LUNCH MEETING at Yukawa Institute, Kyoto Univ.: Dec 17, 2008

Towards Complete Classification of Supergravities from String Compactifications

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We are looking for the origin of 4D physics

Physical information

- Particle contents and spectra
- (Broken) symmetries
- Potential, vacuum and cosmological constant

Supergravity (SUGRA) is a low energy effective theory of Strings

SUGRA should know String Vacua

If Strings produce realistic models, What kind of 4D vacua?

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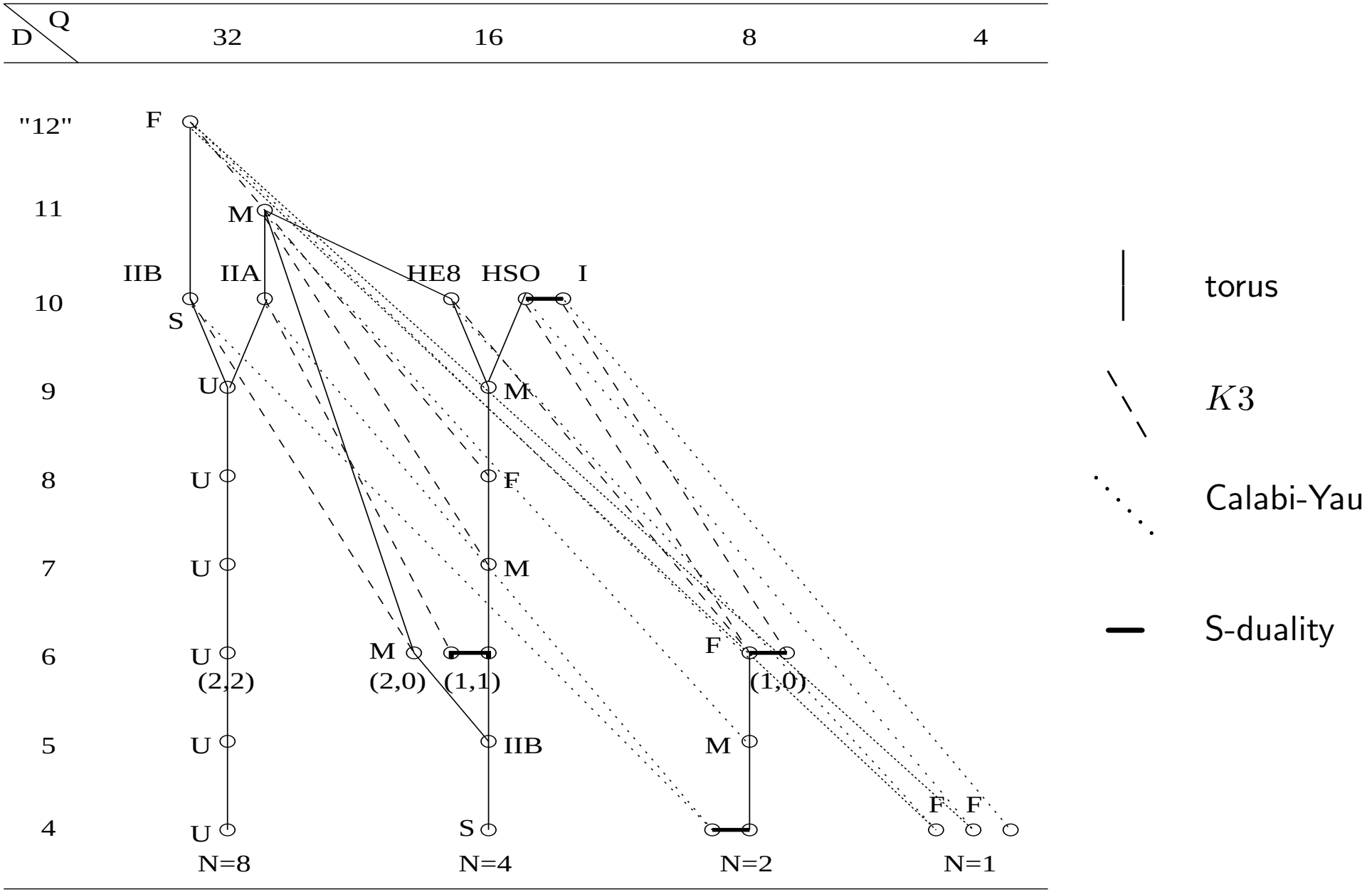
What kind of Compactified Spaces?

