Dynamical determination of compactification parameters

GrahamFest 2011

G.G. Ross, Z. Lalak,
C. Muñoz, J.A.C.
1990

Thanks !!

for such a wonderful idea

GrahamFest

Oxford
29 & 30 September 2011

Programme
Friday 30 September

The day begins at 9am

09:00-09:10 Welcome by Chairman of Phyics

09:10-09:20 Reading out of messages

09:20-09:40 John Ellis (King's College London): *Sniffing out the gluon*

09:40-10:00 Mike Pennington (Jefferson Lab): *Roads to freedom*

10:00-10:20 Keith Ellis (Fermilab): *Perturbation theory and the parton Model in QCD*

10:20-10:40 Alan Barr (Oxford): *Invisible partciles at the LHC*

10:40-11:15 Break

11:15-11:35 Bob Jaffe (MIT): *Encounters with Voodoo QCD*

Generosity

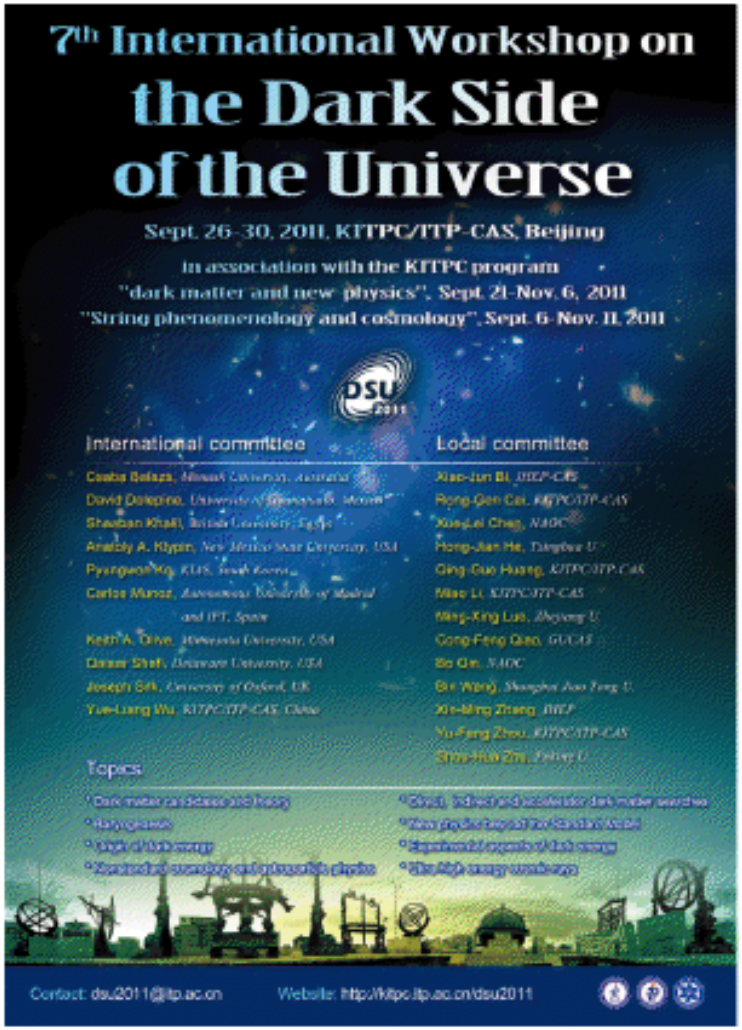
80's

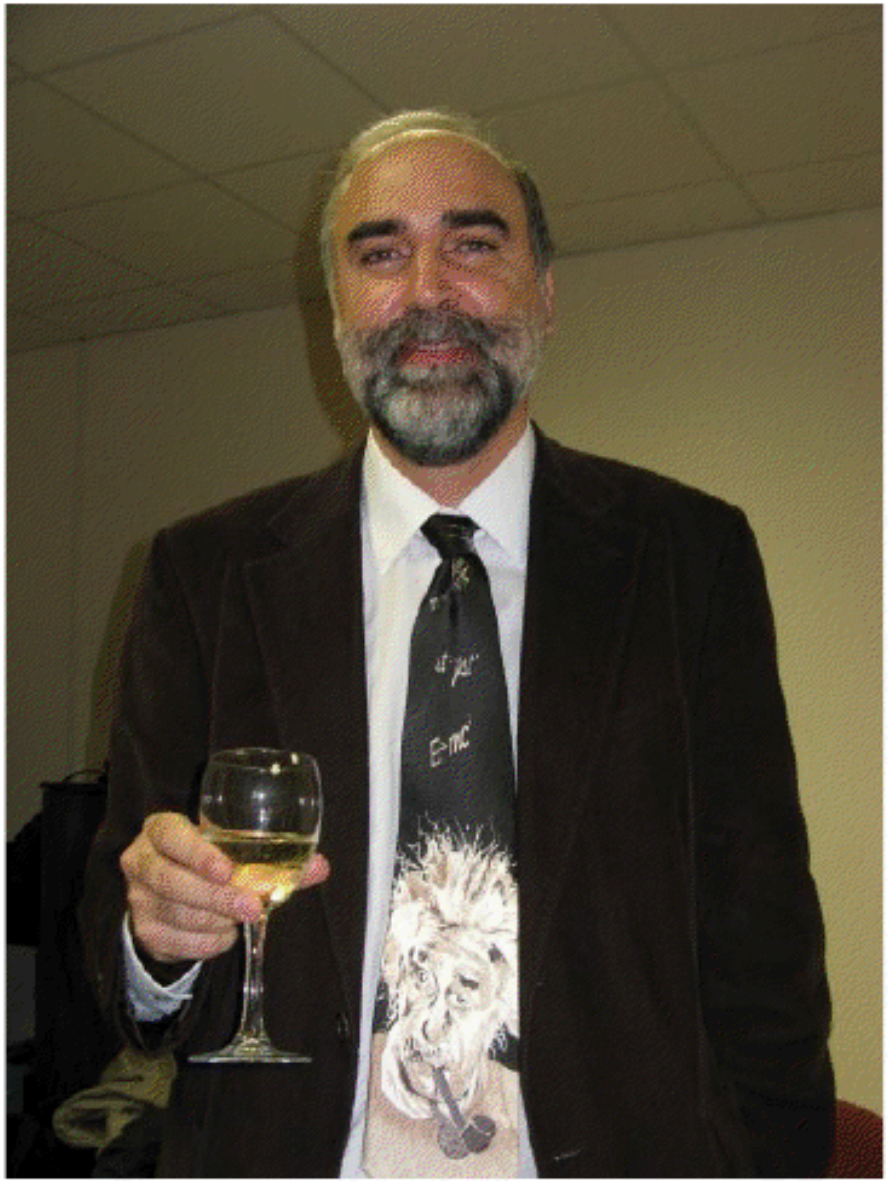
F. del Aguila
L. Ibáñez
J.A.C.
C. Muñoz

90's

B. de Carlos
A. Ibarra

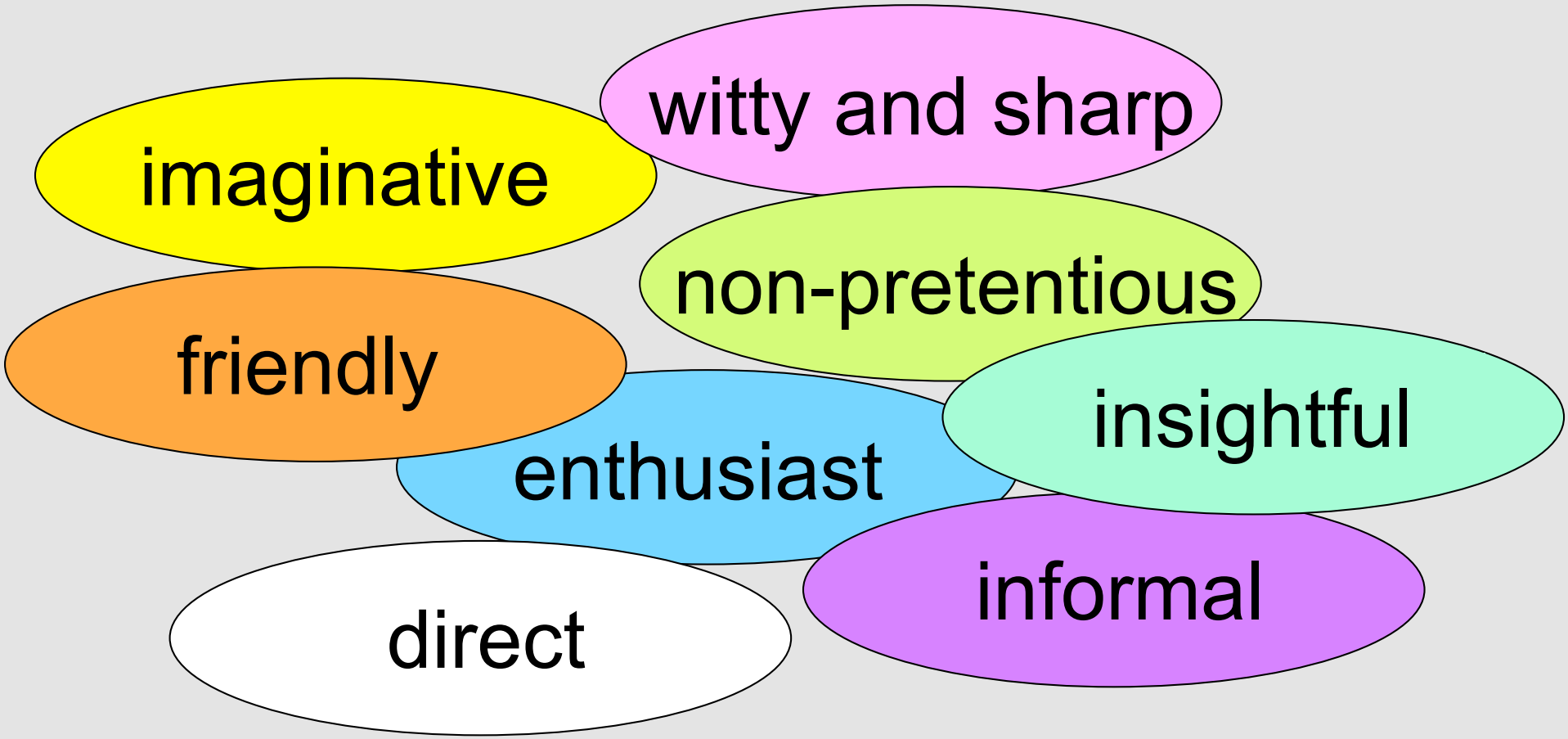
Dear Graham,
from the Dark Side of the Universe, in China,



