Aspects of non-geometric flux compactifications

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MPI for Physics

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Aspects of non-geometric flux compactifications

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with

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Outline

- ★ Motivation
- ★ Simplest non-geometric flux vacua
- ★ Pheno:

  de Sitter vacua

  Supersymmetry Breaking

  Axion Inflation

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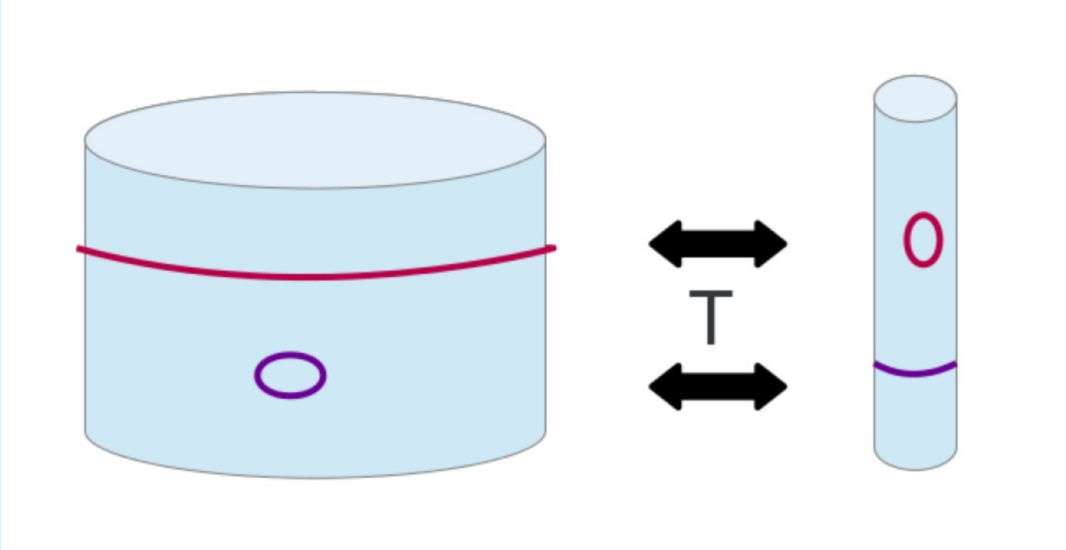
FloWolF's talk

Motivation: T-Duality



Duality between compactifications with different geometries

What happens in the presence of fluxes?

Aspects of non-geometric flux compactifications

***H*-flux**

metric and Kalb-Ramond form
naturally appear in string theory

dB=H-flux

useful to stabilise moduli

Aspects of non-geometric flux compactifications

***geometric* flux**

physics still captured by G and B

a T-duality transformation changes the geometry

this example: *H*-flux dofs now manifest in *geometric* flux

Aspects of non-geometric flux compactifications

Q-flux

not sufficiently

described by metric

and B-field

described by introducing

- bivector

  or

- dual coordinates

Aspects of non-geometric flux compactifications

R-flux

not sufficiently

described by metric

and B-field

described by introducing

- bivector

and

- dual coordinates

Double field theory

- ★ Tool to describe non-geometric fluxes
- ★ More degrees of freedom needed
- ★ Bivector $Q = \partial\beta$
- ★ Doubling of coordinates $R = \tilde{\partial}\beta$
- ★ Strong constraint

Double field theory

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kills half of the extra dofs

:,(

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Flux potential same as in N=2 gauged supergravity

Double field theory

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$\mathcal{N} = 2$ gauged supergravity

swampy or **stringy** **?**

geometric and non-geometric fluxes non solum sed etiam ?

We will not answer this question

geometric and non-geometric fluxes non solum sed etiam ?

We will not answer this question

We investigate the phenomenology of these vacua

and motivate why we want them

geometric and non-geometric fluxes non solum sed etiam ?

more on non-geometry

Talks by

Stefano Massai and Erik Plauschinn

Outline

- ★ Investigate simplest non-geometric flux vacua
- ★ Kahler moduli stabilisation at tree-level
- ★ de Sitter vacua from D-terms or Anti-D3-brane
- ★ Supersymmetry breaking
- ★ Build axion inflation models

Outline

- ★ Investigate simplest non-geometric flux vacua
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particularly the latter is a super motivation to look into non-geometric fluxes

