On de Sitter string vacua from anti-D3-branes in the Large Volume Scenario

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String Compactification

$$\mathcal{M}_{10d} = \mathbb{R}^{1,3} \times X_{6d}$$

Superstring theory
vs
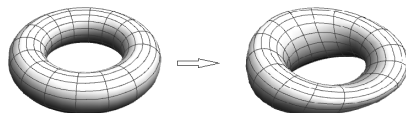**Observations**

$\implies$

$\Downarrow$

Moduli

Moduli
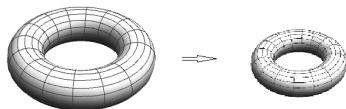
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4d: (Unobserved) massless scalar fields

⇒Moduli Stabilisation

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Geometric deformations of the compact 6d manifold

- Complex structure moduli: Z_α

- Kähler moduli: $T_i = \tau_i + i\theta_i$ **Fluxes**

- axio-dilaton $\leftrightarrow g_s$

4d: (Unobserved) massless scalar fields

$\Rightarrow$Moduli Stabilisation

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Fluxes

Quantum Corrections

- axio-dilaton $\leftrightarrow g_s$
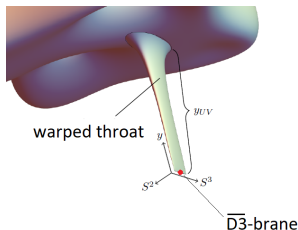
4d: (Unobserved) massless scalar fields

$\Rightarrow$ Moduli Stabilisation

Moduli stabilisation and de Sitter vacua

Moduli stabilisation
(Flux compactification+KKLT/LVS)
vs
Cosmology

$\Rightarrow$

KKLT [ArXiv:hep-th/0301240]

warped throat

y_{UV}

y

S^2 S^3

$\overline{D}3$-brane

(Image from [ArXiv:1902.07724])

Our setup

- anti-D3 on top of O3 → **Nilpotent goldstino** [ArXiv:1507.07556]
- Large Volume Scenario [ArXiv:hep-th/0502058]
- 2 Kähler moduli ($\mathcal{V} = \tau_b^{3/2} - \tau_s^{3/2}$)
- Explicit stabilisation of only one complex structure modulus

Building a concrete example: Constraints

- dS minimum: $V_{min} \gtrsim 0$

- EFT: $g_s \ll 1$; $\mathcal{V} \gg 1$

- Consistency of the 4d description:

$$M_p \gg M_s \gtrsim M_{KK}^{(i)} \gg m_{moduli}, m_{3/2}$$

- SUGRA: $g_s|M| \gg 1$

- D3-charge cancellation: $Q_{D3}^{flux} = MK < |Q_{D3}^{O3/D3/D7}| = 149$

Building a concrete example: small ranges for the moduli

- Positive definite Hessian:

- de Sitter: $V_{min} \gtrsim 0$

$$\tau_s < \tau_s^H(g_s)$$
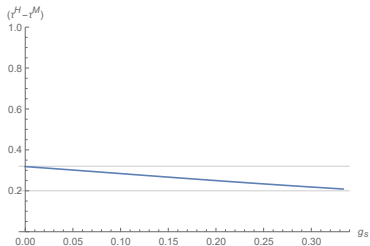
$$\tau_s \gtrsim \tau_s^M(g_s)$$

Building a concrete example: small ranges for the moduli
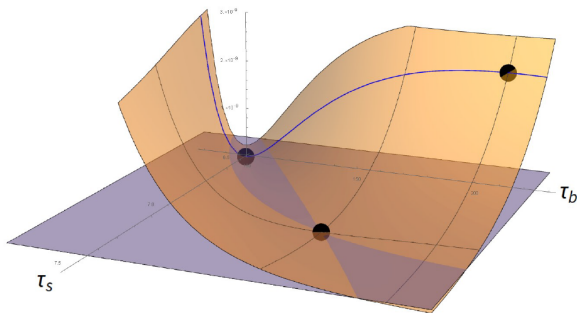
- Positive definite Hessian:

  $$\tau_s < \tau_s^H(g_s)$$

- de Sitter: $V_{min} \gtrsim 0$

  $$\tau_s \gtrsim \tau_s^M(g_s)$$

Explicit model

$\chi = 500$
$W_0 = 5$
$g_s = 0.248$

$\tau_s = 6.4$
$\tau_b = 102$
$\zeta = 3.5 \times 10^{-2}$
$MK = 124$

Conclusions

- Consistency of String theory with observations:
    - Compactification
    - Moduli Stabilisation on a dS minimum

- Not easy (even in a simple model) but not impossible!

- What's next?
    - More realistic models (visible sector, inflation,...)
    - Explicit complex structure moduli stabilisation

Thanks!