

$$\Rightarrow V \sim (M + N \cdot b)^2$$

⁴¹

discrete shift symmetry retained

in:

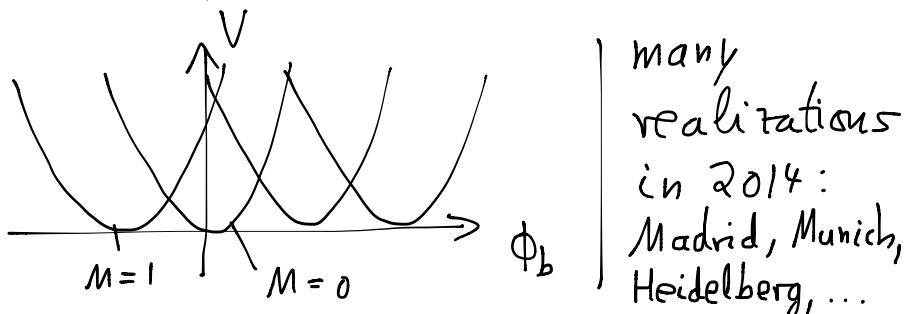
$$b \rightarrow b + 1, M \rightarrow M - N$$



fluxes can only
shift discretely

~ many branches labeled

by flux choice M !



similarly also D-brane sources :
(2008 models)
& work in 2015

e.g. D5-branes :

$$S_{D5} \sim \int d^6 \xi \sqrt{-\det(G + B_2)} \\ \downarrow M_4 \times \Sigma_2 \\ \sim \int d^4 x \sqrt{-g} \sqrt{L_{\Sigma_2}^2 + b^2} \\ \downarrow M_4$$

$$\Rightarrow V \sim b \text{ linear}$$

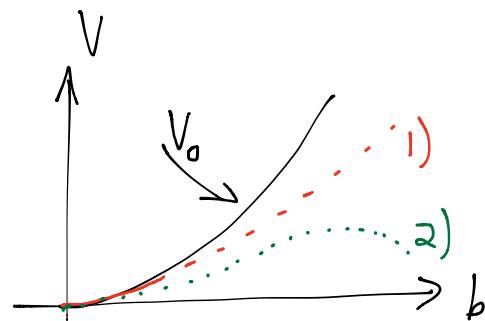
full embedding into string theory:

→ moduli stabilization

⇒ moduli co-evolve & backreact
during inflation driven by b

~ 4D EFT with 4-forms: Kaloper, Lawrence
Sorbo 2008, 2011

\sim flattening of leading-order potential $V_0(b)$: 43



$$1) V_{\text{eff.}}(b) \sim b^p, \quad p < p_0 = 2, 4$$

$$2) V_{\text{eff.}}(b) \sim b^2 - \lambda \cdot b^4, \quad \lambda \ll 1$$

toy example for 1):

$$X_6 = T^2 \times T^2 \times T^2 \quad \text{in } \mathbb{P}B$$

$$b = \int_{T^2} B_2, \quad F_1 \& F_3 - \text{flux}$$

1011.4521
1405.3652

$$|\tilde{F}_5|^2 \geq |F_3 \wedge B_2|^2, \quad |F_1 \wedge B_2 \wedge B_2|^2 \sim b^2, b^4 \quad \boxed{44}$$

F_3 - flux fixes complex structure modulus u of tori T^2

$$\Rightarrow \mathcal{L}_b \sim \frac{1}{L^4} (\partial_\mu b)^2 - u \left(\frac{b}{L^2} \right)^4 + \frac{N_3^2}{u^3}$$

$$\text{integrate out } u: \quad u = u(b) \sim \frac{L^2}{b}$$

$$\Rightarrow V_{\text{eff.}}(\phi_b) \sim \phi_b^3 \quad \text{not } \phi_b^4$$

toy example for 2):

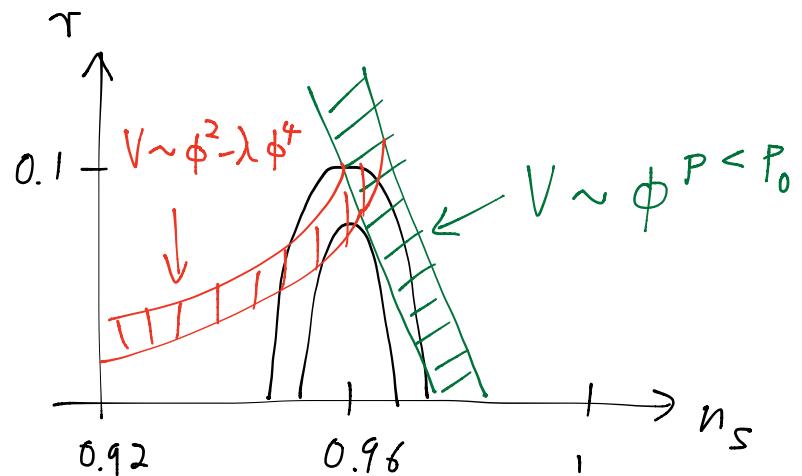
1404.3711
1501.05812

$$V(\phi, L) \sim \frac{A}{L^{12}} - \frac{B e^{-\alpha L^4}}{L^8} + \frac{C \cdot \phi^2}{L^{12}}$$

$$\Rightarrow L^4(\phi) = L_o^4 + f L^4(\phi)$$

45

$$\Rightarrow V(\phi) \sim m^2 \phi^2 - \lambda \phi^4$$



$\Rightarrow \left\{ \begin{array}{l} \text{maybe discriminate model} \\ \text{classes? future data?} \end{array} \right.$