Non-geometric flux vacua

described in 4D by the superpotential

$$W = \int_{\mathcal{M}} \left[\mathcal{F} + \mathcal{D}\Phi_c^{ev} \right]_3 \wedge \Omega_3$$

$$\Phi_c^{ev} = i\,(S \,-\, G^a \omega_a - T_\alpha\, \tilde{\omega}^\alpha \,)$$

$$\mathcal{D} = d \,-\, H\,\wedge - F\,\circ - Q\,\bullet - R\,\llcorner$$

DFT with background fluxes

→ perturbation on a Calabi-Yau

The simplest class of non-geometric flux vacua

- ★ Very few fluxes turned on
- ★ Minima easy to find
- ★ All masses have the same scaling with fluxes
- ★ Saxion vevs controlled

The simplest class of non-geometric flux vacua

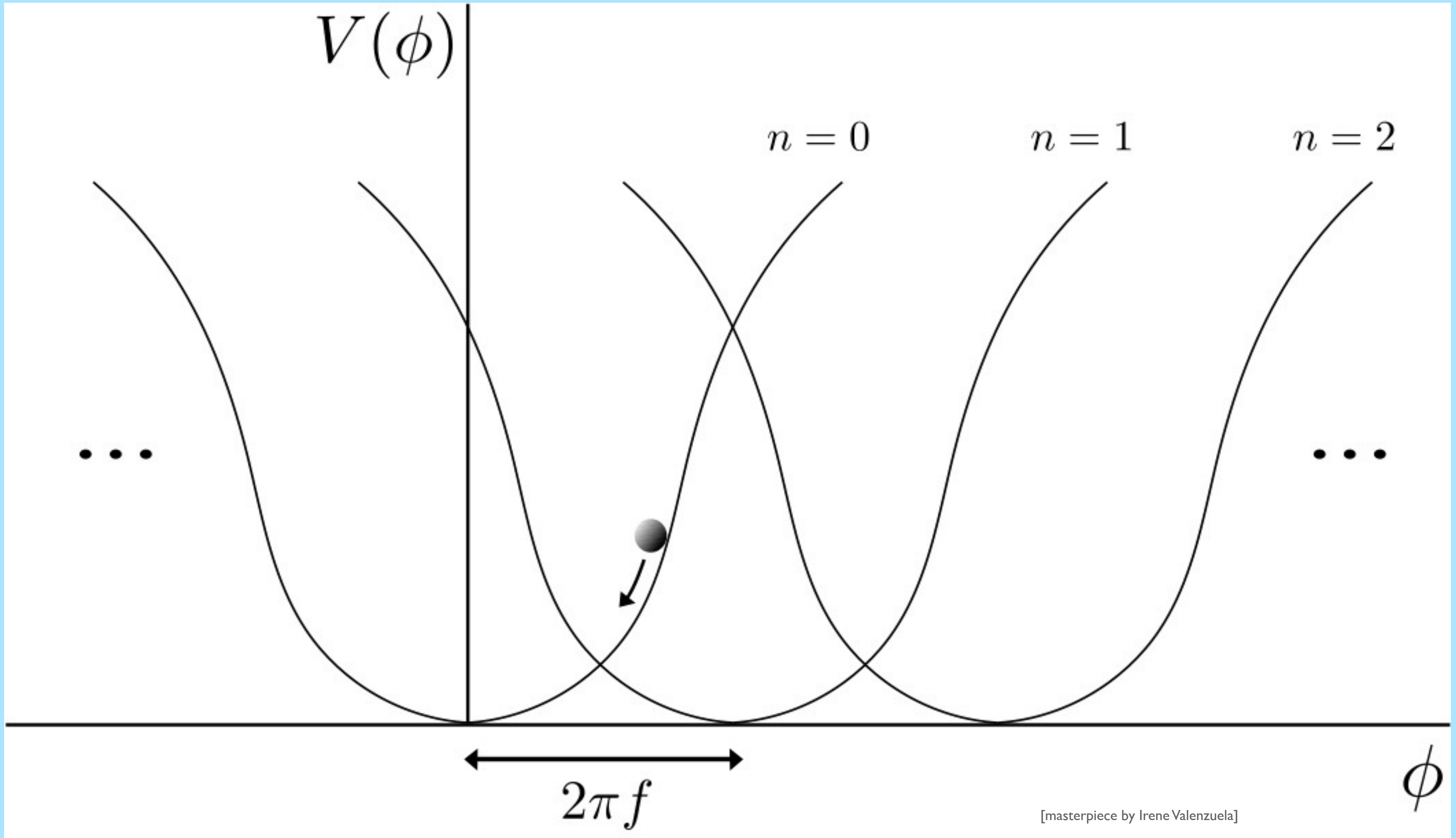
Phenomenological aspects

- ★ Stable AdS vacua with massless axions
- ★ Susy vacua contain tachyons (above BF-bound)
- ★ Non-susy vacua have high susy breaking scale
- ★ Less stable for many complex structure moduli

