INVITED SPEAKERS
Ana Achucarro (LEIDEN)
Howard Baer (OKLAHOMA)
Cliff Burgess (MCMASTER/PI)
Ki Young Choi (PUSAN)
Ed Copeland (NOTTINGHAM)
Ruth Durrer (GENEVA)
Katherine Freese (MICHIGAN)
Juan Garcia-Bellido (MADRID)
Karsten Jedamzik (MONTPELLIER)
Julien Lesgourgues (CERN)
Liam McAllister (CORNELL)
Antonio Melgarejo (COLUMBIA)
Federico Piazza (APC, PARIS)
Antonio Riotto (CERN)
Pierre Salati (LAPTH, ANNECY)
Paul Shellard (CAMBRIDGE)
Jean-Philippe Uzan (IAP, PARIS)
Licia Verde (BARCELONA)
Simon White (MPA, GARCHING)
Yvonne Wong (AACHEN)

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ABSTRACTS BOOK

COSMO·11

INTERNATIONAL CONFERENCE ON PARTICLE PHYSICS AND COSMOLOGY

22-26 AUGUST 2011 / PORTO PORTUGAL

Organizers

Centro de Astrofísica da Universidade do Porto

CEN TRA

With the support of

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QREN QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL PORTUGAL 2007.2013

UNIÃO EUROPEIA Fundo Europeu de Desenvolvimento Regional

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Graphic design and DTP by Paulo Pereira / CAUP
Printed in Porto, Portugal
August, 2011

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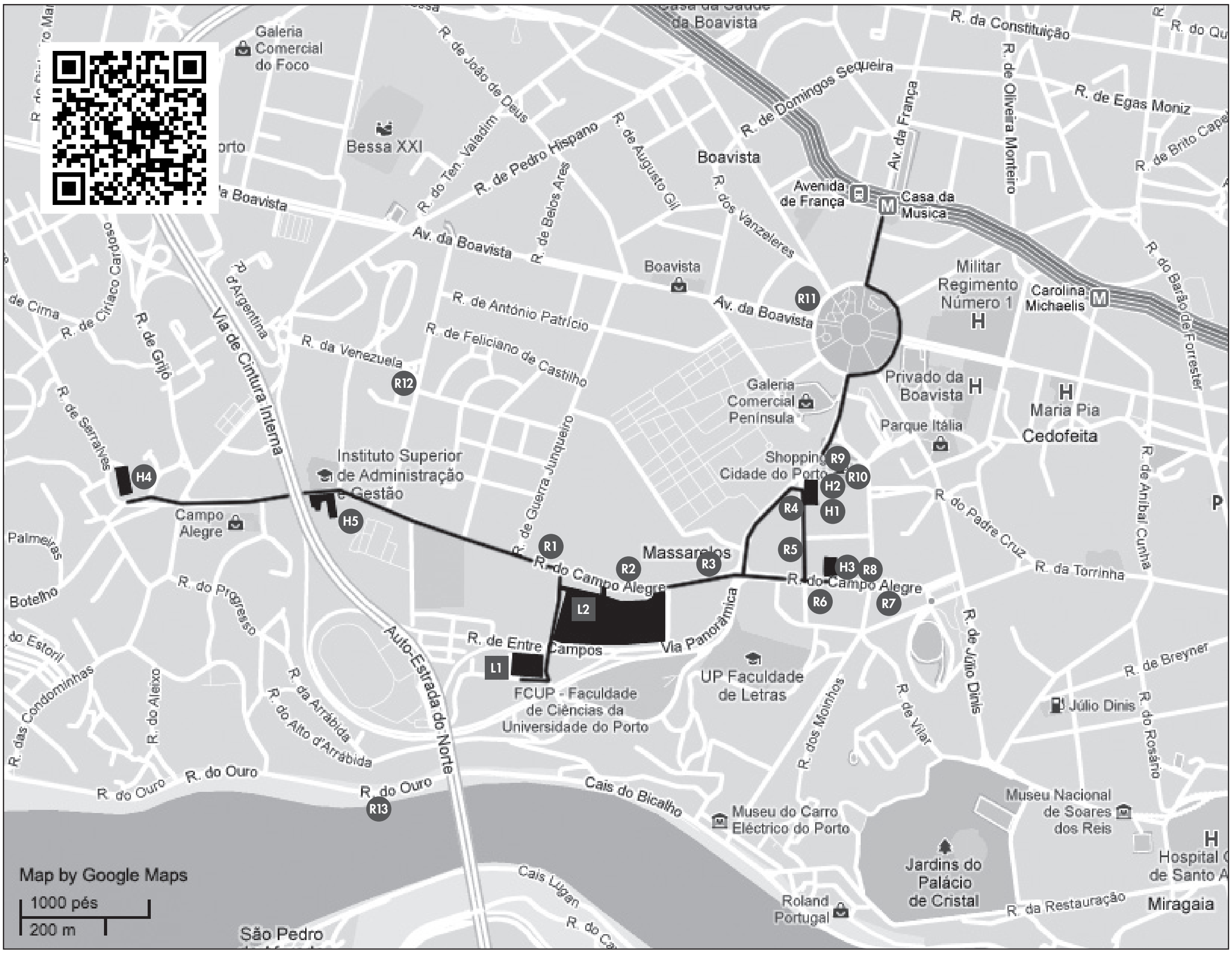
MAP



