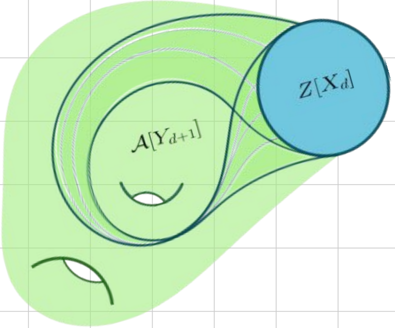
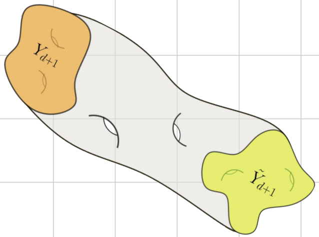


ANOMALIES & BORDISMS

OF NON-SUPERSYMMETRIC STRINGS

Matilda Delgado



Based on:
[2310.06895] I. Basile, A. Debray, M.D., M. Montero

BIG PICTURE

Our world is non-supersymmetric

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(**at least** at low energies)

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It is crucial for phenomenology to understand Quantum Gravity in setups without supersymmetry!

BIG PICTURE

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It has GR, chiral matter and gauge symmetries

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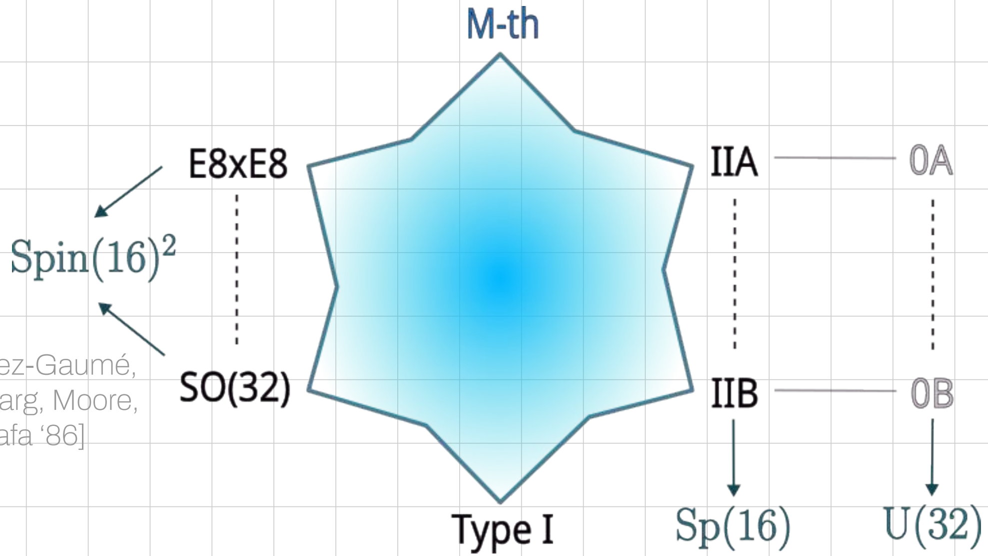
In ten dimensions, there are three of them

10D NON-SUPERSYMMETRIC STRING THEORIES



[Alvarez-Gaumé, Ginsparg, Moore, Vafa '86]

[Sugimoto '99] [Sagnotti '95]

They can be related by **duality** to the supersymmetric (well-understood string theories).

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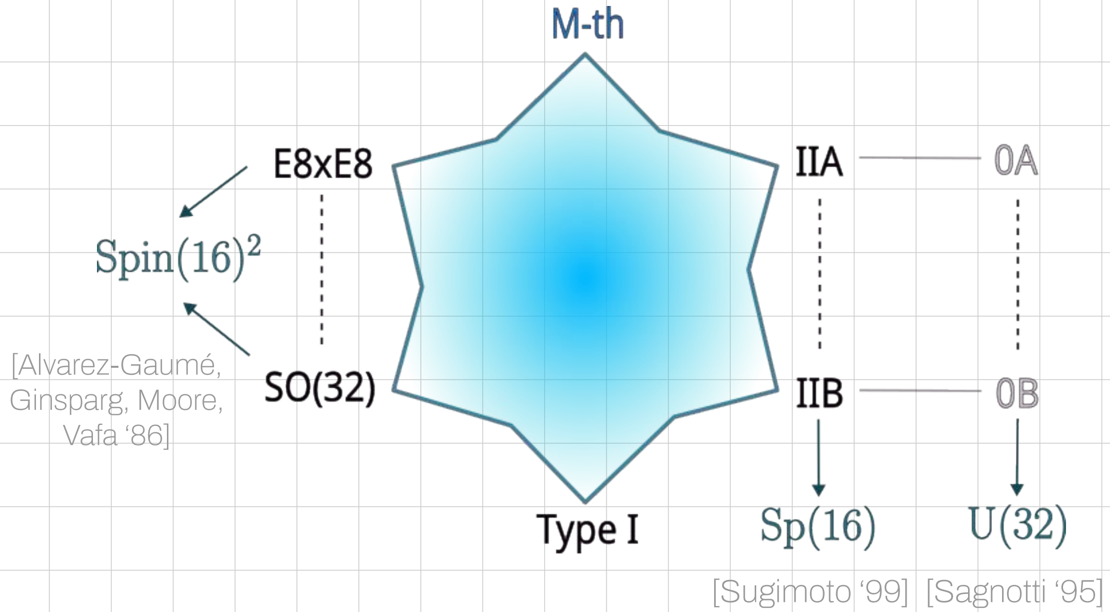

