

PERSPECTIVES

STRINGS 2007
MADRID



DAVID GROSS

Kavli Institute
for
Theoretical
Physics





"It's all string theory to me."

HARVEY'S PLACE

TONITE 5-8
IS STRING
THEORY
BULLSHIT?

10:00
8:00





String Theory

AN INTRODUCTION TO THE PHYSICS OF
SUPERSTRINGS AND M
THEORY

BY
JOHN H. SCHUBERT
AND
MARTIN J. STRASSER



Strong/Weak Interpolation in the Spectrum of AdS/CFT

Niklas Beisert

MPI für Gravitationsphysik
Albert-Ludwigs-Institut
Potsdam, Germany

Strings 2007
Madrid, July 26, 2007

Work by NB, Eden, Herrmann, Lopatev, McLoughlin, Roiban, Staudacher.
References: hep-th/0610044, hep-th/0701002, hep-th/0701032

World-sheet Scattering in $AdS_5 \times S^5$

T.Klose, T.McLoughlin, R.Roiban, K.Zarembo
T.Klose, K.Zarembo, hep-th/0701240
T.Klose, T.McLoughlin, J.Minahan, K.Zarembo, hep-th/07043891

Strings 2007, Madrid, 26.06.07

$N=4$ SUSYM

Super Yang Mills scattering
amplitudes at strong coupling

Juan Maldacena

Strings 2007, Madrid

Based on L. Alday & JM arXiv:0705.0303 [hep-th]

Baryons from Instantons in holographic QCD

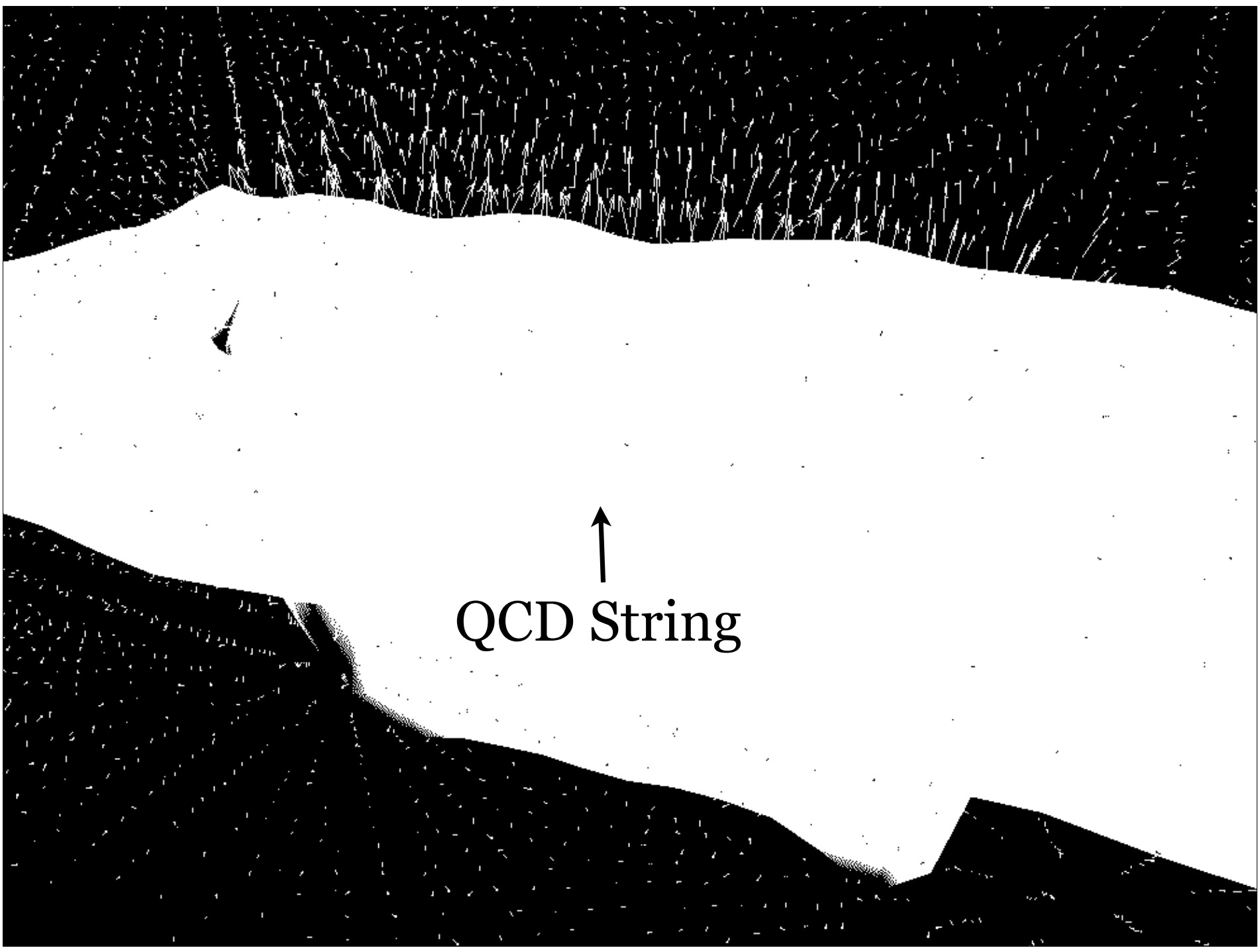
Shigeki Sugimoto (Nagoya Univ.)

