Chiral anomalies and their implications in 10d non-supersymmetric $\mathfrak{sp}(16)$ gauge theories

Vittorio Larotonda

University of Bologna/ INFN Bologna

Work in progress with Ling Lin

String Phenomenology 2024
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Setting: non-supersymmetric String Theories

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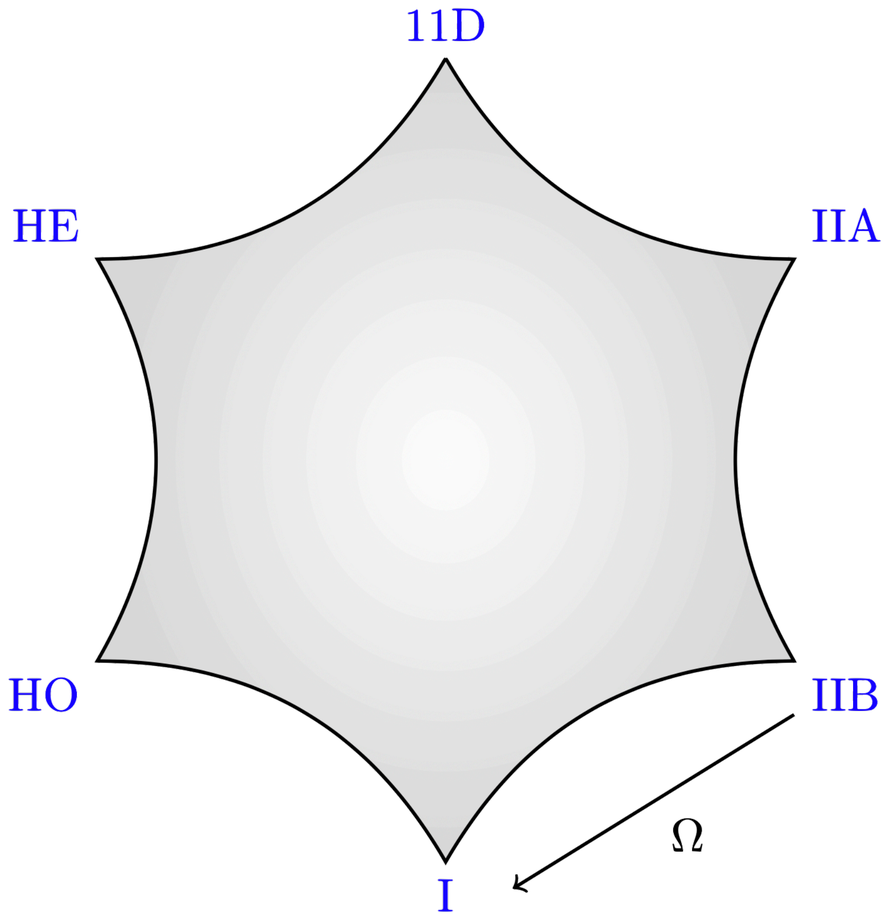

[Basile, Debray, Delgado, and Montero ’23]