KEY to understand Quantum Gravity away from SUSY !!

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They all have low-energy effective actions that are schematically given by:

$$S \sim \frac{1}{2\kappa^2} \int dx^{10} \sqrt{-g} \left(R - \frac{1}{2}(\partial\phi)^2 - \frac{1}{4}\mathrm{tr}|F|^2 - T e^{a\phi} + \cdots \right)$$

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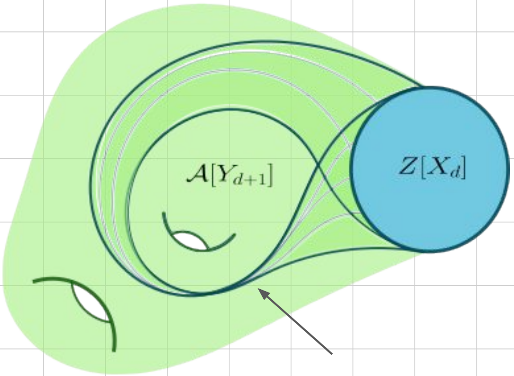
Review in: [García-Etxebarria, Montero '18]

The modern way of computing **global gauge and gravitational** anomalies of a theory on X_d is through a (d+1)-dimensional *anomaly theory* on Y_{d+1} such that $\partial Y_{d+1} = X_d$.



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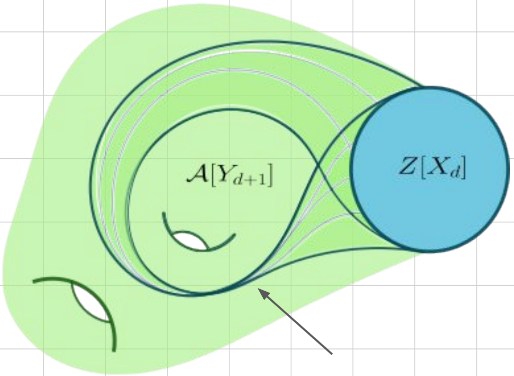

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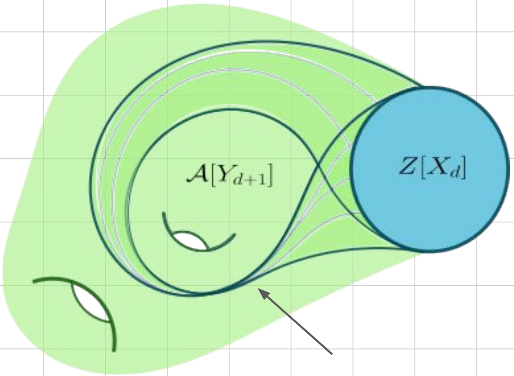

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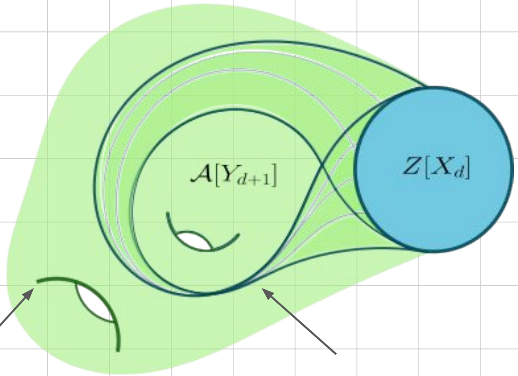

In QG, allow for topology-change

⇒ "Dai-Freed anomalies" Account for the possibility of a transformation that involves topology change

Non-collapsible path in configuration space of gauge field / metric

[García-Etxebarria, Montero '18]