Based on) H.Hata, T.Sakai, S.S and S.Yamato
hep-th/0701280

T.Sakai and S.S.
hep-th/0412141, hep-th/0507073

See also) D.Hong, M.Rho, H.Yee and P.Yi
hep-th/0701276, arXiv:0705.2632

Strings 2007 @ Madrid, Spain June 25-29, 2007



QCD String

APPLICATIONS OF

STRING THEORY



David M. ...
University of California, Santa Barbara

Jose L. F. Barbon
Jordan L. Howe
Hoyos
Shing-Tung Kobayashi
Martín Kruczenski
Shuji Matsuura
Robert C. Myers
Leonardo R. Motl
Rowan T. Thomas
David J. Winters

Hiroshi Ooguri

Urs Achim Wiedemann
CERN PH-TH Department
28 June 2007

TO QCD &

CONDENSED

Pavel Kovtun (KITP), C. Savory, Barbara

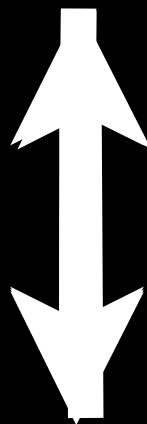
with C. Herzog (U. Washington)
S. Sachdev (Harvard)
D. Son (U. Washington)
S. Hartnoll (KITP)

MATTER

Soo-Jong Rey
Seoul National Univ. Korea

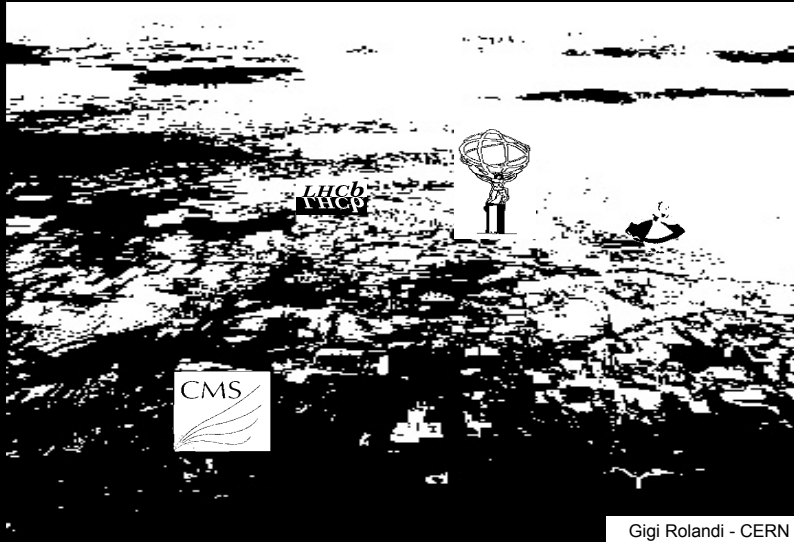
based on works submitted to Nature + to appear
acknowledgement to P. Kim, D. Kutasov, S. Sugimoto

GAUGE THEORY



STRENGTH THEORY

Status and prospects of the LHC machine and experiments



Gigi Rolandi - CERN

The Cosmic String Inverse Problem

Joe Polchinski
KITP, UCSB

JP & Jorge Rocha, hep-ph/0606205
JP & Jorge Rocha, gr-qc/0702055
Florian Dubath & Jorge Rocha, gr-qc/0703109
Florian Dubath, JP & Jorge Rocha, work in progress
JP, review in preparation

