Costas Legacy

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Kounnas Memorial Day

Corfu, 4 September 2022

Costas Kounnas 1952-2021

Costas Kounnas 1952-2021

Costas Kounnas 1952-2021

Costas 60th anniversary, Cyprus 2012

Costas Kounnas 1952-2021

Costas 60th anniversary, Cyprus 2012

some history

I knew Costas since 1977

- he was 3 years older
- he graduated from the university of Athens in 1974
- immediately after he was drafted in the army
  fight against the Turkish invasion of Cyprus
- he was thrown out from his home city and lost everything
  Varosha became a ghost town until now
- he finished his PhD in ENS with John Iliopoulos when I started mine
  (doctorat 3e cycle 1978)
- since then we started an intense scientific collaboration [11]
  and became very close friends

Varosha before 2014

Varosha before 2014

Varosha now

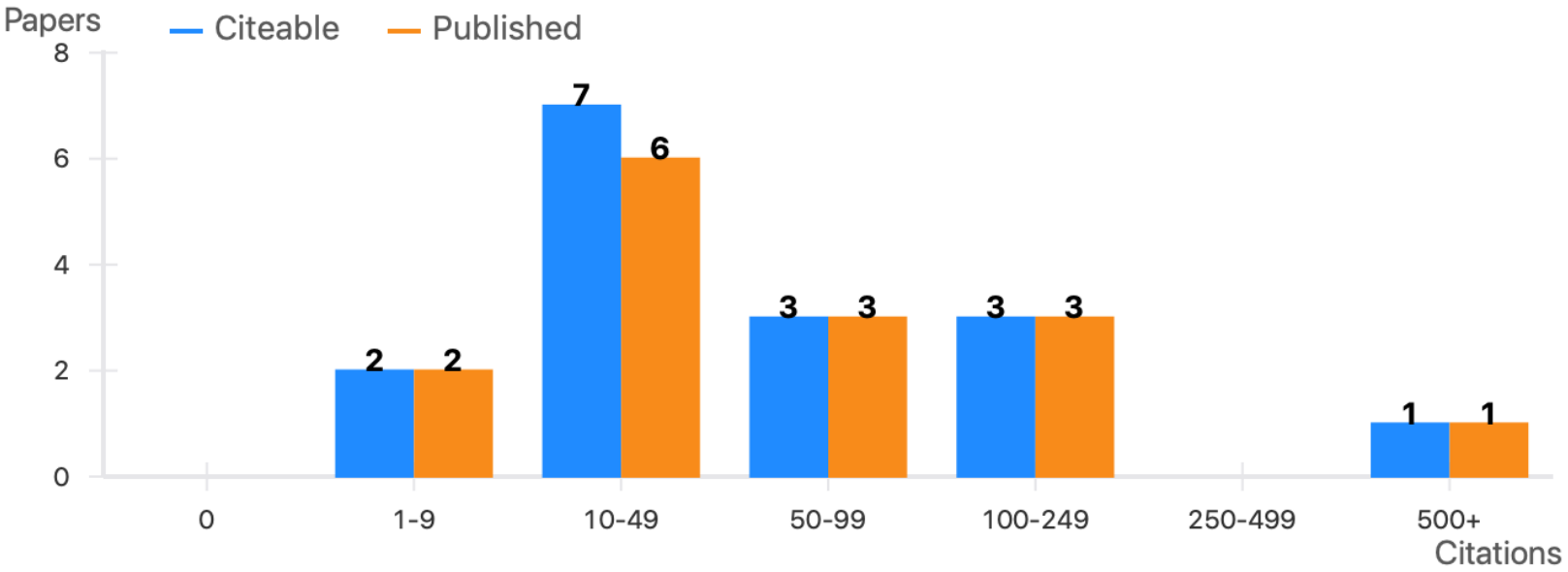
Varosha now [6]

summary of joint publications

Citation Summary

Exclude self-citations

	Citeable	Published
Papers	**16**	**15**
Citations	**1,801**	**1,786**
h-index	**14**	**13**
Citations/paper (avg)	**112.6**	**119.1**



