Backreaction of SUSY-breaking branes

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T. Wrase and M. Zagermann

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Outline

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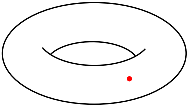
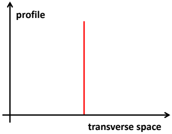
Localised sources

- Localised sources (D-branes, O-planes) are important ingredients in string theory/supergravity compactifications:
  SUSY breaking, tadpole cancelation, dS uplifts, ...

e.g. Kachru, Kallosh, Line, Trivedi 03; Douglas, Kallosh 10





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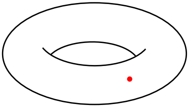

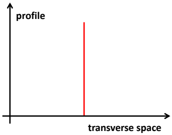

- Equations of motion (Einstein, dilaton, RR fields) include delta functions:

$$S_{\mathrm{loc}} = \mu_p \mathrm{e}^{\frac{p-3}{4}\phi} \int \mathrm{d}^{10}x \sqrt{g}\,\delta^{(9-p)}(x) - \mu_p \int C_{p+1} \wedge \delta^{(9-p)}$$

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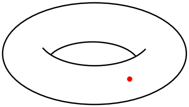

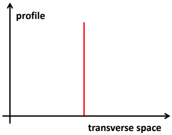

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Usually hard to solve!

Smearing

- Common trick: take 'smeared limit' as approximation, i.e. simplify computations by assuming

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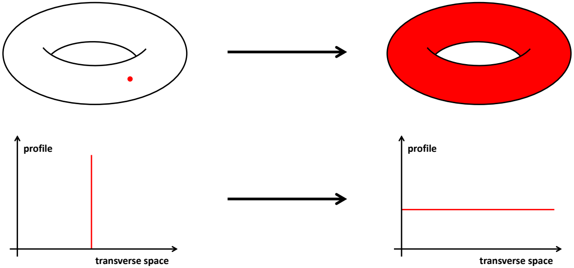

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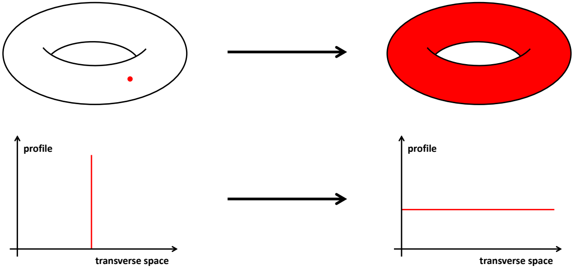

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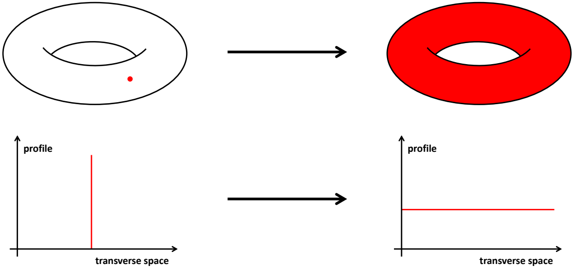

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Easier!

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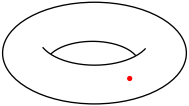
- Example: compactifications down to $p+1$ dimensions with spacetime-filling (anti-) Op-planes, fluxes and Ricci-flat internal space



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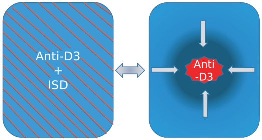

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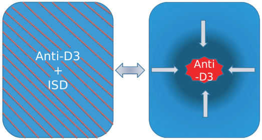

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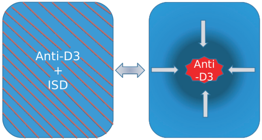

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Smearing justified in non-BPS setups?

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Blåbäck, Danielsson, DJ, Van Riet, Wrase, Zagermann 11

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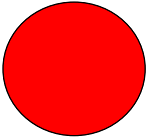

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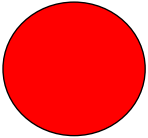

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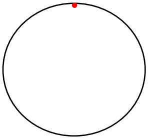
Is there also a localised solution?