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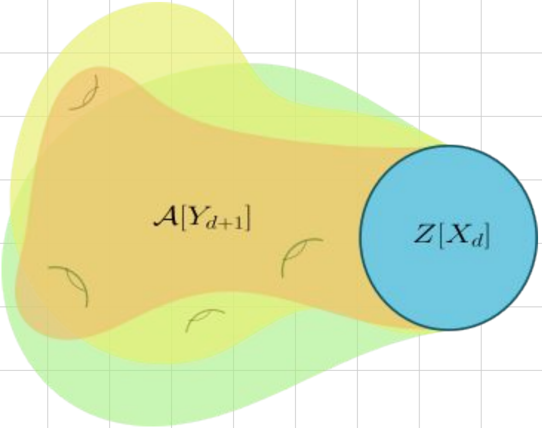

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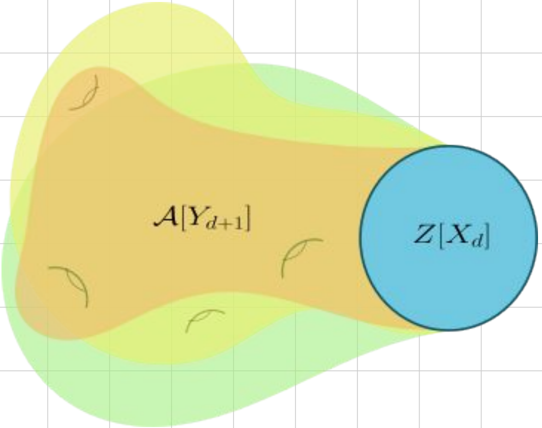

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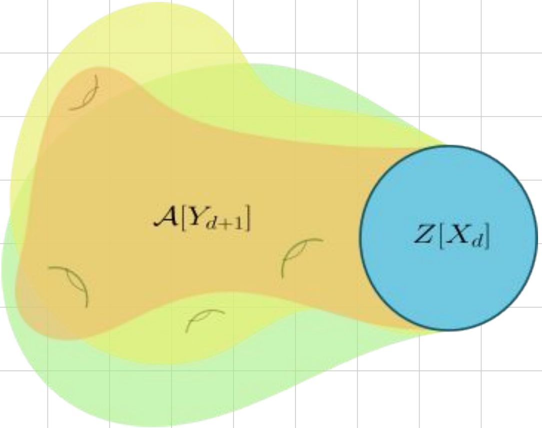

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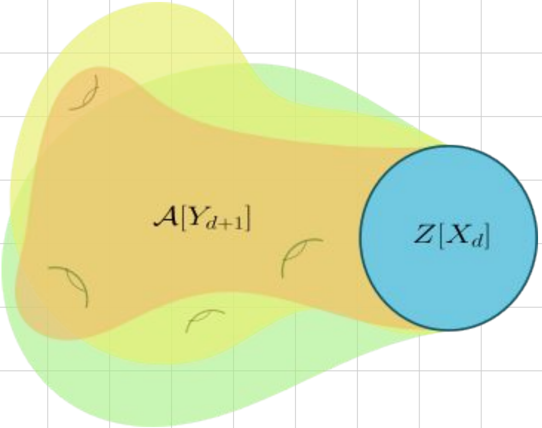

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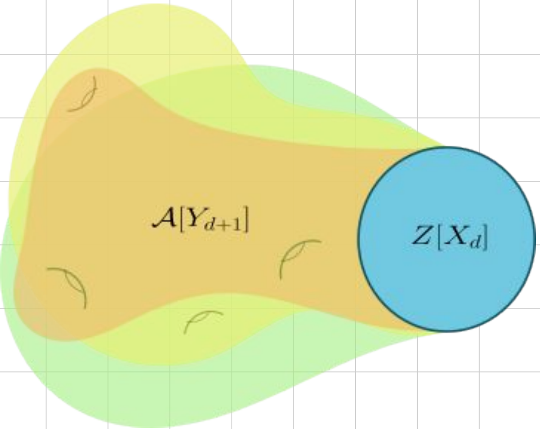

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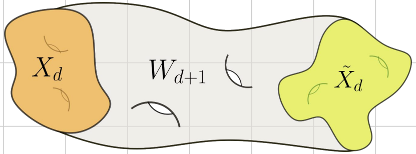

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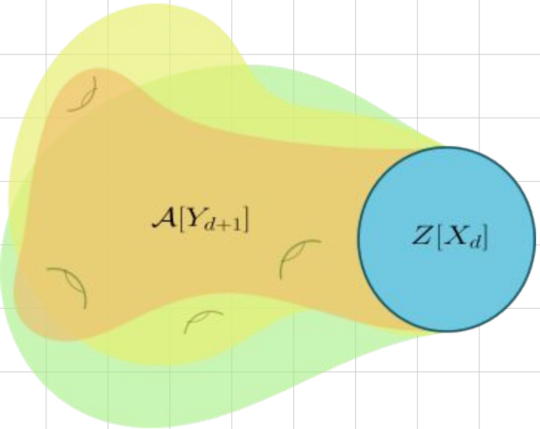