QCD: deep inelastic and electroproduction

A Proof of the Factorization of Mass Singularities in the Bjorken Limit #1

Ignatios Antoniadis (Ecole Normale Superieure), L. Baulieu (Ecole Normale Superieure), C. Kounnas (Ecole Polytechnique) (Sep, 1979)

Published in: *Nucl.Phys.B* 168 (1980) 394-408

pdf DOI cite 10 citations

Factorization Properties and Their Probabilistic Interpretation in Polarized Electroproduction and Annihilation Processes #2

Ignatios Antoniadis (Ecole Normale Superieure), C. Kounnas (Ecole Polytechnique) (May, 1980)

Published in: *Phys.Rev.D* 24 (1981) 505

DOI cite 26 citations

QCD: deep inelastic and electroproduction

Factorisation between long and short distance dynamics

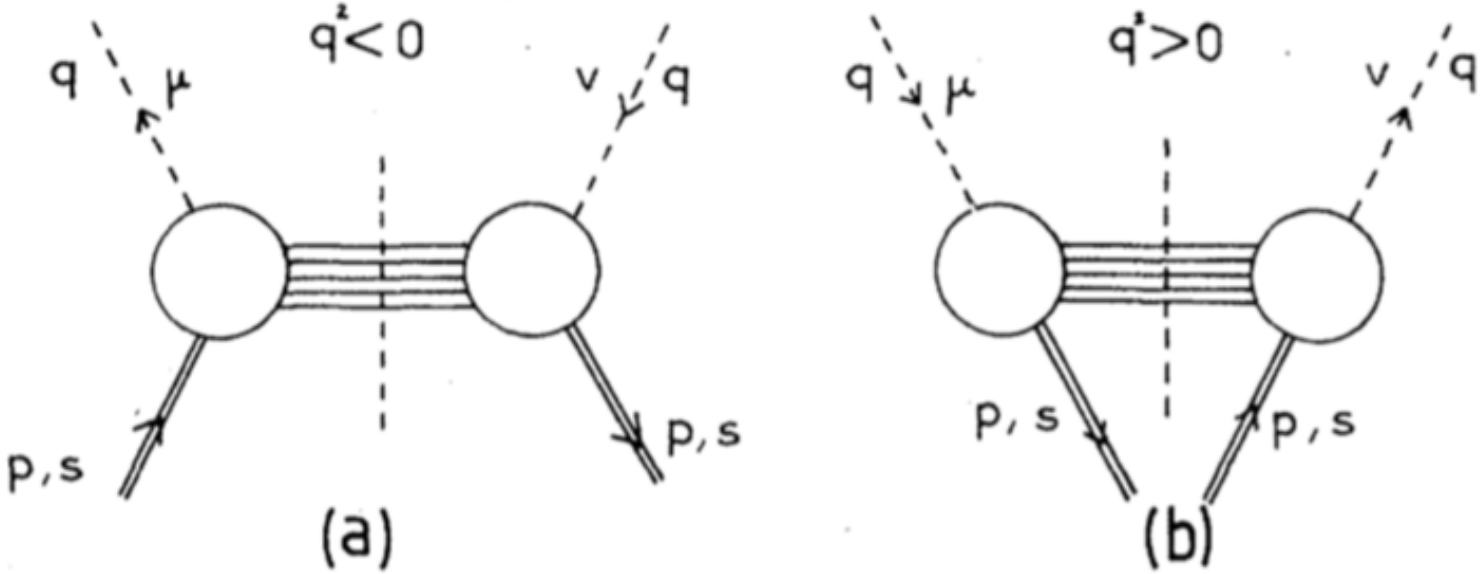
based on light-cone OPE

long-distance: universal parton distribution functions

short-distace: calculable in perturbation due to asymptotic freedom

$\Rightarrow$ scaling violations due to anomalous dimensions

Generalisation from space-like to time-like processes



BSM: Unification, Supersymmetry and Supergravity

Symmetry Breaking Effects in Grand Unified Theories #4

Ignatios Antoniadis (Ecole Polytechnique), C. Kounnas (Ecole Normale Superieure), C. Roiesnel (Ecole Polytechnique) (Oct, 1981)

