

Metastable SUSY breaking in supergravity and string theory

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Phenomenology

Requirements for string constructions:

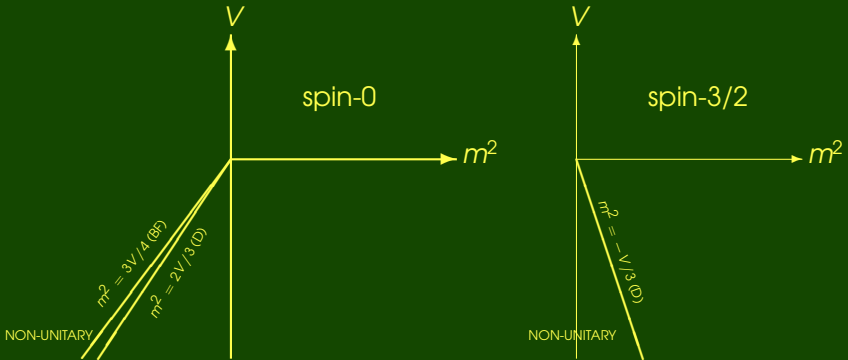
- Moduli stabilisation
- Broken SUSY
- Small but positive CC
- Inflation in very early universe

All governed by scalar potential of effective field theory!

If compactification preserves SUSY: 4D supergravity theory.
What do the different scalar potentials allow for?

Are there any non-SUSY vacua?

Stability



Possible to attain stability in the case of broken SUSY?

Examples

All known dS solutions of $N \geq 4$ supergravity are unstable.

Only in $N \leq 2$ we know how to build scalar potentials with stable non-SUSY dS solutions¹.

Surprisingly, $N \geq 4$ does allow for non-SUSY AdS vacua²!

Can one say something completely general about this, independent of examples? (i.e. avoid proof by lack of imagination...)

Yes we can!

¹ (Fre, Trigiante, Van Proeyen '02, D.R. , Rosseel '09)

² (Fischbacher, Pilch, Warner '10, Dibitetto, Guarino, D.R. '11)

Non-SUSY critical points

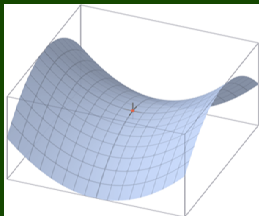
Focus on particular scalar direction defined by SUSY breaking¹:

Gravitino becomes massive by eating some spin-1/2 field

⇒ defines would-be Goldstino direction

⇒ defines sGoldstino direction

Particular multiplet that would be massless in SUSY case!



¹(Gomez-Reino, Scrucca '06,...)

Extended supergravity

Extended supergravity has N gravitini and therefore N^2 sGoldstini:

$$\square \otimes \square = \square \oplus \square$$

- sGoldstini in the antisymm correspond to gauge transformations of gravity multiplet,
- sGoldstini in the symm correspond to physical scalars.

No stable dS for $N = 2$ and $N = 4$ without vector multiplets¹!

What about $N < 8$: no vector multiplets, SUSY mass terms and D-terms - possible to rule out stable dS?

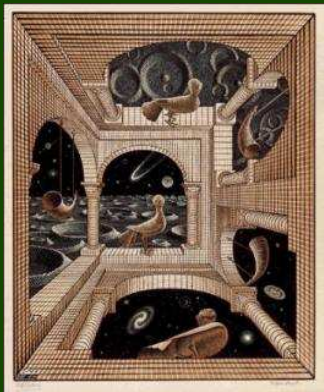
So far true for dS from SUSY Minkowski²!!

¹ (Gomez-Reino, Louis, Scrucca '08, Borghese, D.R. '10)

² (Borghese, Linares, D.R. - in progress)

Conclusions

- Which supergravity theories allow for dS vacua?
- Only examples in $N \leq 2$ with "bells and whistles"
- No known examples in $N \geq 4$
- sGoldstini are key to say something general.
- Fails to prove absence of stable dS in $N = 4$ - but looks very promising for $N = 8$!
- What about slow-roll inflation?
- Surprise: non-supersymmetric and stable AdS in $N \geq 4$.
- Role in condensed matter / flux compactifications?



Thanks for your attention!