Anti-brane backreaction :

the ugly and non-existent solutions

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1. Anti-brane backreaction in simple setups

Arxiv: 1009.1877, 1105.4879, 1111.2605

Uppsala : Johan Blaback, Ulf Danielsson
Hannover : Daniel Junghans, Marco Zagermann
Cornell : Timm Wrase

Susy and extremal flux solutions in string theory

1. Compact : GKP (2001), back reacted O3 plane solutions
2. Non-compact: KS (2001), dissolved D3 and fractional D5

$$dF_5 = H \wedge F_3 + Q_3\delta$$

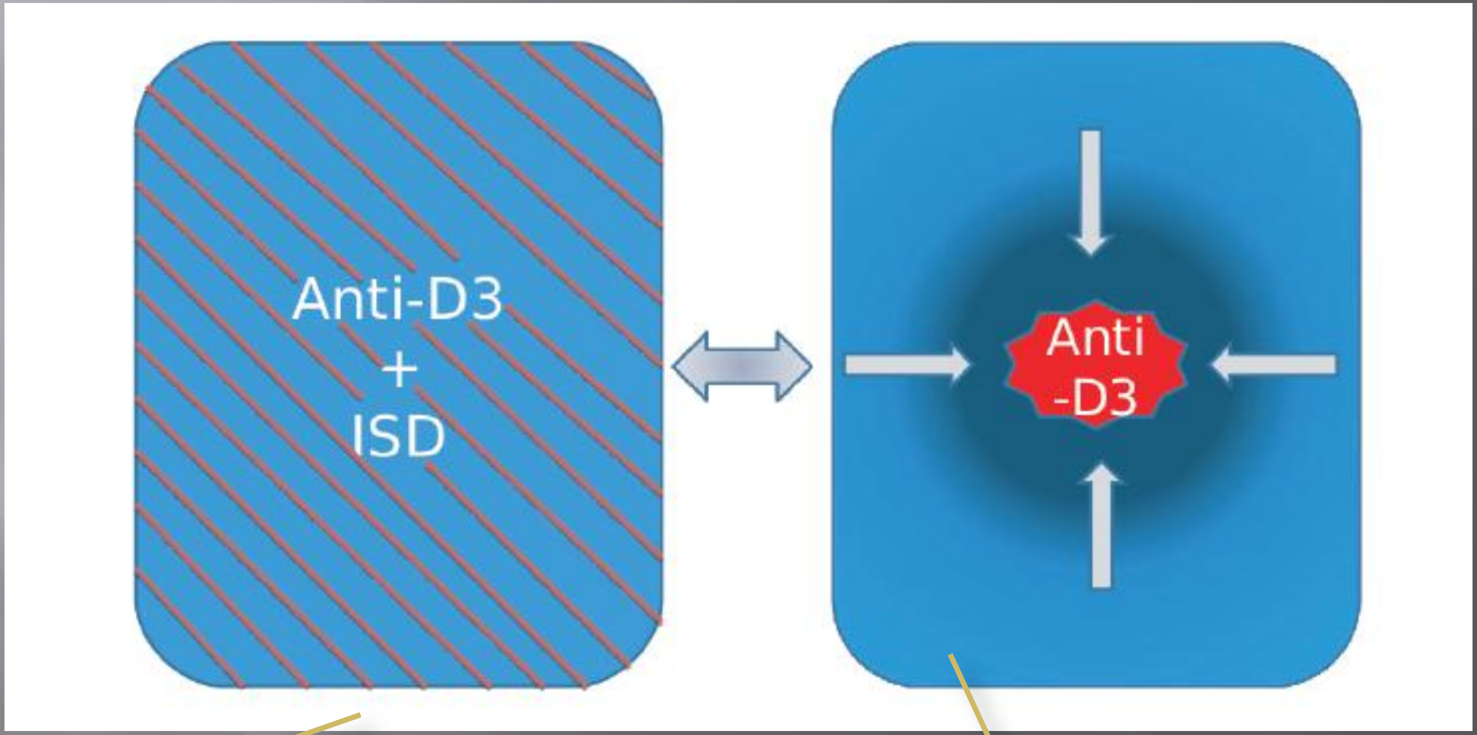
Flux acts as charge density:
ISD = positive charge
IASD = negative charge

Genuine, localised charge density

Why extremal? ➔ Balance of forces.
ISD-flux acts as smeared D3 cloud

. ``Warping solves itself and doesnt affect the moduli-vevs ´´

Add localised anti-D3 branes: KPV,   KKLT. Balance is lost? Only-time dependent solution?



