



Capacities/Research Potential
FP7-REGPOT-2009-1

Project No. 228644

CRETEHEPCOSMO

Crete Center for particle Physics and Cosmology

Deliverable D4

1st Workshop announcement on the website, presentations posted at the website
and report

Project start date:	01/04/2009
Project duration:	41 months
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Actual submission date:	11th month
Dissemination level:	PU

REPORT

CRETE WORKSHOP ON THE FRONTIERS OF COSMOLOGY

DEPARTMENT OF PHYSICS UNIVERSITY OF CRETE

MARCH 29 – APRIL 04 2010

THEME TITLE: FP7-REGPOT-2008-1

Project acronym: Crete-HEP-Cosmo

Project full title: Crete Center for Particle Physics and Cosmology

Grant Agreement No: 228644

- **PROGRAM/TALKS:** The structure of the Workshop was centered around two central talks per day with emphasis on extensive discussions.
- **ELECTRONIC PROCEEDINGS:** The slides or transparencies of all talks have been posted in the [program webpage](#).

MONDAY MARCH 29

09:30 – 10:30 Registration--Coffee

10:30 – 11:45 Morning Lecture

S. Sarkar (*Oxford*): Dark Matter

11:45 – 12:30 Discussion

13:00 – 15:00 Lunch Break

15:00 – 15:30 Coffee

15:30 – 16:45 Afternoon Lecture

R. Brustein (*Ben Gurion*): Small-Field Models of Inflation

16:45 – 17:30 Discussion

TUESDAY MARCH 30

09:30 – 10:30 Coffee

10:30 – 11:45 Morning Lecture

R. Brandenberger (*McGill*): Bouncing Cosmologies

11:45 – 12:30 Discussion

13:00 – 15:00 Lunch Break

15:00 – 15:30 Coffee

15:30 – 16:45 Afternoon Lecture

S. Mukohyama (*Tokyo*): Horava-Lifshitz Gravity

16:45 – 17:30 Discussion

WEDNESDAY MARCH 31

09:30 – 10:30 Coffee

10:30 – 11:45 Morning Lecture

P. Binetruy (*APC*): Gravitational Waves

11:45 – 12:30 Discussion

13:00 – 15:00 Lunch Break

15:00 – 15:30 Coffee

15:30 – 16:45 Afternoon Lecture

A. Davis (*Cambridge*): Modified Gravity Theories

16:45 – 17:30 Discussion

19:30 – Workshop Dinner

THURSDAY APRIL 01

09:30 – 10:30 Coffee

10:30 – 11:45 Morning Lecture

T. Prokopec (*Utrecht*): Primordial Spectrum Non-Gaussianity

11:45 – 12:30 Discussion

13:00 – Free Afternoon

FRIDAY APRIL 02

09:30 – 10:30 Coffee

10:30 – 11:45 Morning Lecture

C. Skordis (*Nottingham*): Alternative Theories of Gravitation

11:45 – 12:30 Discussion

13:00 – 15:00 Lunch Break

15:00 – 15:30 Coffee

15:30 – 16:45 Afternoon Lecture

N. Toumbas (*Cyprus*): Superstring Cosmology

16:45 – 17:30 Discussion

SATURDAY APRIL 03

09:30 – 10:30 Coffee

10:30 – 11:45 Morning Lecture

K. Skenderis (*Amsterdam*): Holographic Inflationary Correlations

11:45 – 12:30 Discussion

13:00 – 15:00 Lunch Break

15:00 – 15:30 Coffee

15:30 – 16:45 Afternoon Lecture

B. Craps (*Brussels*): Holographic Singularities Resolution

16:45 – 17:30 Discussion

SUNDAY APRIL 04

10:00 - Orthodox Easter Feast

- **IMPLICATIONS FOR THE CENTER / IMPACT ASSESSMENT:**

Center members came in close and extensive contact with top researchers and hot topics on the subject of the Workshop. This will allow them to further their research, provides important visibility to the Center and its facilities, and in the long-run advance the status of the Center on the European research map.

More specifically, the topics presented in the Workshop and thoroughly discussed included:

- (i) The Dark Matter status, with particular attention to the constraints that come from observation and possible theoretical explanations both from the context of standard gravity and alternate gravity (Bekenstein-Milgrom).
- (ii) Gravitational Waves detection, with emphasis on the LISA project, and cosmological implications of their future observation.
- (iii) Alternate Gravity Theories, like F(R) theories, the relativistic MOND theory, the Eddington-Born-Infeld theory, with emphasis on their theoretical structure and confrontation with observations.
- (iv) Inflationary Cosmology, so far the «standard model» of modern cosmology.
- (v) Horava-Lifshitz Cosmology, an exciting very recent proposal that may solve the ultraviolet problem of quantum gravity without invoking string theory and also lead to realistic cosmology without invoking inflation.
- (vi) Bouncing Cosmologies, which try to address the singularity problem by involving new fundamental physics and thus changing either the matter or the gravitational sector of the theory.
- (vii) Non-Gaussianity of the primordial density perturbations spectrum, primarily from the point of view of calculational techniques so that theoretical results for the bispectrum and trispectrum can reliably face observations.
- (viii) Superstring Cosmology, where string dualities can help avoid the initial cosmological singularity and potentially smoothly join with standard cosmology.
- (ix) Holography and Cosmology, where starting from the holographic principle one can apply its powerful calculational techniques to compute physical observables like the primordial perturbations spectrum and also get an insight into theories of gravity well-defined in the ultraviolet.

