Compactifications, Supergravity and Black Holes

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Overview over my work

If you are interested in more details, come and talk to me!

My research interests

String theory → (gauged) supergravity

Compactification on certain geometries

- Spontaneous partial supersymmetry breaking and moduli spaces
- Hidden supersymmetries in string compactifications
- Black holes and their microstates in string theory

String Compactifications and Supersymmetry

Useful tool to understand string theory backgrounds:

Supersymmetry restricts the (quantum) behavior of string backgrounds (to some extend even true if spont. broken)

When can we find hidden (i.e. spont. broken) supersymmetry for certain backgrounds?

Can we thereby understand the quantum behavior of string backgrounds better?

Toy model: Can we find additional, "hidden" supersymmetries in supersymmetric backgrounds?

Spontaneous partial supersymmetry breaking (for Minkowski vacua in supergravity)

- No-go theorem: "Two into one won't go"

  Cecotti, Girardello, Porrati '84;

- Some counter examples were constructed, but the general picture remained unclear

  Ferrara, Girardello, Porrati '95;
  Fre, Girardello, Pesando, Trigiante '96

- In globally supersymmetric theories, $\boldsymbol{N=2}$ to $\boldsymbol{N=1}$ is possible if electric and magnetic FI-terms are present

  Antoniadis, Partouche, Taylor '95

- Spontaneous $\boldsymbol{N=2}$ to $\boldsymbol{N=1}$ is generally possible if both electric and magnetic gaugings are present in supergravity

  Louis, Smyth, HT '09

- Similar story for AdS vacua $(\boldsymbol{\Lambda<0})$

Moduli spaces of supergravities

- Massless scalars are coordinates on certain non-trivial geometry (depending on amount of supersymmetry)

Kinetic term of massless scalars:

$$S = \frac{1}{2}\int g_{ij}(\phi)\mathbf{d}\phi^i \wedge \mathbf{d}\phi^j + \ \dots$$

metric of moduli space

- Relation established between $N = 2$ and $N = 1$ moduli spaces

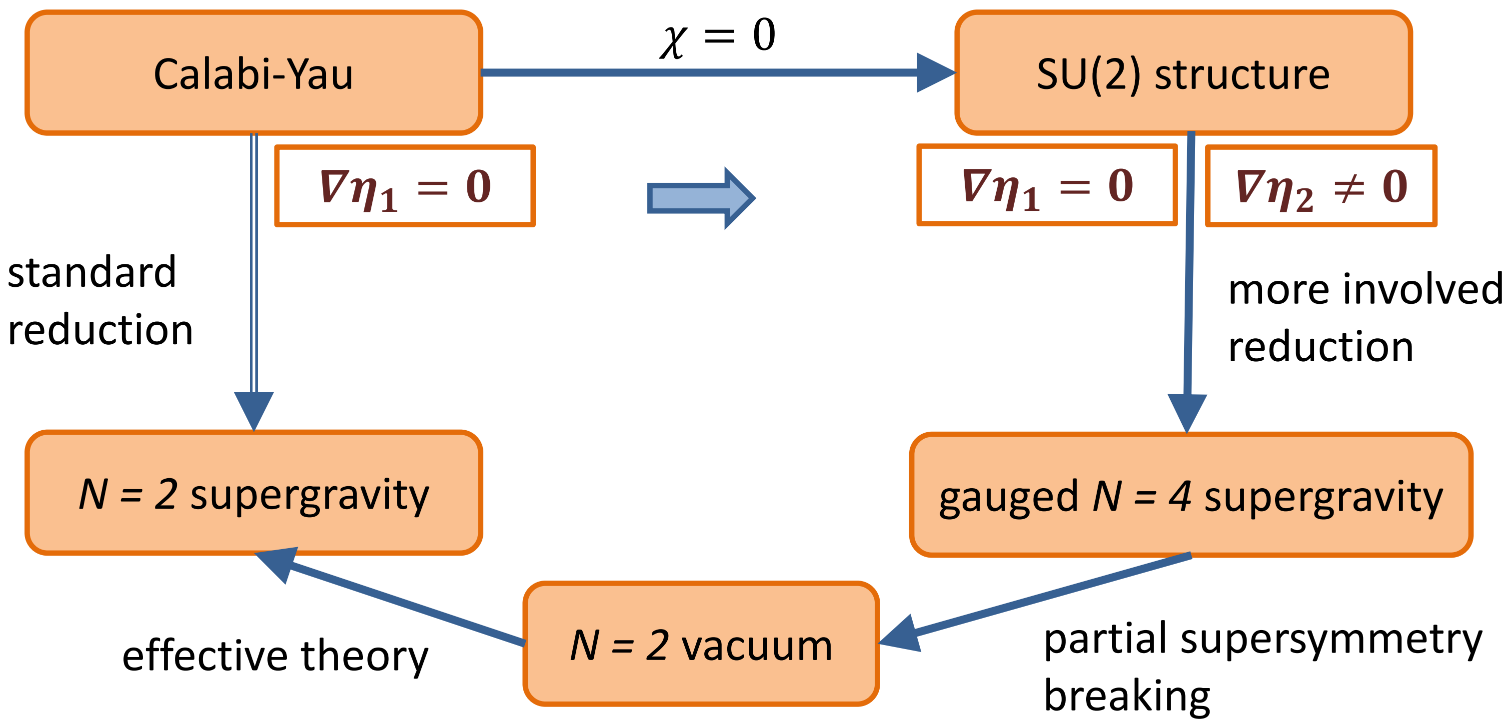
Louis, Smyth, HT '10; Cortés, Louis, Smyth, HT '11