Effectively = KKLT computation

BGH & related work

→ Scape-zilla reasoning: no de Sitter landscape in string theory! More predictive power?

…..HOLD ON: there is another force counter-acting againts the sucking up force:

``flux densities want to smoothen out dynamically and do not like to be pilled up´´

$$ENERGY = \int F^2$$

Our idea: ``Life gets simpler in higher dimensions´´.

$$dF_{8-p} = H \wedge F_{6-p} + Q_p\delta$$

- p=6 is simplest.
- BPS’ness can be broken by changing the O6 for a anti-D6 and solution becomes AdS_7 X S3 when anti-D6 smeared.
- *Does it exist localised?*

Our computations:

- No solution for smooth source profiles, but the solution with constant source profile. Why? For the BPS solution ANY profile works.

- The only possible solution has infinite H-flux density at the anti-D6?

Comparison to anti-D3 back reaction in KKLT & KS

1. Difference: we do not break susy perturbatively. Open string effects probably wash away the solution immediately.

2. Similarity: Gravitational physics is the same: anti Dp inserted in flux cloud of opposite charge.

3. BGH & related also have IR singularities. See Stefano’s talk. We have the same without approximations .

What is next? IR singularity is evil?

1. YES! ☺ The IR singularity can be interpreted as a lack of a balance of forces and the true solution is time-dependent [similar to Dvali et al 2002]. Landscape is no dS landscape?

2. NO! ☹ The IR singularity is simply due to the instability against puffing up a fuzzy 5-brane. The landscape is safe.

2. Backreaction in domain wall space-times and WEFT

Uppsala : Johan Blaback,
CEA-Saclay: Bert Vercnocke

Relevant overlap with papers of Martucci et al.

- Obervation :GKP solutions: moduli values are the same for any O3 profile: related to BPS'ness.

- Question: Does this extend to BPS solutions that are more complicated than the no-scale vacua?

- Idea: Let the moduli flow in BPS and non-BPS ways and check whether moduli for the smeared O3 change when O3 gets localised.

Flowing scalars? → *domain wall* solutions

$$\mathrm{d}s^2_{p+1} = d(z)^2\mathrm{d}s^2_p + c(z)^2\mathrm{d}z^2\,,$$

5-branes wrapping 3-cycles in CY-orientifold :

O3	X|	X	X	X	-	-	-	-	-	-
D5	X|	X	X	-	X	X	X	-	-	-

DW space-time

CY6

Domain walls in p+1 no-scale models = Op/D(p+2) intersection with D(p+2) wrapping a 3-cycle in (9-p)-dimensional compact space.

1. SMEARED Op: domain wall flow equations solve 10D equations

$$\begin{aligned} \dot{\Phi}^I &= -cG^{IJ}\partial_J W(\Phi)\,, \\ \frac{\dot{d}}{d} &= \frac{1}{2(p-1)}cW(\Phi)\,. \end{aligned}$$

2. LOCALISED Op: Nontrivial warp factor depending on external coordinates as well → solutions ? …….. Janssen-Meesen-Ortin (1999)

Conjecture I: for BPS and fake BPS domain walls the moduli flow is ***independent*** of the orientifold source profile. For non-BPS domain walls it is different.

Conjecture II: Warped effective field theory is NOT a supergravity theory

→ Conjecture I restricts the possible warping changes to super and Kahler potential.
→For orientifolds in N>2 compactifications or orientifolds in higher dimensions there is NO room in the SUGRA action for warping corrections.

Then how does the Wilsonian EFT break SUSY?