Published in: *Nucl.Phys.B* 198 (1982) 317-364

DOI cite 34 citations

Light Gluinos in Deep Inelastic Scattering #5

Ignatios Antoniadis (Ecole Polytechnique), C. Kounnas (CERN), R. Lacaze (Saclay) (Jun, 1982)

Published in: *Nucl.Phys.B* 211 (1983) 216-238

DOI cite 71 citations

Simple Treatment of Threshold Effects #6

Ignatios Antoniadis (Ecole Polytechnique), C. Kounnas (CERN), K. Tamvakis (CERN) (Aug, 1982)

Published in: *Phys.Lett.B* 119 (1982) 377-380

DOI cite 105 citations

Noncompact Symmetries and Vanishing of the Cosmological Constant #7

Ignatios Antoniadis (SLAC), C. Kounnas (UC, Berkeley), Dimitri V. Nanopoulos (CERN and UC, Santa Cruz) (May, 1985)

Published in: *Phys.Lett.B* 162 (1985) 309-316

pdf links DOI cite 22 citations

BSM: Unification, Supersymmetry and Supergravity

SIMPLE TREATMENT OF THRESHOLD EFFECTS

I. ANTONIADIS
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and

C. KOUNNAS and K. TAMVAKIS
CERN, Geneva, Switzerland

Received 17 August 1982

Physics Letters B 119 (1982) 377-380

We demonstrate that contributions from threshold effects in coupling constant differences at low energies in GUTs are simply taken into account in a scheme that preserves supersymmetry (DR dimensional reduction). Therefore, automatically in supersymmetric GUTs the naive step approximation at the physical mass associated with the threshold gives the correct result.

Construction of 4d strings

Supersymmetry Among Free Fermions and Superstrings #1

Ignatios Antoniadis (SLAC), Constantin Bachas (SLAC), C. Kounnas (UC, Berkeley and LBL, Berkeley), Paul Windey (UC, Berkeley and LBL, Berkeley) (Sep, 1985)

Published in: *Phys.Lett.B* 171 (1986) 51-56

pdf links DOI cite 238 citations

Four-Dimensional Superstrings #2

Ignatios Antoniadis (CERN), C.P. Bachas (Ecole Polytechnique), C. Kounnas (LBL, Berkeley) (Dec, 1986)

Published in: *Nucl.Phys.B* 289 (1987) 87

DOI cite 881 citations

Higgs Phenomenon in String Theories #12

Ignatios Antoniadis (CERN), C. Bachas (Ecole Polytechnique), C. Kounnas (UC, Berkeley and LBL, Berkeley) (Oct, 1987)

Published in: *Phys.Lett.B* 200 (1988) 297-304

DOI cite 48 citations

Construction of 4d strings

SUPERSYMMETRY AMONG FREE FERMIONS AND SUPERSTRINGS

I. ANTONIADIS [1,2], C. BACHAS [1]

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C. KOUNNAS [3,4] and P. WINDEY [3]

Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720, USA

Received 17 October 1985

Physics Letters B 171 (1986) 51-56

A complete classification is given of all supersymmetric theories of free massless two-dimensional fermions. This, in particular, implies a classification of all free-fermion representations of super Kac–Moody algebras. It is shown that these cannot be used to construct new string theories with unbroken supersymmetry in Minkowski space–time, other than the torus-compactifications of the known ten-dimensional superstrings. Assuming anti-de-Sitter space–time could restore conformal invariance, it is shown how one could construct a string theory whose low-lying excitations form a multiplet of gauged $N = 8$ supergravity.

Non-linear SUSY among 2d free farmions

Supersymmetry among free fermions. Let us begin by considering N free Weyl–Majorana fermions in two dimensions, whose euclidean action is

$$S = \frac{1}{2} \int dz\, d\bar{z}\ \psi^A \partial_{\bar{z}} \psi^A \ , \tag{1}$$

where $z = x + it$, $A = 1, ..., N$, and summation over repeated indices is implied. This action is invariant under

$$\delta\psi^A = \eta^{ABC} \psi^B \psi^C \epsilon \tag{2}$$

(with ϵ an infinitesimal Grassmann parameter) if and only if η^{ABC} is totally antisymmetric in its indices. We now prove the following theorem:

Theorem. Transformation (2) is a supersymmetry if and only if the η^{ABC} are appropriately normalized structure constants of a semi-simple Lie group G.