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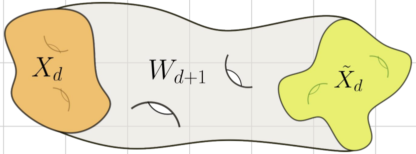

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➡ **twisted string bordism**

Not many of them are known, we computed

$$\Omega_{11}^{string-\mathrm{Sp}(16)}, \quad \Omega_{11}^{string-\mathrm{Spin}(16)^2}, \quad \Omega_{11}^{string-U(32)}$$

using the Adams spectral sequence.

[García-Etxebarria, Montero '18]

GLOBAL ANOMALIES

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[García-Etxebarria, Montero '18]

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Huge consistency check!

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➥ **We also computed lower-dimensional cobordism groups for these theories!!**

$\Omega_0^{\text{String-}Sp(16)} \cong \mathbb{Z}$	$\Omega_6^{\text{String-}Sp(16)} \cong \mathbb{Z}_2$
$\Omega_1^{\text{String-}Sp(16)} \cong \mathbb{Z}_2$	$\Omega_7^{\text{String-}Sp(16)} \cong \mathbb{Z}_4$
$\Omega_2^{\text{String-}Sp(16)} \cong \mathbb{Z}_2$	$\Omega_8^{\text{String-}Sp(16)} \cong \mathbb{Z}^{\oplus 3} \oplus \mathbb{Z}_2$
$\Omega_3^{\text{String-}Sp(16)} \cong 0$	$\Omega_9^{\text{String-}Sp(16)} \cong (\mathbb{Z}_2)^{\oplus 3}$
$\Omega_4^{\text{String-}Sp(16)} \cong \mathbb{Z}$	$\Omega_{10}^{\text{String-}Sp(16)} \cong (\mathbb{Z}_2)^{\oplus 3}$
$\Omega_5^{\text{String-}Sp(16)} \cong \mathbb{Z}_2$	$\Omega_{11}^{\text{String-}Sp(16)} \cong 0.$

Example: Sugimoto

➤ NO GLOBAL ANOMALIES! ✅

But that's not all …

➥ We use anomaly inflow to gain insight into the worldvolume theory of 5-branes in these theories✅

➥ **We also computed lower-dimensional cobordism groups for these theories!!**

$$\Omega_0^{\text{String-}Sp(16)} \simeq \mathbb{Z} \qquad \Omega_6^{\text{String-}Sp(16)} \simeq \mathbb{Z}_2$$
$$\Omega_1^{\text{String-}Sp(16)} \simeq \mathbb{Z}_2 \qquad \Omega_7^{\text{String-}Sp(16)} \simeq \mathbb{Z}_4$$
$$\Omega_2^{\text{String-}Sp(16)} \simeq \mathbb{Z}_2 \qquad \Omega_8^{\text{String-}Sp(16)} \simeq \mathbb{Z}^{\oplus 3} \oplus \mathbb{Z}_2$$
$$\Omega_3^{\text{String-}Sp(16)} \simeq 0 \qquad \Omega_9^{\text{String-}Sp(16)} \simeq (\mathbb{Z}_2)^{\oplus 3}$$
$$\Omega_4^{\text{String-}Sp(16)} \simeq \mathbb{Z} \qquad \Omega_{10}^{\text{String-}Sp(16)} \simeq (\mathbb{Z}_2)^{\oplus 3}$$
$$\Omega_5^{\text{String-}Sp(16)} \simeq \mathbb{Z}_2 \qquad \Omega_{11}^{\text{String-}Sp(16)} \simeq 0.$$

Example: Sugimoto

By the **Cobordism Conjecture** we know they all have to **vanish in QG**.
[McNamara, Vafa '19]

This predicts the existence of **new extended objects** in these theories, that can trivialize these classes!

On the quest to characterizing these new extended objects:

[Andriot, Angius, Blumenhagen, Buratti, Carqueville, Cribiori, Calderon-Infante, DeBiasio, Debray, Delgado, Dierigl, Friedrich, Garcia-Etxebarria, Hebecker, Heckman, Huertas, Kneissl, Makridou, Montero, McNamara, Lust, Torres, Uranga, Vafa, Valenzuela, Velazquez, Walcher, Wang...'19-'24]

THANKS!