$$4 \;=\; 10 - 6 \;=\; 11 - 7$$



B. de Wit, J. Louis in the Proceedings "NATO Advanced Study Institute on Strings, Branes and Dualities (1997)," hep-th/9801132

- Many Abelian SUGRA in lower dimensions

  Compactifications by Tori, Calabi-Yaus, etc.

  Minkowski ground state, massless fields

  Global E_7, local $U(1)^{28}$ symmetries (4D case)

- Many Gauged SUGRA in lower dimensions

  Compactifications by group manifolds, twisted tori, torsionful manifolds, etc.

  Scalar potential which gives mass terms of scalar fields [Moduli Stabilization]

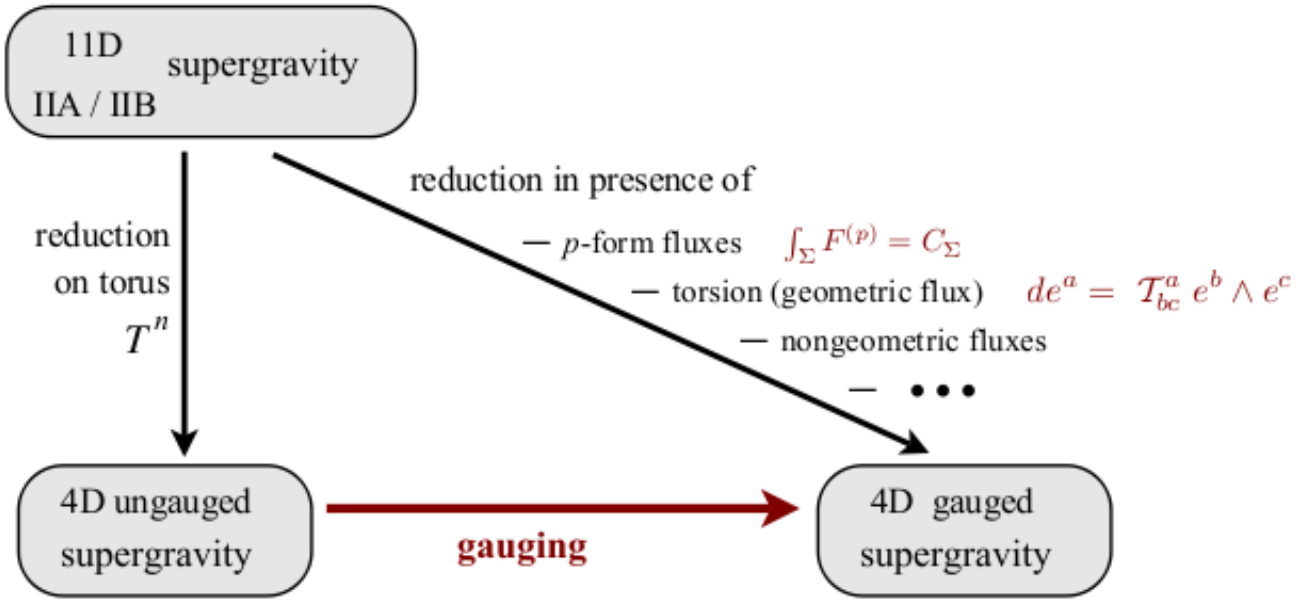
  Non-trivial cosmological constant

There exist various gauged SUGRA which cannot be derived from Strings compactified on conventional geometric backgrounds

We (want to) believe that all SUGRA come from Strings

Compactify the Strings on extended geometries:

