Non-geometric fluxes in higher dimensions

based on 1106.4015, 1202.3060 and 1204.1979 in collaboration with

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$\Delta p \cdot \Delta q \geq \frac{1}{2} \hbar$

Four dimensions

Non-geometric flux compactification

- In gauged supergravity: [Shelton, Taylor, Wecht: 2006]

$$
\begin{aligned}
[Z_a, Z_b] &= H_{abc} X^c + f^c{}_{ab} Z_c \\
[Z_a, X^b] &= -f^b{}_{ac} X^c \\
[X^a, X^b] &= 0
\end{aligned}
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- T-duality chain: $H_{abc} \;\rightarrow\; f^b{}_{ac} \;\rightarrow\; Q_c{}^{ab} \;\rightarrow\; R^{abc}$

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Phenomenological impact

- Moduli fixing [Micu, Palti, Tasinato: 2007]
- De Sitter vacua [de Carlos, Guarino, Moreno: 2009]

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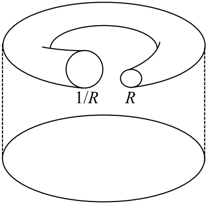
What is the ten-dimensional origin
of non-geometric fluxes?

Ten dimensions

Non-geometric backgrounds:

- Structure group includes $O(d, d)$ transformations [Dabholkar, Hull: 2005]

  [Hellerman, McGreevy, Williams: 2002]
- Can be obtained as T-duals of geometric backgrounds



- Consistent string backgrounds [Hull: 2004]
- No straightforward target space interpretation
- **Examples**: torus fibrations with non-trivial monodromies, asymmetric orbifolds

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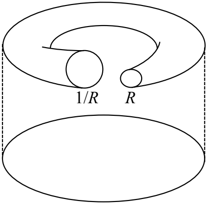

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How are non-geometric fluxes connected to non-geometric backgrounds?

Method

Field redefinition: introduction of a bivector $\tilde{\beta}^{mn}$

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$$\boxed{\hat{\mathcal{L}}(\hat{g}, \hat{B}, \hat{\phi}) \;=\; \tilde{\mathcal{L}}(\tilde{g}, \tilde{\beta}, \tilde{\phi}) + (\text{total derivative})}$$

Method

Field redefinition: introduction of a bivector $\tilde{\beta}^{mn}$

- Ten-dimensional supergravity, NSNS sector only
- Generalised metric $\mathcal{H} = \mathcal{E}^T \mathcal{E}$ and different vielbeins

$$\hat{\mathcal{E}} = \begin{pmatrix} \hat{e} & 0 \\ -\hat{e}^{-T}\hat{B} & \hat{e}^{-T} \end{pmatrix}, \quad \tilde{\mathcal{E}} = \begin{pmatrix} \tilde{e} & \tilde{e}\tilde{\beta} \\ 0 & \tilde{e}^{-T} \end{pmatrix}$$

This gives in particular

$$\hat{B}_{mn} \;\rightarrow\; \tilde{\beta}^{mn} = (\hat{g} + \hat{B})^{-1}\; \hat{B}\; (\hat{g} - \hat{B})^{-1}$$

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- Global issues: track total derivatives

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Results

This method

- Reveals non-geometric fluxes

$$Q_p{}^{mn} = \partial_p \tilde{\beta}^{mn} \; , \quad R^{mnp} = 3 \tilde{\beta}^{k[m} \partial_k \tilde{\beta}^{np]}$$

- Resolved ill-definedness in some cases
  $\longrightarrow$ Dimensional reduction possible

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Extension to double field theory

- Geometric interpretation of non-geometric fluxes, i.e.
  Q as connection, R as tensor