Construction of 4d strings

FOUR-DIMENSIONAL SUPERSTRINGS

I. ANTONIADIS*

CERN, Genève, Switzerland

C.P. BACHAS

Centre de Physique Théorique, Ecole Polytechnique, 91128 Palaiseau Cedex, France

C. KOUNNAS**

Lawrence Berkeley Laboratory, Berkeley, California 94720, USA

Received 30 December 1986

Nuclear Physics B 289 (1987) 87-108

We solve completely the constraints of factorization and multiloop modular invariance for closed string theories in which all internal quantum numbers of the string are carried by free periodic and antiperiodic world-sheet fermions. We derive a simple set of necessary and sufficient rules, and illustrate how they can be used to find the spectrum, one-loop amplitudes and low-energy lagrangian of many realistic four-dimensional chiral models. We prove that modular invariance and factorization ensure the presence of a massless graviton and the correct connection between spin and statistics. We also prove that the existence of a massless spin-$\frac{3}{2}$ state ensures the absence of tachyons and the vanishing of the one-loop cosmological constant.

Construction of 4d strings

Basic idea:

describe the compactification space by a (S)CFT of free 2d fermions

Heterotic string $c = (6 + 3, 22) \Rightarrow$ 18 L-moving and 44 R-moving

↑

with non-linear supersymmetry $SU(2)^6$

Parameters:

boundary conditions around the 2 cycles of the world-sheet torus

$\Rightarrow$ Hamiltonian and fermion number projection

Constraints: one-loop modular invariance and 2-loop factorisation

$\Rightarrow$ sum over several sectors of boundary conditions

Set of rules for constructing chiral models with interesting phenomenology

$N = 1$ SUSY, 3 generations, exact α'-calculability of effective SUGRA,

$SO(10)$ underlying structure: flipped $SU(5)$, Pati-Salam, Standard Model

Curved backgrounds and non critical strings

Exact supersymmetric string solutions in curved gravitational backgrounds #15

Ignatios Antoniadis (Ecole Polytechnique), S. Ferrara (CERN), C. Kounnas (CERN) (Feb, 1994)

Published in: *Nucl.Phys.B* 421 (1994) 343-372 • e-Print: hep-th/9402073 [hep-th]

pdf DOI cite 68 citations

$N = 2$ Superliouville and Noncritical Strings #13

Ignatios Antoniadis (Ecole Polytechnique), C. Bachas (CERN), C. Kounnas (Ecole Normale Superieure) (Mar, 1990)

Published in: *Phys.Lett.B* 242 (1990) 185-190

DOI cite 20 citations

The Dilaton Classical Solution and the Supersymmetry Breaking Evolution in an Expanding Universe #1

Ignatios Antoniadis (SLAC), C. Kounnas (UC, Berkeley and LBL, Berkeley) (Feb, 1986)

Published in: *Nucl.Phys.B* 284 (1987) 729 • Contribution to: ICHEP 86

pdf links DOI cite 25 citations

On the Possibility of Avoiding Singularities by Dilaton Emission #2

Ignatios Antoniadis (CERN), G.F.R. Ellis (CERN), John R. Ellis (CERN), C. Kounnas (LBL, Berkeley), Dimitri V. Nanopoulos (Wisconsin U., Madison) (Feb, 1987)

Published in: *Phys.Lett.B* 191 (1987) 393-398

DOI cite 9 citations

Superstrings at finite temperature

Superstring phase transition at high temperature #1

Ignatios Antoniadis (Ecole Polytechnique), C. Kounnas (Ecole Normale Superieure) (Feb, 1991)

Published in: *Phys.Lett.B* 261 (1991) 369-378

DOI cite 159 citations

Nonperturbative supersymmetry breaking and finite temperature instabilities in N=4 superstrings #2

Ignatios Antoniadis (Ecole Polytechnique), J.P. Derendinger (Neuchatel U.), C. Kounnas (Ecole Normale Superieure and CERN) (1998)