Strings 07, Mac 1, 6, 9/07

EXPERIMENTS

Beyond the MSSM (BMSSM)

Nathan Seiberg

~~Strings 2007~~

SUSY 2012

Based on
M. Dine, N.S., and S. Thomas, to appear

F. Quevedo [Cambridge]

String Theory Scenarios
Confront Experiments

L. Randall [Harvard]

Black Holes and Quantum
Gravity at the LHC

Schellekens



EXPLORING

THE
RCFT ORIENTIFOLD
"LANDSCHAPE"

THE

LANDSCAPE

Based in part on work with:

McAllister and Sundrum (hep-th/0703105)

Argurio, Bertolini and Franco (hep-th/0610202, hep-th/0703236)

Exploring the Kähler potential

Rutgers and IHES

Strings 2007 Madrid

Abstract

based on hep-th/0601261, 0703001 to appear with:

Robert Fliegner
Sergio Lukic
Rene Reinbacher
Jessie Shelton
Gonzalo Torroba

[Introduction](#)
[Kähler potential](#)
[Simple model of ...](#)
[Ten dimensional ...](#)
[Brane and ...](#)
[Balanced metrics](#)

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Comments Anti-Comments

Amir Y. Chen (Stanford and SLAC)

MELANIE BECKER

work with M.GRANA, R.MINASIAN, A.TOMASIELLO, D. WALDRAM
hep-th/0609124
hep-th/0707 ...

Petrini

Type I and II supersymmetric backgrounds

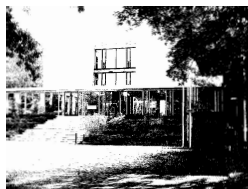
George Papadopoulos

King's College London

Strings 2007
Madrid

D-brane Instantons in Supersymmetric 4D String Vacua

Max-Planck-Institut für Physik, München



Dimers and orientifolds



Angel M. Uranga
CERN and IFT, Madrid



Strings 2007





On the ubiquity of meta-stable vacua

Hirosi Ooguri (Caltech)

Strings 07

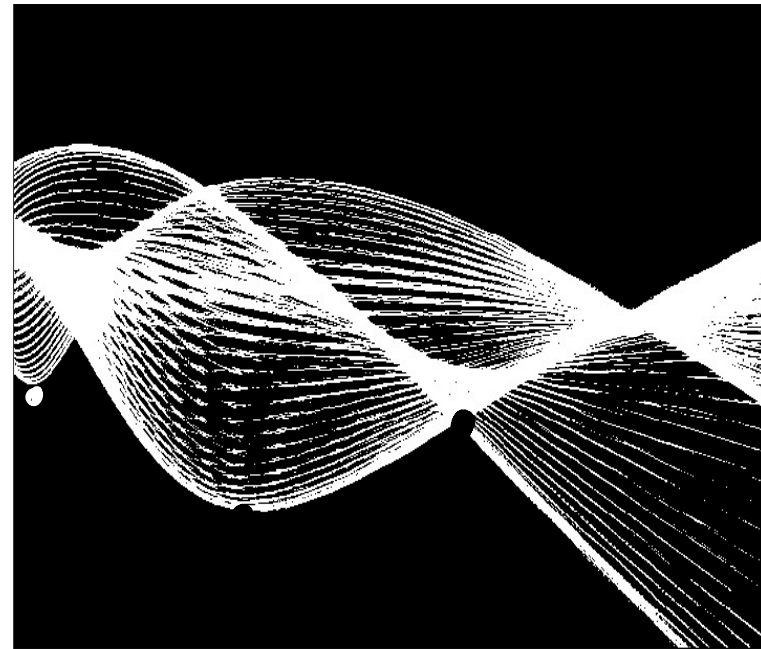
June 25 - 29, 2007; Madrid, Spain

1

Geometric Metastability

[arXiv:hep-th/0610249](https://arxiv.org/abs/hep-th/0610249)

[arXiv:hep-th/0702077](https://arxiv.org/abs/hep-th/0702077)



Phases of Higher-Dimensional Black Holes

Strings 07

Roberto Emparan
ICREA & U. Pr

BLACK

Resolving Black Holes using AdS/CFT

HOLE

de Boer, Amsterdam
Madrid, July 27, 2007

Marginal Stability and $\mathcal{N} = 4$ Dyon
Spectrum

Based mainly on:

hep-th/0508023 - Vijay Balasubramanian, JdB, Vishnu Jejjala, Joan Simon
hep-th/0511246 - Luis F Alday, JdB, Ilies Messamah
hep-th/0607222 - Luis F Alday, JdB, Ilies Messamah
to appear - JdB, Sheer El-Showk, Ilies Messamah