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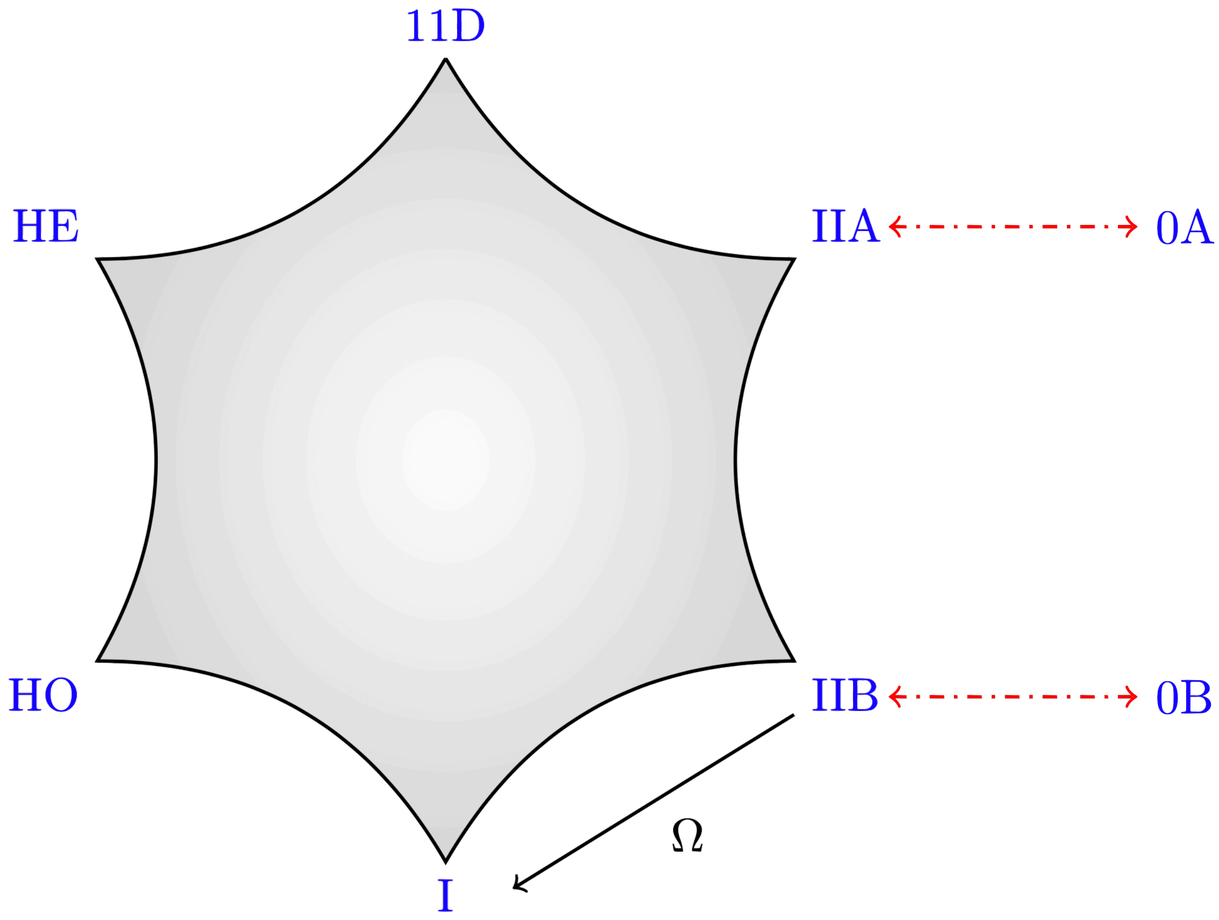