Ansatz

- Now consider our setup with localised sources



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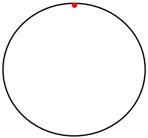

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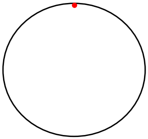

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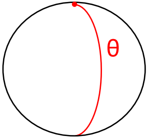
- Most general ansatz compatible with symmetries: warped AdS times a conformal sphere, i.e.

$$\mathrm{d}s^2 = \mathrm{e}^{2A}\mathrm{d}s_7^2 + \mathrm{e}^{2B}\mathrm{d}s_3^2,$$

and (a priori) arbitrary

$$\phi, F_0, F_2, H$$

- Further simplify problem: form eoms demand F_0 to be constant and determine F_2 and H up to an unknown function α, spherical symmetry demands eoms to only depend on 1 angle θ



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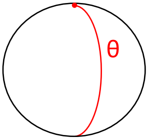

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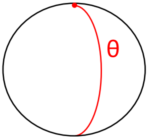

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Seems tractable...

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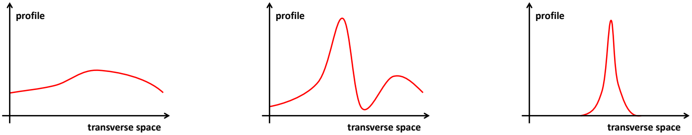
Warmup: regularised sources

- Assume smooth source profile of any shape:



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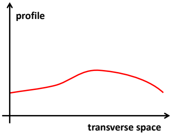

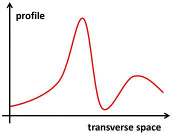

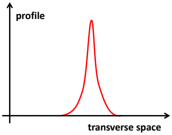

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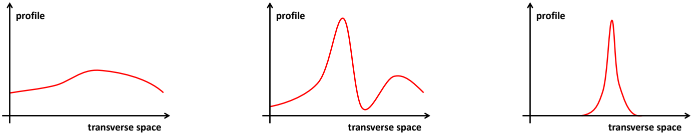

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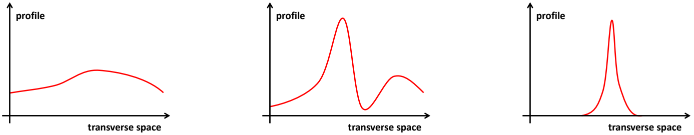

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Last resort: genuine delta profiles...

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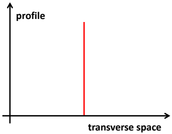

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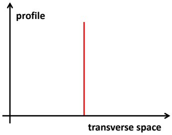

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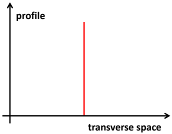

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- Expand (possibly divergent) functions around the source and solve eoms locally to find strong restriction:

1. standard 'flat space' bc: flux/source are BPS near source

cf. Janssen, Meessen, Ortín 99

2. 'unusual' bc: flux/source not BPS, H has divergent energy density

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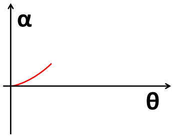

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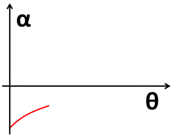

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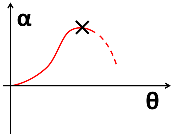

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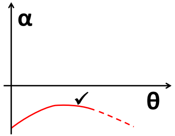

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- However: no obvious interpretation of H-singularity! Can this be resolved in full string theory? Or is solution unphysical?
- Closely related problem debated in the literature: put anti-D3-branes into Klebanov-Strassler throats (KKLT!), same singularity will show up

Klebanov, Strassler 00; Kachru, Pearson, Verlinde 02

Kachru, Kallosh, Line, Trivedi 03

Bena, Graña, Halmagyi 09

Bena, Giecold, Graña, Halmagyi, Massai 11

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- Myers effect: in presence of fluxes, branes clump together into higher-dimensional brane

  Myers 99; Kachru, Pearson, Verlinde 02

  DJ, Wrase, Zagermann (in progress)

Several suggestions...

- Singularity is due to partial smearing of the branes (excluded in our analysis!)

  Bena, Graña, Halmagyi 09

- Singularity is due to linear perturbation around BPS background (excluded in our analysis!)

  Dymarsky 11

- Solution does not exist, true solution is time-dependent

  Blåbäck, Danielsson, Van Riet 12

- Myers effect: in presence of fluxes, branes clump together into higher-dimensional brane

  Myers 99; Kachru, Pearson, Verlinde 02

  DJ, Wrase, Zagermann (in progress)

Fate of backreacted solution unclear...

Outline

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Thank you!