Collaborators:

Nabamita Banerjee, Justin David, Dileep Jatkar

HOLE

Black Holes and Large Order Quantum Geometry

Madrid: June 28, 2007

Albrecht Klemm



Wall Crossing and an Entropy
Enigma

G. Moore

Strings 2007, Madrid, June 28

Non-Supersymmetric Attractors

Sandip Trivedi

Tata Institute of Fundamental
Research, Mumbai, India

Madrid, June '07

Analytic Progress in Open String Field
Theory

Zweibach

STRING

FIELD THEORY

2+1-Dimensional Gravity Revisited

Edward Witten
Strings 2007
Madrid

THE SEARCH FOR
THE HOLOGRAPHIC
DUAL OF THE
HETEROTIC STRING
WORLD SHEET CFT

Josh Lapin, Aaron Simons & AS
IN PROGRESS

see also
Dabholkar & AS (unpublished)
Cabeza, Pando
Kraus & Larsen '07
Gaiotto & Strominger '06

STRINGS '07 MADRID

DIMENSIONAL - DUALITY

E. Silverstein

Dimensional duality.

Daniel Green (SLAC & Stanford U., Phys. Dept.), Albion Lawrence (Brandeis U.), John McGreevy (MIT, LNS), David R. Morrison (Duke U., CGTP & UC, Santa Barbara), Eva Silverstein (SLAC & Stanford U., Phys. Dept.). NSF-KITP-07-56, SLAC-PUB-12439, SU-ITP-07-05, MIT-CTP-3829, BRX-TH-586, DUKE-

ULTRAVIOLET

BEHAVIOR OF

Evidence for ultraviolet
finiteness

STRING

J. Russo [U.A. Barcelona]

The planar structure of type II
effective action and UV behaviour

THEORY

Why should you care about observational cosmology?



Licia Verde

University of Pennsylvania
Princeton University

www.phys.su.anna.uv/verde



R. Kallosh

Stanford

Strings 2007

Based on RK Linde 0704.0647

RK, March/07 059,

Kachru, KK, S. G. Shvabaza. Am. work in progress

Grimm, work in progress

THEORY & COSMOLOGY

Cosmological Predictions in the Landscape

Raphael Bousso

Center for Theoretical Physics
University of California, Berkeley

Strings 2007, Madrid



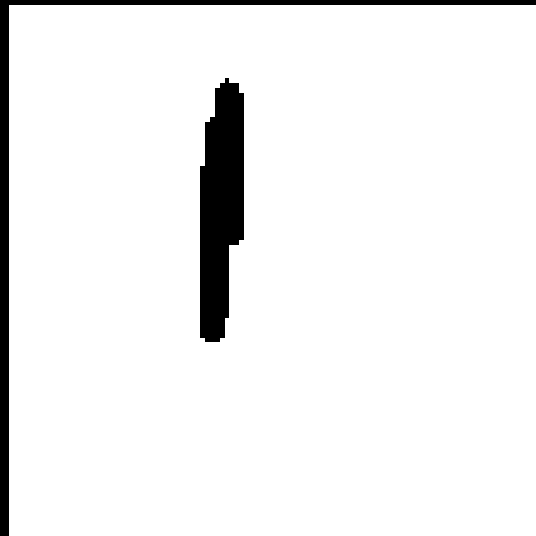
Eternal Inflation
and String Theory Landscape

Andrei Linde

Strings 2007

STRING THEORY

Where do we stand?



WHAT IS STRING THEORY?



THE FAILURES OF STRING THEORY

- We still do not understand what string theory is.

We do not have a formulation of the dynamical principle behind ST. All we have is a vast array of dual formulations, most of which are defined by methods for constructing consistent semiclassical (perturbative) expansions about a given background (classical solution).

WHAT IS MISSING ?

- Perhaps “String theory” is like quantum field theory - a framework and not a definitive theory.
- Perhaps we are missing a fundamentally new principle of symmetry, of dynamics, of consistency, ... that leads to a unique solution --- not a “vacuum” but a space-time, a cosmology.
- Emergent Space-Time

WHAT ARE THE NEW RULES?