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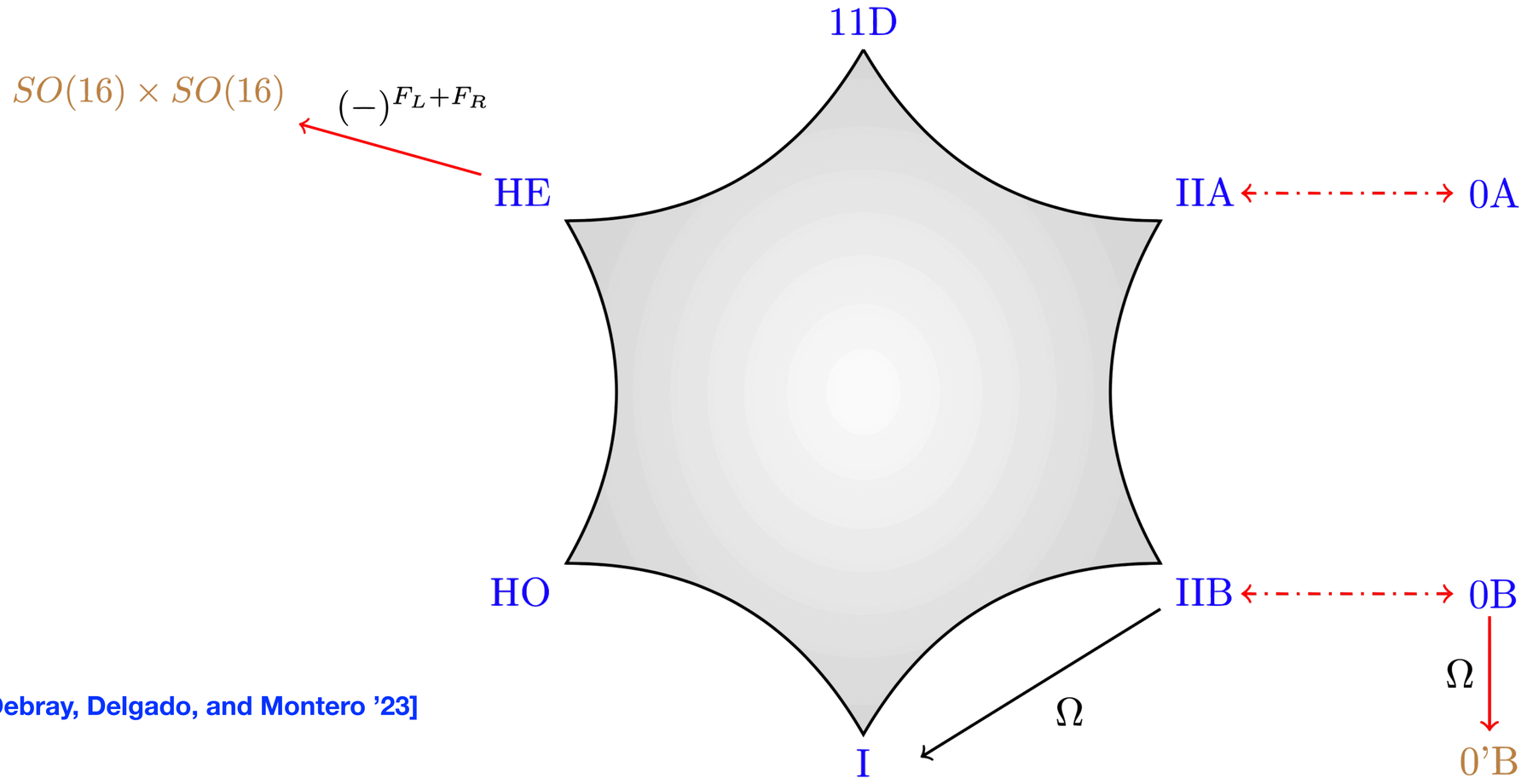