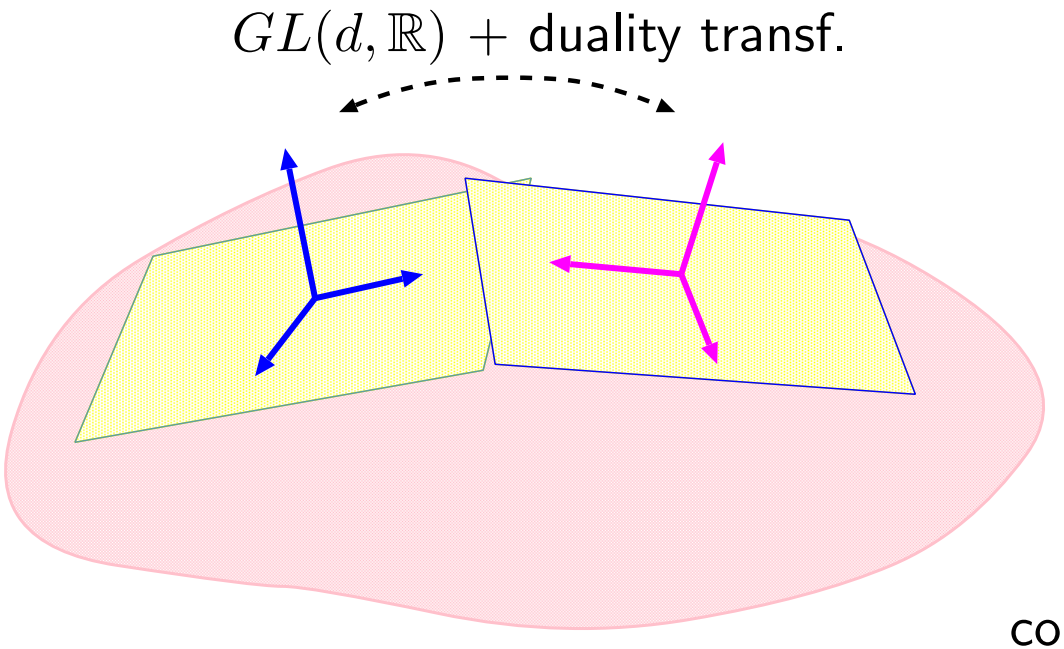
Nongeometric Backgrounds



H. Samtleben "RTN Winter School: Lectures on gauged supergravity and flux compactifications (2008)," arXiv:0808.4076

What is a Nongeometric Background?

Structure group = Diffeo. $(GL(d,\mathbb{R}))$ + Duality transf. groups



compactified space $\mathcal{M}_d$

Examples of SUGRA on Nongeometric Backgrounds

- 4D $\mathcal{N}=4$ SUGRA has a rigid $SL(2)\times SO(6,22)$

  Gauging introduces the couping constant, the structure constants, etc.

  $\dashrightarrow$ regarded as the (non)geometric fluxes on compactified 6D space with $SL(2;\mathbb{Z})\times SO(6,22;\mathbb{Z})$ duality symmetry

  J. Schön, M. Weider hep-th/0602024, B. de Wit, H. Samtleben, M. Trigiante arXiv:0705.2101

  R.A. Reid-Edwards, B. Spanjaard arXiv:0810.4699

- Lower-dim. Gauged SUGRA compactified by Scherk-Schwarz mechanism

  "Kaloper-Myers" algebra:

$$
\begin{aligned}
[Z_a, Z_b] &= f_{ab}{}^{c}\, Z_c + H_{abc}\, X^c \\
[X^a, X^b] &= Q^{ab}{}_{c}\, X^c + R^{abc}\, Z_c \\
[X^a, Z_b] &= f^{a}{}_{bc}\, X^c - Q^{ac}{}_{b}\, Z_c
\end{aligned}
$$

  N. Kaloper, R.C. Myers hep-th/9901045

  J. Shelton, W. Taylor, B. Wecht hep-th/0508133, A. Dabholkar, C.M. Hull hep-th/0512005

  M. Graña, R. Minasian, M. Petrini, D. Waldram arXiv:0807.4527

String Theories compactified on Extended geometries

All Gauged SUGRA

— Extended geometries (in Modern Times) —

Generalized Geometries (Hitchin)

Doubled Formalism (Hull)

etc..