THE END

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THE
UNIVERSE

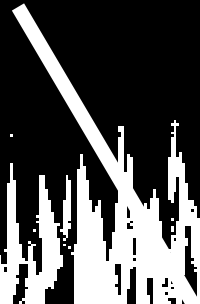
=
SPACETIME
HISTORY

BEGINNING

WHAT
ARE THE
RULES ?

THE LANDSCAPE

UNIVERSE A



THE ANTHROPIC PRINCIPLE



CAN WE EXPLAIN

$$\Lambda_{\text{observed}} \sim 10^{-4} \text{ev}^4$$

or

$$\frac{\Lambda_{\text{observed}}}{\Lambda_{\text{susy}}} \sim 10^{-64}$$

or

$$\left(\frac{\Lambda_{\text{observed}}}{\Lambda_{\text{susy}}} \right)^{1/4} \sim 10^{-16}$$

DIRAC (1937)

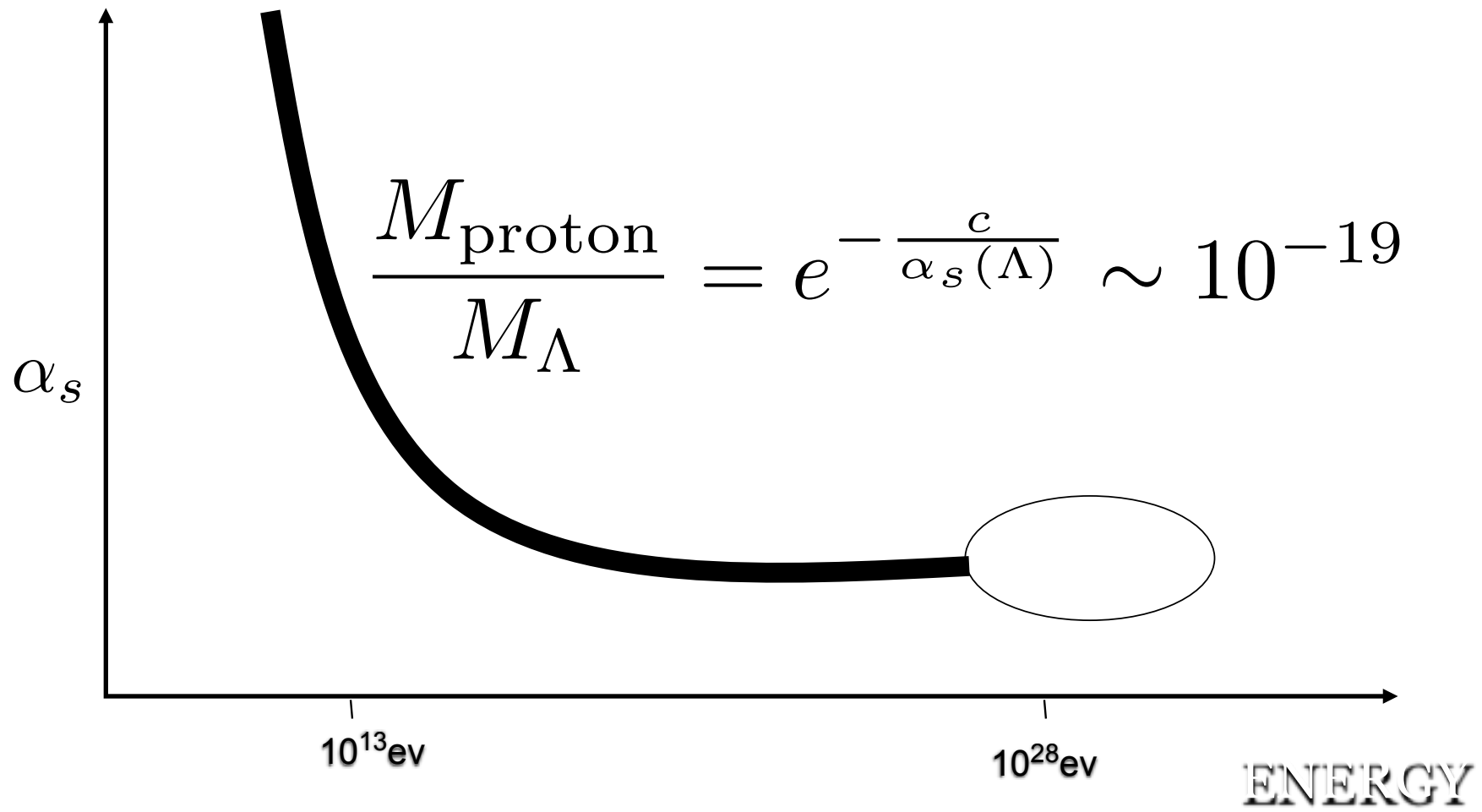
The Large Number Problem

$$\frac{M_{\text{proton}}}{M_{\text{planck}}} \sim 10^{-19}$$

Dirac did not invoke anthropic arguments.