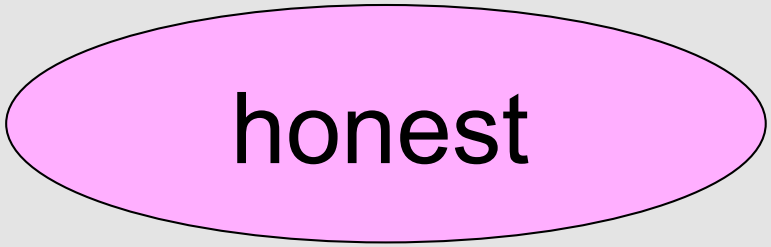


As you can check, I am also celebrating appropriately the "GrahamFest".
Many regards, and happy new life!!

Graham's style of doing research



Graham's style of doing research



Those were the days...


Thanks a lot Graham!

Dynamical determination of compactification parameters

Collaboration with Graham,
Z. Lalak and C. Muñoz 1990

"Historical" context (circa 1990)

★ Paradigm ≡ Heterotic String

★ Problems:

- No mechanism of SUSY breaking at the correct (~ E.W.) scale

- No mechanism to fix the dilaton, S (~ g^{-1} at M_P), neither the moduli

★ General believe: the physical vacuum should be "selected" dinamically

Existing mechanisms of SUSY breaking:

- **VEV for the antisymmetric tensor field:** $\langle H \rangle$

- **Gaugino Condensation:**

$$\langle S\ \lambda\lambda \rangle \ \sim \ M^3 e^{-(3S/2b_0)} \ \equiv \ f(S) \ \in \ W$$

Both problematic

Our Work

First we showed that for any superpotential of the form

$$W = f(S) + W_T$$

trilinear in the matter fields

any SUSY breaking minimum must fulfill some conditions, like:

$$\mathrm{Re}(S) < (1+\sqrt{3}) \left| \frac{f(S)}{f'(S)} \right|$$

This is completely general, i.e. it does not depend on the explicit form of f(S). These conditions are very powerful.

Second, we showed that, when applied to one gaugino condensate, there is no realistic minimum, independently of the explicit form of W_T.

$$\mathrm{Re}(S) \; < \; \frac{7}{18}\, b_0$$

(far too large gauge coupling)

Interesting, but frustrating....

why just one condensate?

Third, we showed that, when applied to several (e.g. 2) gaugino condensates, there can arise a realistic minimum ($g_{GUT} \sim 2$), depending on the gauge groups involved and the matter content associated.

Moreover:

- At the same time, $m_{3/2}$ can get a realistic value ~ TeV

- The moduli, which appear in the Yukawa couplings, get also stabilized.

- The presence of (hidden) matter is crucial.

- We illustrated all these points with examples in the Z_3 orbifold.

After sending the paper we discovered that the idea of multiple gaugino condensation had just been proposed by Dixon, Kaplunovsky and Peskin in a conference.

Then, all of us discovered that the idea of several condensates had been proposed before by Krasnikov.

However, he did not considered matter. As a result he found it impossible to stabilize the dilaton at a realistic value and to get the correct amount of SUSY breaking, corroborating our results.

Later, our formulation was refined by making it T-dual invariant. However our basic results were correct and have remained.

The mechanism was later called "racetrack mechanism" and has been used in many papers

Remarks on the racetrack scheme

Racetrack models in theories from extra dimensions.

Building a better racetrack.

Racetrack inflation.

Moduli-mixing racetrack model.

Inflation in a refined racetrack.

D-term Uplifted Racetrack Inflation.

Patterns of supersymmetry breaking in (...) racetrack models.

..... etc.

Congratulations, Graham!