Applications:

- ★ Axion monodromy inflation
- ★ de Sitter vacua

Axion monodromy inflation



- ★ approach to realise large field inflation
- ★ axionic shift symmetry protects potential

Axion monodromy inflation

- ★ F-term scalar potential as inflation potential
- ★ Fluxes break shift symmetry softly
- ★ Light axion for effective single field inflation
- ★ Our procedure for moduli stabilisation needs a massless axion as starting point

Non-geometric flux-scaling de Sitter vacua

uplift flux-scaling AdS vacua to de Sitter

Problems

- ★ uplift with Anti-D3-branes destabilises flux-scaling AdS vacua
- ★ too few fluxes turned on to get numerical dS vacua
- ★ flux-scaling construction cuts across analytical constructions for dS vacua

So how do we get

Non-geometric flux-scaling de Sitter vacua

?

2 approaches

- ★ add Anti-D3-brane and find new vacua with flux-scaling behaviour
- ★ add D-term generated by geometric and non-geometric fluxes

de Sitter from a non-geometric D-term

$h_{+}^{2,1} \neq 0$

$$V_D = -\frac{M_{\rm Pl}^4}{2}\left[(\mathrm{Im}\,\mathcal{N})^{-1}\right]^{\hat{\lambda}\hat{\sigma}} D_{\hat{\lambda}} D_{\hat{\sigma}}$$

with

$$D_{\hat{\lambda}} = \frac{1}{\mathcal{V}}\left[-r_{\hat{\lambda}}\left(e^{\phi}\mathcal{V} - \tfrac{1}{2}\kappa_{\alpha a b} t^{\alpha} b^{a} b^{b}\right) - q_{\hat{\lambda}}{}^{a}\,\kappa_{a\alpha b} t^{\alpha} b^{b} + f_{\hat{\lambda}\alpha}\, t^{\alpha}\right]$$

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R-flux

de Sitter from a non-geometric D-term

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R-flux

Q-flux

de Sitter from a non-geometric D-term

$h_+^{2,1} \neq 0$

$$V_D = -\frac{M_{\rm Pl}^4}{2}\left[(\mathrm{Im}\,\mathcal{N})^{-1}\right]^{\hat\lambda\hat\sigma} D_{\hat\lambda} D_{\hat\sigma}$$

geometric flux

with

$$D_{\hat\lambda} = \frac{1}{\mathcal{V}}\left[-r_{\hat\lambda}\left(e^{\phi}\mathcal{V} - \tfrac{1}{2}\kappa_{\alpha a b} t^{\alpha} b^a b^b\right) - q_{\hat\lambda}{}^{a}\kappa_{a\alpha b} t^{\alpha} b^b + f_{\hat\lambda\alpha} t^{\alpha}\right]$$

R-flux

Q-flux

de Sitter from an Anti-D3-brane

- ★ same story as with the D-term
- ★ not an uplift of an old AdS vacuum as in KKLT
- ★ add term for Anti-D3-brane in the throat

$$V_{\rm up} = \frac{A}{\mathcal{V}^{\frac{4}{3}}} \frac{M_{\rm Pl}^4}{4\pi}$$

de Sitter vacua which ***could*** perfectly realise inflation

mass hierarchy problem

de Sitter from an Anti-D3-brane

★ same story as with the D-term

not an uplift of an old AdS vacuum as in KKLT

but

new stable de Sitter vacua

★ nilpotent goldstino not enough to capture the Anti-D3-brane

Outlook

★ non-geometric flux compactifications are an interesting toy model

★ tree-level Kahler moduli stabilisation makes

axion monodromy inflation realisable

★ de Sitter vacua

★ hard to justify to integrate out KK- and stringy states

★ stringy origin…… rainbows and unicorns..