He suggested that this ratio was related to the size of the universe in atomic units

-----> prediction that $\dot{G}_N, \dot{\alpha} \neq 0$



The Hierarchy

$$\frac{M_{\text{ew}}}{M_{\text{Gut}}} \sim 10^{-16}$$

Supersymmetry
+ Logarithms

Neutrino Masses

Seesaw
Mechanism

$$M_\nu \sim 1\text{eV} \sim \frac{M_{\text{Dirac}}}{M_{\text{Majorana}}^2}$$

The problem is not that

$$\left(\frac{\Lambda_{\text{obs.}}}{\Lambda_{\text{est.}}}\right)^{\frac{1}{4}} \sim 10^{-16} \quad \text{is so small.}$$

The problem is that we do not understand any mechanism that could determine Λ .

THE ANTHROPIC PRINCIPLE

Two red drinks — pure alcohol, with a maraschino cherry — in the bar next door, deep in the afternoon. While I hide in my cool corner, admiring the sawdust and the sides of beef, work is taking place all over the world: diamonds are being quarried, slaves are sewing dresses, policemen are loading their rifles, aiming their guns. As for the rest of us (when we're not drinking), diligently, we apply ourselves to solving the problems of the multitudes, diligently, we communicate

our ideas. And here is more to chew on: seventeen rich grandchildren are coming for lunch tomorrow. Russia awaits, Africa, the prevention of nuclear war. If I were free, I would suggest that this is how we do it: more sports, more food. Certainly, more television. Ducks in funny costumes, wielding hammers, quacking out a song. That's how we conquered Communism — the ducks alone brought down the Berlin wall.

So three drinks later, back in the office, I blast fax out my



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...and the world is
...and the world is

...and the world is
1.800.631.0203 • tim

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...

So three drinks later, back in the office, I blast fax out my manifesto, which is simple: we should all relax. Apparently, no matter what we do, we already do our part; we balance the cosmological constant just by getting up in the morning and smacking around our wives. Isn't that amazing! And here's how it works: according to the anthropic principle,

there could be an infinity of universes: starry bubbles, burning balls, solid boxes of hard time. You name it and they made it: some are gelatinous, Some are inside out. But there is one commonality: none are peopled. None have us. Only the composition of our universe allows for our existence – in fact, our presence is required or the whole thing falls apart. So

here's what I think: what if we all held our breath and stood sideways in a corner so we couldn't be found? Our universe would go wailing through the empty corridors of physics, knocking over furniture and pictures, searching for its vanished friends. Afterward, when we said *Gothcha!* and the universe wept with relief, we could all sit down for a nice cup of something comfy, have a heart-to-heart, and someone, somewhere, might wise up.

All poems from Our Post-Soviet History Unfolds
By Eleanor Lerman, published by Sarabande Books.

So here's what I think: what if we all held our breath and stood sideways in a corner so we couldn't be found? Our universe would go wailing through the empty corridors of physics, knocking over furniture and pictures, searching for its vanished friends.

Afterward, when we said *Gothcha!* and the universe wept with relief, we could all sit down for a nice cup of something comfy, have a heart-to-heart, and someone, somewhere, might wise up.

*All poems from Our Post-Soviet History Unfolds
By Eleanor Lerman, published by Sarabande Books.*

CALCULATE
THE
CALCULATE
STRATEGY
CALCULATE
& OBSERVE



STRINGS - 003

REFRAME

KOREA

ISRAEL

PRINCETON

USA:

STANFORD

MUCHOS GRACIAS

Enrique Álvarez
Luis Álvarez-Gaumé
José L. F. Barbón
Alberto Casas
Anamaría Font
César Gómez
Rafael Hernández
Luis E. Ibáñez

José M. F. Labastida
Karl Landsteiner
Esperanza López
Patrick Meessen
Carlos Muñoz
Tomás Ortín
Ángel Uranga
Silvia Vaula

Lola Gómez
Isabel Pérez

THE END