- Work in progress: Moduli spaces of $N = 2$ and $N = 1$ AdS vacua in supergravity

De Alwis, Louis, McAllister, HT, Westphal: to appear soon

Hidden supersymmetries in string compactifications

Kashani-Poor, Minasian, HT '13



- Helps to understand quantum corrections of CY spaces better
- Work in progress: Similar arguments for other string compactifications (e.g. G_2 manifolds)

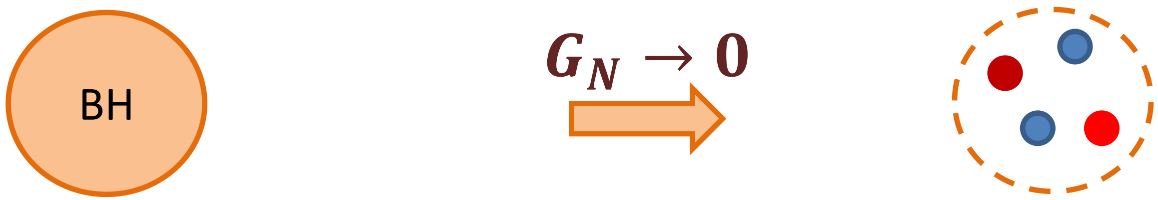
Kashani-Poor, Minasian, HT
work in progress

Black holes and their stringy microstates

- Understand black holes as thermodynamical objects:

  Explain entropy $S \sim A$ microscopically

- In string theory:



(supersymmetric) black hole
(in Minkowski spacetime)

D-brane bound state

- Counting the number of D-brane microstates N with correct charges gives the entropy:

$$S = \log(N)$$

Sen '95;
Strominger, Vafa '96

AdS black holes in string theory

- Large supersymmetric AdS black holes exist in 5d supergravity

Gutowski, Reall '06

  - BH in curved background
  - Interesting for AdS/CFT

- Uplift to string theory:

Stack of D3-branes in
Sasaki-Einstein geometry

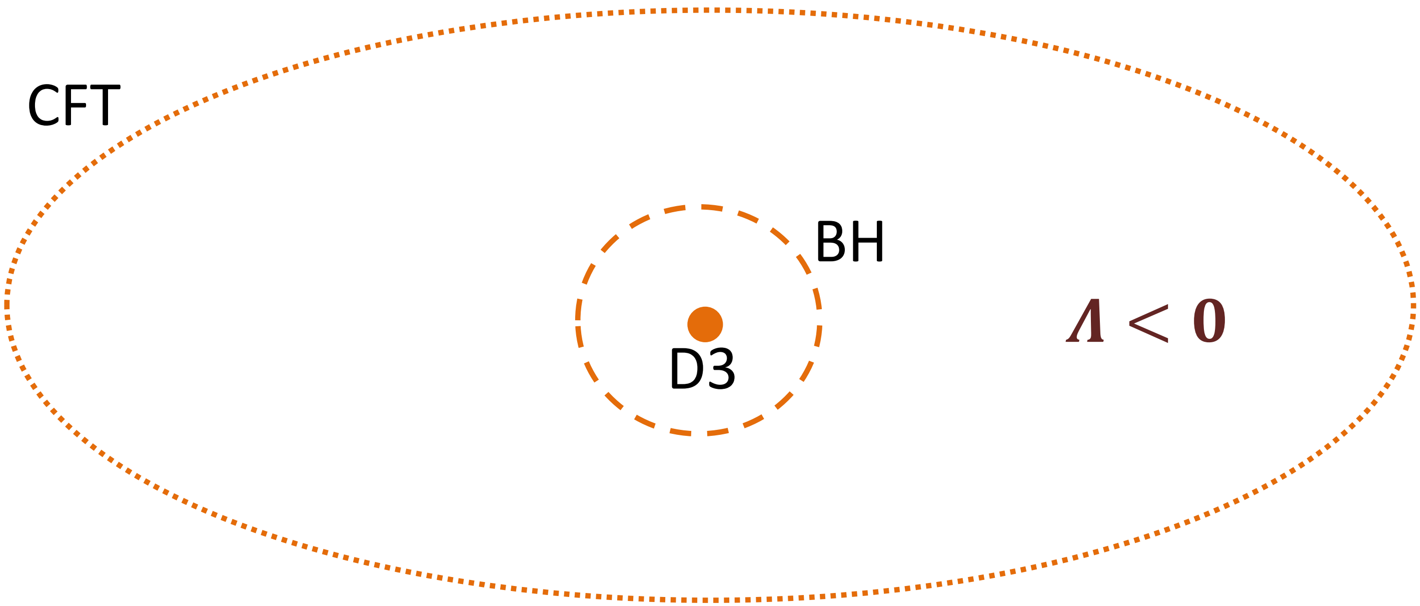
Bah, Bena, HT, Vercnocke
work in progress

Can we count microstates?

AdS black holes in string theory

- Two different types of field theory descriptions:

Bah, Bena, HT, Vercnocke
work in progress



- ➢ boundary CFT on $R^1 \times S^3$
- ➢ D3 worldvolume theory on $R^1 \times \overline{S}^3$

Relation?