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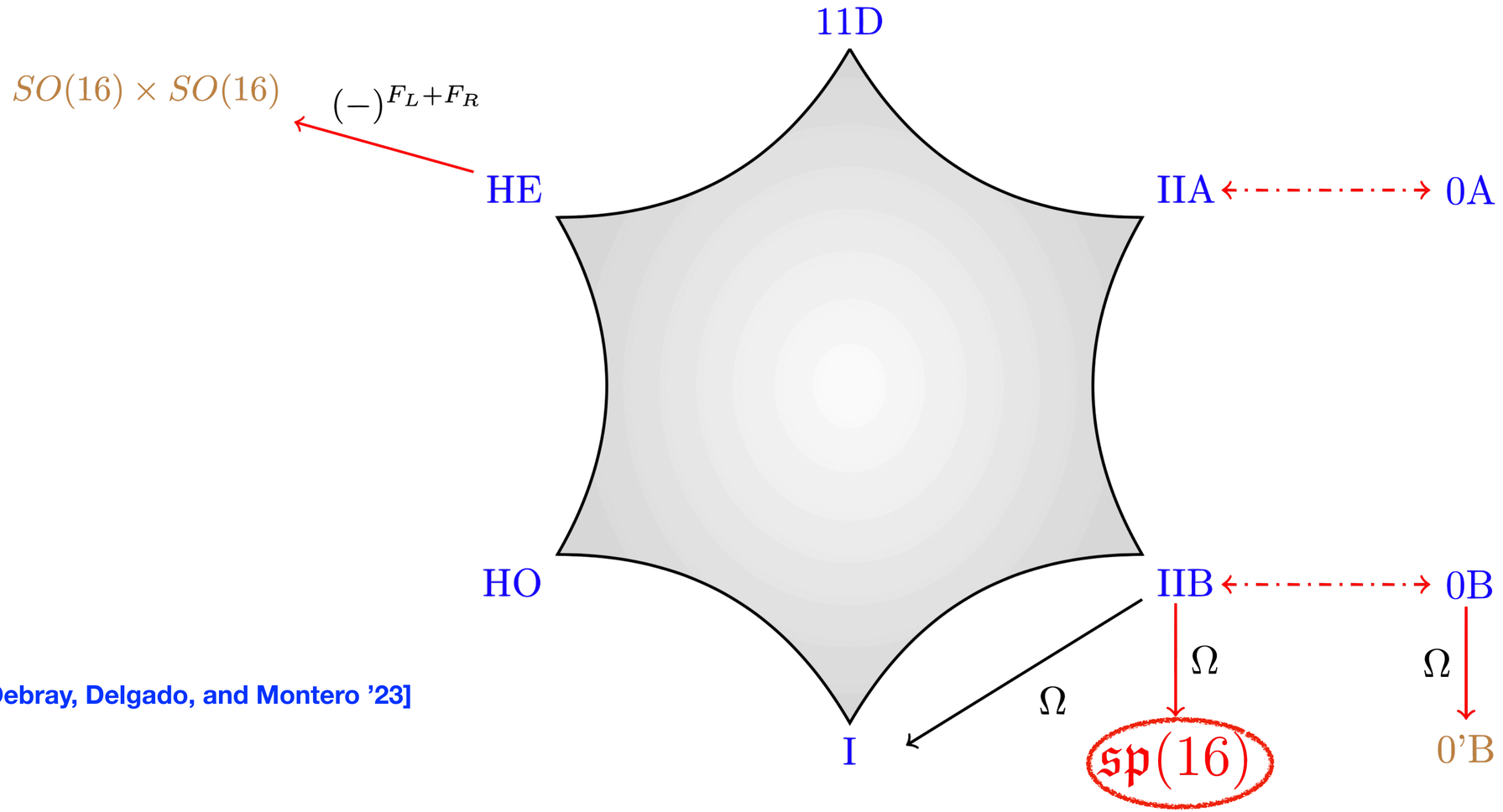

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[Sagnotti '95/ Sagnotti '97]

[Sugimoto '99]

Sugimoto model

The (other) orientifold of Type IIB

- Anomaly cancellation: $O9 + 16\bar{D}9$

  $\Longrightarrow$ Brane supersymmetry breaking

[Antoniadis, Dudas, Sagnotti '99/ Angelantonj '00/ Aldazabal, Uranga '99/ Angelantonj, Antoniadis, D'Appollonio, Dudas, A. Sagnotti '00]

- Open string sector: $\mathfrak{sp}(16)$ gauge algebra.

- Chiral massless spectrum: Gravitino, Dilatino and **495** (anti-symmetric).

- Two dual RR gauge fields B_2 and $B_6 \Longrightarrow$ charged $D1$ and $D5$- branes.