The members of the Center actively participated in discussions, both during the talks and in private, with the visiting scientists focusing primarily on the topics of their own research: Elias Kiritsis (Horava-Lifshitz cosmology, Bouncing cosmologies, Superstring Cosmology, Holography), Tassos Petkou (Holography), Theodore Tomaras (Horava-Lifshitz cosmology, Alternate Gravity Theories), Nicholas Tsamis (Inflationary Cosmology, Non-Gaussianity, Alternate Gravity Theories, Gravitational waves).

The junior members of the Center had similar extensive contacts.

- **ADVERTISEMENT:** The Workshop was announced in a four-fold way,

- (i) the website of the Center: <http://hep.physics.uoc.gr/cosmo10/index.html>
- (ii) university, research center, and conference announcement sites
- (iii) emails to scientists relevant to the subject
- (iv) press release to the local press

- **WORKSHOP EXPENSES**

Expenses	Amount
Travel and Accomodation expenses	13,840.69
Catering and coffees	997.50
Banquet	754.55
TOTAL	15,592.74

The Following scientists were supported with Travel and Accommodation expenses:

1. Binetruy Pierre (APC, Paris)
2. Brandenberger Robert (McGill University)
3. Brustein Ramy (University Ben Gurion)
4. Craps Ben (Vrije Universitat Brussels)
5. Davis Anne (University of Cambridge)
6. Mukohyama Shinji (IPMU, Tokyo)
7. Sarkar Subir (Oxford University)
8. Kounnas Kostas (ENS, Paris)
9. Dimopoulos Kostas (University of Lancaster)
10. Toumpas Nikolaos (University of Cyprus)
11. Papantonopoulos Lefteris (Athens Technical University)
12. Tamvakis Kyriakos (University of Ioannina)
13. Tetradis Nikolaos (University of Athens)
14. Scordis Kostas (Perimeter Institute)
15. Lee Bumhoon (Sogang University)
16. Prokopec Tomislav (University of Utrecht)
17. Skenderis Kostas (University of Amsterdam)

- **SCIENTIFIC CONCLUSIONS:** In one sentence, the Workshop confirmed the current penetrating activity in the subject. There is a wealth of experimental data that is coming and will come in the near future from cosmological measurements. Moreover, the accuracy of these measurements

is increasing and, therefore, can put better constraints on theories of cosmological evolution. More precisely:

(i) We expect measurements related to dark matter to eventually select between competing theoretical models: the standard CDM and alternate theories of gravity (Bekenstein-Milgrom).

(ii) We expect more precise measurements of the primordial density perturbations spectrum to eventually select between, for instance, competing inflationary cosmologies. This is important since the parameter space of viable such cosmologies is ever-increasing.

(iii) On the more theoretical front -- where fundamental issues like the ultraviolet problem of quantum gravity or the cosmological singularity are addressed -- ideas from superstrings, holography, Horava-Lifshitz gravity are employed and the models developed are becoming more and more concrete.

- **PARTICIPANTS:** Of the 36 participants in the Workshop, 11 were local (members of the Crete Center for Theoretical Physics) and 25 were visitors from Greece and abroad:

List of Foreign Participants

1. Pierre Binetruy (APC, Paris, France)
2. Robert Brandenberger (McGill University, Montreal, Canada)
3. Ramy Brustein (Ben Gurion University, Israel)
4. Ben Craps (Vrije University, Brussels, Belgium)
5. Anne Davis (Cambridge University, England)
6. John Estes (Ecole Polytechnique, Paris, France)
7. Kostas Dimopoulos (University of Lancaster, England)
8. Costas Kounnas (ENS, Paris, France)
9. Bumhooon Lee (Sogang University, Seoul, Korea)
10. Shinji Mukohyama (IPMU, Tokyo, Japan)
11. Nicholas Nikoloudakis (University of Durham, England)
12. Grigoris Panotopoulos (University of Valencia, Spain)
13. Lefteris Papantonopoulos (National Technical University of Athens, Greece)
14. Herve Partouche (Ecole Polytechnique, Paris, France)
15. Leandros Perivolaropoulos (University of Ioannina, Greece)
16. Tomislav Prokopec (Utrecht University, Holland)
17. Gerasimos Rigopoulos (University of Helsinki, Finland)
18. Subir Sarkar (Oxford University, England)
19. George Savidy (Demokritos Research Institute, Athens, Greece)
20. Kostas Skenderis (University of Amsterdam, Holland)
21. Costas Skordis (University of Nottingham, England)
22. Kiriakos Tamvakis (University of Ioannina, Greece)
23. Nicholas Tetradis (University of Athens, Greece)
24. Nicholas Toumbas (University of Cyprus, Nicosia, Cyprus)
25. Vasilios Zarikas (TEI, Greece)

List of Local Participants

1. Petros Ditsas (University of Crete)
2. Ioannis Iatrakis (University of Crete)
3. Elias Kiritsis (University of Crete)
4. George Kofinas (University of Crete)
5. Ioannis Konstantinou (University of Crete)
6. Matthew Lippert (University of Crete)
7. Tasos Petkou (University of Crete)
8. Theodore Tomaras (University of Crete)
9. Nicholas Tsamis (University of Crete)
10. Daisuke Yamada (University of Crete)
11. Hong Bao Zhang (University of Crete)