

In Memory of Costas Kounnas

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Costas Kounnas

Costas has made several important contributions to string theory and theoretical high energy physics:

QCD, effective supergravity theories, no-scale models, MSSM and GUTs, four-dimensional string constructions, string dualities, threshold corrections to string couplings, finite temperature and susy breaking in string theory, string model building via the fermionic constructions, flux compactifications, string cosmology, moduli stabilization, scale invariant gravity and inflation . . .

Some of my favourite earlier papers of Costas, from which I have learned a lot and have impacted my work, include:

- “Naturally Vanishing Cosmological Constant in N=1 Supergravity,” Phys. Lett. B 133 (1983) 61, with E. Cremmer, S. Ferrara and D. Nanopoulos;
- “Four-Dimensional Superstrings,” Nucl. Phys. B 289 (1987) 87, with C. Bachas and I. Antoniadis;
- “Spontaneous Broken Supersymmetry in String Theory,” Nucl. Phys. B 310 (1988) 355-370, with M. Porrati;
- “Coordinate Dependent Compactifications and Discrete Symmetries,” Nucl. Phys. B 341 (1990) 641-665, with B. Rostand;

- “Cosmological string backgrounds from gauged WZW models,” Phys. Lett. B 289 (1992) 56-60, with D. Lust;
- “Dynamical topology change,” Phys. Lett. B 331 (1994) 51-62, with E. Kiritsis;
- “Nonperturbative temperature instabilities in N=4 strings,” Nucl. Phys. B 551 (1999) 41-77, with I. Antoniadis and J. Pierre Derendinger.

He was an exceptional physicist, coordinated many projects and initiated many collaborations. He also organized several conferences and workshops.

[90 collaborators listed in INSPIRE - HEP; E. Kiritsis (23), S. Ferrara (19), H. Partouche (18) ...]

I met Costas in 2004 (after my return to Cyprus from the USA).

We developed a long and fruitful collaboration, and a strong friendship.

To me he was a great mentor, a second father . . .

We wrote 12 papers together, participated in several research programs and meetings and co-organized Summer Schools and Workshops.







Costas was a very passionate and youth-like person in all aspects of his life!

Somehow he kept carrying his youth dreams to the very last moment.

He had a strong mind of his own, and he could be a difficult person to persuade on many things. At the same time, he was a very open, dynamic, lively and pleasant person to interact and work with, both scientifically and socially.

He was full of life; he wouldn't compromise with defeat and he would never give up!

Working with Costas was very intense and exciting. There was always a sense of a great purpose!

Costas managed to instil his energy and optimism to his collaborators. It involved endless discussions and arguing back and forth, lots of smoking – we both used to smoke like chimneys – and calculations.

The day would often end with dinner and drinking (Costas liked to drink vodka and me coca cola zero). He would then switch to telling his stories and talk about his achievements (often with a dose of exaggeration). The following morning Costas would come and present perfect solutions to difficult problems we struggled with the day before!

He was very proud of Ecole Normale and the lab, and he always talked about the many great developments in our field that took place here.

He was also very proud of our island, Cyprus, and his city, Famagusta.



He was very happy when back in 2008 we organized a conference in Agia Napa, a town close to Famagusta. Costas organized several trips to take his friends and see the city where he grew up and share stories from his childhood.

He was also very happy when many of his friends and collaborators came to Cyprus in 2012 to celebrate his 60th birthday.

Costas worked very hard to improve tertiary education and establish research institutions in Cyprus. He helped establish the University of Cyprus, the Cyprus Institute, the Research and Innovation Foundation and the Quality Assurance Agency. He also participated in the committees for the accreditation and evaluation of the private Universities, and pushed for Cyprus to join CERN as an associate member.

He also participated in Evaluation and Review Committees for Universities in Greece, which for Costas was a second country.

We all have stories to tell from conferences we attended with Costas. He really enjoyed Corfu and Kolymbari, but his favourite one was the ENS Summer Institute, which he organized several times with Eugene Cremmer.

Most of my work with Costas and collaborators focused on *String Cosmology*.

→ Our goal was to try to extend the web of string dualities to time-dependent, cosmological settings.

Technically and conceptually challenging:

In phases with broken susy + geometric variation, string theory can become an inflexible tool.

- With the moduli acquiring time dependence → may wander through cross-over regions of moduli space, where we have no control over the quantum corrections, and the effective field theory approach breaks down.
- At a more fundamental level: it is hard to identify (and compute) the correct, precise observables.

2nd quantized version to probe the theory directly off-shell ??

In phases of persistent geometric variation it is not clear how to apply holography . . .

Our work includes:

- construction of the HH wavefunction for cosmological WZW string backgrounds, which admit a realization in terms of compact T-folds in the Euclidean [Kounnas, NT, Troost];
- the study of the cosmologies of several string models with spontaneous susy breaking and temperature, and moduli stabilisation [Catelin-Jullien, Kounnas, Partouche, NT];
- the study of thermal configurations of $\mathcal{N} = (4, 0)$ type II superstring models, where Hagedorn and other tachyonic instabilities are lifted by gravito-magnetic fluxes, and cosmological applications [Angelantonj, Florakis, Kounnas, Partouche, NT];

- realizing the matter bounce scenario in string theory [Brandenberger, Kounnas, Partouche, Patil, NT];
- R^2 inflation from scale invariant supergravity [Kounnas, Lust, NT].

I am grateful to Costas for many things:

the physics, the support and his friendship. I am also grateful for introducing me to great friends and collaborators.

I will always cherish the moments we spent together! He will be Forever Missed.