Goals of this work

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~~SUSY~~ theories are (perturbative) anomaly free

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  - Form of the chiral spectrum

  - Global structure of the gauge group

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$Sp(16)$ VS $Sp(16)/\mathbb{Z}_2$

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(Gauge) anomaly: non invariance of the Path Integral under a gauge transformation

$$\delta_\epsilon Z[A] \neq 0$$

Quantified via the Anomaly Polynomial: $I_{d+2} = X_{d+2} + X_2 \wedge X_d + X_4 \wedge X_{d-2} + \dots$

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Anomaly inflow: the coupling term of a defect

$$\int_{W_{p+1}} B_{p+1}$$

[Callan, Harvey '85/ Blum, Harvey '94/ Freed, Harvey, Minasian, Moore '98/ Lawrie, Schäfer-Nameki, Weigand '17/ Kim, Shiu, Vafa '19/ Angelantonj, Bonnefoy, Condeescu, Dudas '20/ Martucci, Risso, Weigand '23/ Hamada, Vafa '21/ Bedroya, Hamada, Montero, Vafa '21/ Hamada, Loges '23 & '24/ Loges '24/…]

contributes to its anomaly and must be canceled by dynamical d.o.f. on world-volume.

Chiral brane anomalies in the Sugimoto model

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D1-brane

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$(+)$	$\mathbf{8}_c$	$\mathbf{1}$	$\square\!\!\square$
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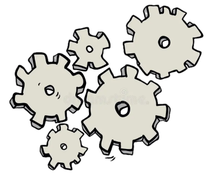

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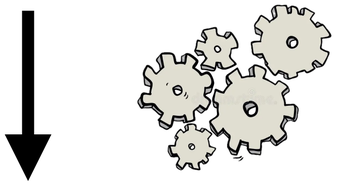

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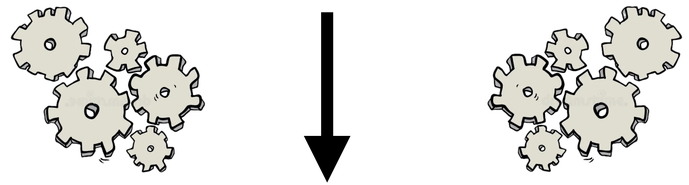

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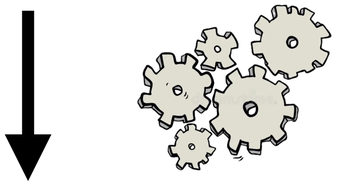

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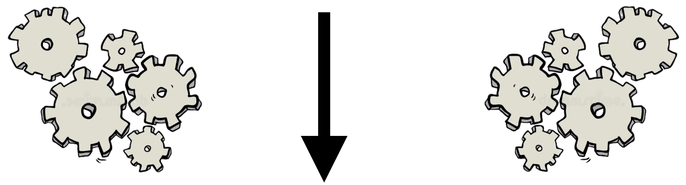

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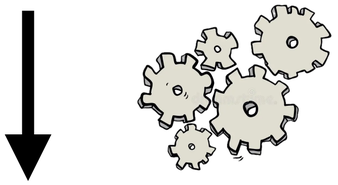

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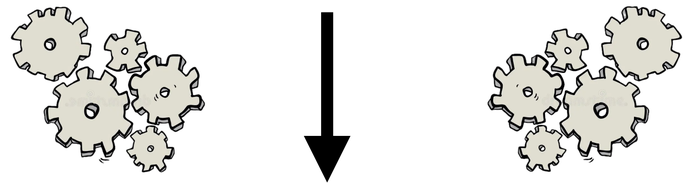

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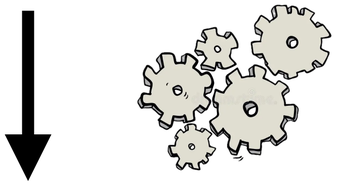

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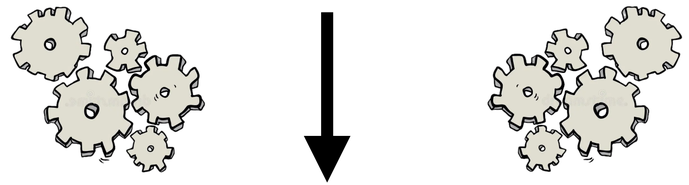

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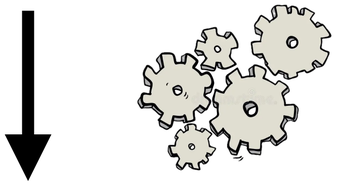

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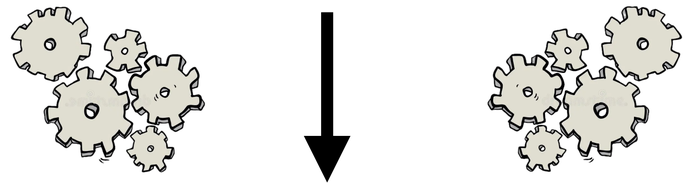

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- $Sp(16)/\mathbb{Z}_2$ has no 1-form symmetry anomaly.

