8^2 + dy^2) + dx^2\right)$$



String theory / M-theory ?

Conclusions

- Situation in $D=9$ is non-trivial !

- Can we learn something about $D<9$?

- New sectors in string theory / M-theory ?