THE END

KPV explain what happens at open string level:

1. Perturbative: instability towards puffing up NS5 brane
2. Non-perturbative: meta-stable wrt brane/flux anihilation if small amount of anti-D3 branes.

→ KKLT reasoning: … Hence if small number of anti-D3 we can uplift AdS to meta-stable dS …

Brane wants to eat flux at the classical closed string level?

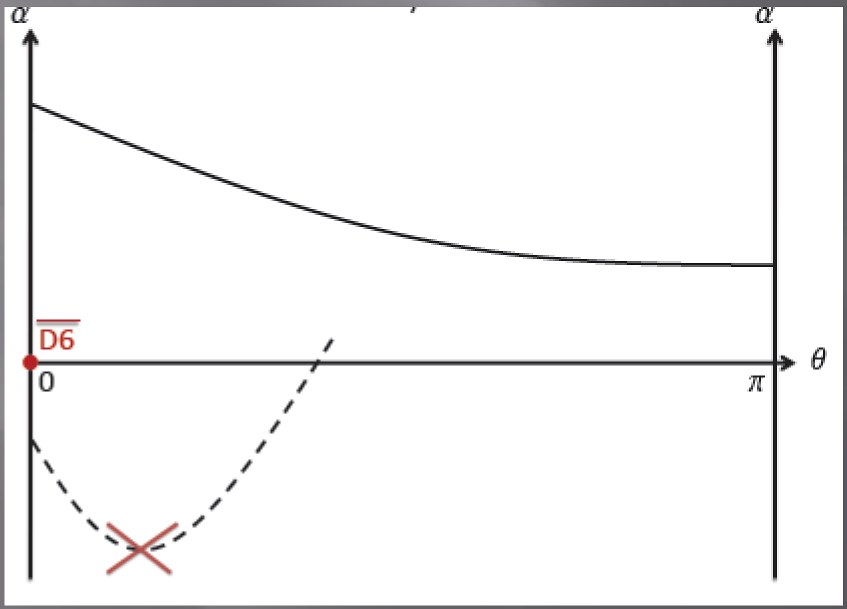
$$\tilde{\nabla}^2(e^{4A}-\alpha) = \frac{e^{2A}}{6\,\mathrm{Im}\,\tau}\left|iG_{(3)} - *_6 G_{(3)}\right|^2 + e^{-6A}|\partial(e^{4A}-\alpha)|^2 + 2\kappa_{10}{}^2 e^{2A}\left[\frac{1}{4}(T^m_m - T^\mu_\mu)^{\mathrm{loc}} - T_3\rho_3^{\mathrm{loc}}\right]$$

STEP 2. Solve full EOM near the anti-D6 to understand boundary conditions. Only 2 solutions:

1 Solution locally BPS near the anti-D6: finite IASD flux.

2. Solution has singular ISD flux near anti-D6 (consistent with intuition).

Solution 1 = exluded globally due to STEP 1 :



Derivation proceeds in two steps

STEP 1 : Flux cloud cannot easily interchange from IASD flux to ISD flux. Intuitively clear & technically elegant:

$$H = \lambda F_0 \mathrm{e}^{\frac{7}{4}\phi} \star_3 1\,,$$

$$F_2 = \mathrm{e}^{-\frac{3}{2}\phi-7A} \star_3 \mathrm{d}\alpha\,,$$

$$\xrightarrow{\text{H-EOM}} \quad \boxed{\alpha = \mathrm{e}^{\frac{3}{4}\phi+7A}\lambda\,,}$$

Sign alpha
= flux type!

$$\xrightarrow{\text{F2 Bianchi}} \quad \boxed{\frac{\left(\mathrm{e}^{-\frac{3}{2}\phi-7A+B}\sin^2\theta\right)'}{\mathrm{e}^{3B}\sin^2\theta}\alpha' + \mathrm{e}^{-\frac{3}{2}\phi-7A-2B}\alpha'' = \alpha\mathrm{e}^{\phi-7A}F_0^2\,.}$$

Hence, if

$$\boxed{\alpha' = 0} \longrightarrow \boxed{\operatorname{sgn}\alpha'' = \operatorname{sgn}\alpha.}$$