[Apruzzi, Dierigl, Lin '20/
Cvetič, Dierigl, Lin, Zhang '20]

- The chiral spectrum must be $\mathbb{Z}_2$ invariant

$$\Longrightarrow \quad I_{12} = n_{\mathbf{1}} I_{12\,\mathbf{1}} + n_g I_{12\,g} + n_{\begin{smallmatrix}\square\\\square\end{smallmatrix}} I_{12\,\begin{smallmatrix}\square\\\square\end{smallmatrix}} + n_{\square\square} I_{12\,\square\square} + n_{\square\square\square\square} I_{12\,\square\square\square\square} + \ldots$$

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Results

(1) The only possible (minimal) 10d realization of $\mathfrak{sp}(16)$ is the Sugimoto model!

(2) $Sp(16)$ is *THE* group of this class of theories!

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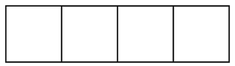

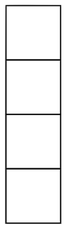

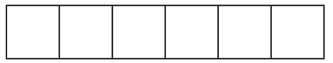

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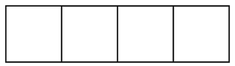

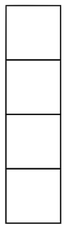

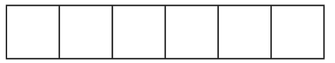

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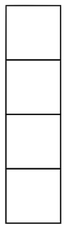

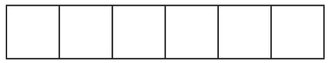

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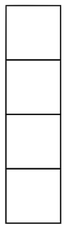
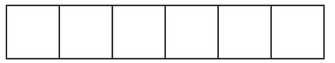


$\beta = \frac{4095}{3071}$



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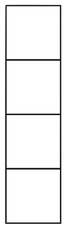

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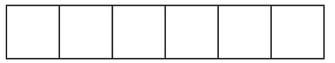

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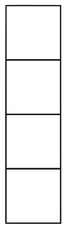

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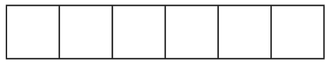

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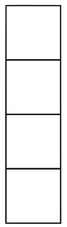

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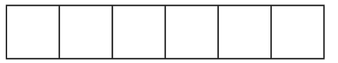

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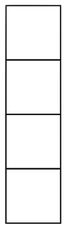

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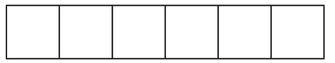

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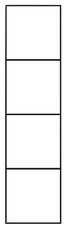

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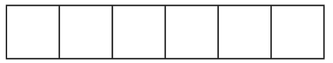

$Sp(16)/\mathbb{Z}_2$?

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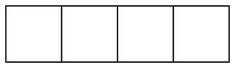

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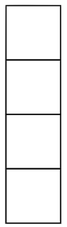

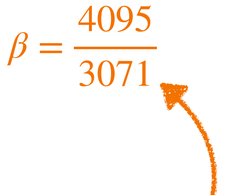

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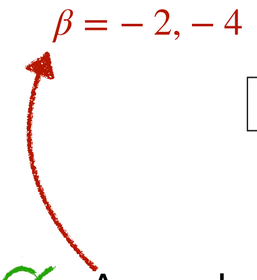
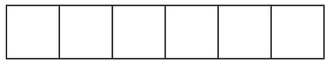
❌ Obstruction to anomaly inflow onto 1-brane





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