Published in: *PoS* corfu98 (1998) 074 • Contribution to: CORFU 1998, CORFU 1998, 074 • e-Print: hep-th/9908137 [hep-th]

pdf links DOI cite 15 citations

Nonperturbative temperature instabilities in N=4 strings #3

Ignatios Antoniadis (Ecole Polytechnique), J.Pierre Derendinger (Neuchatel U.), Costas Kounnas (CERN) (Feb, 1999)

Published in: *Nucl.Phys.B* 551 (1999) 41-77 • e-Print: hep-th/9902032 [hep-th]

pdf DOI cite 72 citations

Superstrings at finite temperature

Superstring phase transition at high temperature

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Centre de Physique Théorique de l'Ecole Polytechnique, F-91128 Palaiseau Cedex, France

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Received 26 February 1991

Physics Letters B 261 (1991) 369-378

We analyse the phase transition of superstring at high temperature. We derive the exact effective potential of the "T-winding" mode which becomes tachyonic above the Hagedorn temperature. We show that in the heterotic case a phase transition occurs which, from the world-sheet point of view, is a generalization of the Kosterlitz–Thouless transition. We derive the conformal field theory describing the new phase and we find that the central charge of the system $\hat{c}$ is lowered by two units. The resulting high-temperature phase then corresponds to a non-critical superstring in $(7+1)$ dimensions. Moreover, the new vacuum exhibits a miraculous "space-like" supersymmetry which leads to the vanishing of the free energy, at least up to the one-loop level. We finally argue that our result could describe a transition from a "cold" to a "hot" phase in the history of the early universe.

Superstrings at finite temperature

Non-perturbative temperature instabilities in $N = 4$ strings *

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[b] *Institut de Physique, Université de Neuchâtel, Breguet 1, CH-2000 Neuchâtel, Switzerland*
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Received 11 February 1999; accepted 8 March 1999

Nuclear Physics B 551 (1999) 41-77

Abstract

We derive a universal thermal effective potential, which describes all possible high-temperature instabilities of the known $N = 4$ superstrings, using the properties of gauged $N = 4$ supergravity. These instabilities are due to three non-perturbative thermal dyonic modes, which become tachyonic in a region of the thermal moduli space. The latter is described by three moduli, s, t, u, which are common to all non-perturbative dual-equivalent strings with $N = 4$ supersymmetry in five dimensions: the heterotic on $T^4 \times S^1$, the type IIA on $K_3 \times S^1$, the type IIB on $K_3 \times S^1$ and the type I on $T^4 \times S^1$. The non-perturbative instabilities are analyzed. These strings undergo a high-temperature transition to a new phase in which five-branes condense. This phase is described in detail, using both the effective supergravity and non-critical string theory in six dimensions. In the new phase, supersymmetry is perturbatively restored but broken at the non-perturbative level. In the infinite-temperature limit the theory is topological with an $N = 2$ supersymmetry based on a topologically non-trivial hyper-Kähler manifold.

Superstrings at finite temperature

exponential degeneracy of states $\Rightarrow$ limiting temperature T_H (Hagedorn)

string gas partition function diverges at T_H

universal value depending only on the critical dimension

microscopic description: tachyonic T-winding mode for $T > T_H$

Euclidean time on a circle of radius $1/(2\pi T)$ suggesting phase transition

Euclidean theory in one dimension lower has spontaneously broken SUSY

due to boundary conditions: bosons periodic vs fermions antiperiodic

Basic idea: compute the effective supergravity in 4d compactifications

$\Rightarrow$ effective potential of the T-winding mode and radion

minimum: non-critical string with central charge deficit $\delta\hat{c} = 4 \Rightarrow$

High-T phase: 6d non-critical string with half supersymmetry restored

Conclusions

- He was a close friend and a precious colleague
- He had a unique way of doing physics in lively and intense discussions
- My memory is full of stories

  - working on the blackboard after midnight inside a smoking cloud

  - with after dinner drinks listening his numerous funny stories
- Our community lost a great physicist with unique personality
- His legacy will stay in our memories for ever