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CAPTION

L1 – CAUP CENTRO DE ASTROFÍSICA DA UNIVERSIDADE DO PORTO (Building Planetário do Porto)

L2 – FACULDADE DE CIÊNCIAS DA UNIVERSIDADE DO PORTO DEPARTAMENTO DE FÍSICA E ASTRONOMIA (Building FC3)

HOTELS

H1 – Tuela Porto

H2 – Fénix Porto

H3 – Ipanema Porto

H4 – Hotel Ipanema Park

H5 – Residência Universitária do Campo Alegre

RESTAURANTS

R1 – Alicantina

R2 – Duvália

R3 – Campo Alegre

R4 – Convívio

R5 – Restaurante Franganito

R6 – Capa Negra II

R7 – Cervejaria Galiza

R8 – Gambamar

R9 – Shopping Center Cidade do Porto

R10 – Casa Agrícola

R11 – Restaurante da Casa da Música

R12 – bbGourmet

R13 – Restaurante/ Pizzeria Casad'oro

PROGRAMME

SUNDAY, 21ST AUGUST

16:00—18:30	Registration
18:30—19:30	Porto d'Honra at CAUP/Planetarium building

MONDAY, 22ND AUGUST

09:00—09:45	Welcome and Opening Remarks by LOC & SC

PLENARY SESSION 1—CHAIR: D. LYTH

09:45—10:30	**Cosmological Parameters** Licia Verde (Barcelona)
10:30—11:00	Coffee break
11:00—11:45	**String Cosmology** Liam McAllister (Cornell)
11:45—12:30	**Supergravity and Inflationary Cosmology** Ana Achucarro (Leiden/Bilbao)
12:30—14:30	Lunch
14:30—16:30	PARALLEL SESSIONS INF1+CMB1+STR1
16:30—17:00	Coffee break
17:00—19:00	PARALLEL SESSIONS DEN1+NGA1+STR2
19:00—20:00	Poster session at Chemistry building

TUESDAY, 23RD AUGUST

PLENARY SESSION 2—CHAIR: L. ROSZKOWSKI

09:00—09:45	**Dark Matter Theory in Light of Recent Searches** Katherine Freese (Michigan)
09:45—10:30	**Direct Dark Matter Searches** Antonio Melgarejo (Columbia)
10:30—11:00	Coffee break
11:00—11:45	**Dark Matter Indirect Detections** Pierre Salati (Annecy)
11:45—12:30	**The Fine-Scale Structure of Dark Matter Halos** Simon White (Garching)
12:30—14:30	Lunch
14:30—16:30	PARALLEL SESSIONS INF2+CMB2+DMA1
16:30—17:00	Coffee break
17:00—19:00	PARALLEL SESSIONS DEN2+NGA2+DMA2
21:00—22:00	**Public talk** Jean-Philippe Uzan

WEDNESDAY, 24TH AUGUST

PLENARY SESSION 3—CHAIR: A. RIOTTO

09:00—09:45	**The Equivalence Principle and the Quest for New Physics** Federico Piazza (APC)
09:45—10:30	**Dark Energy Theory** Ed Copeland (Nottingham)
10:30—11:00	Coffee break
11:00—11:45	**Modifications of General Relativity and the Equivalence Principle** Jean-Philippe Uzan (IAP)
11:45—12:30	**Good things from brane back-reaction** Cliff Burgess (McMaster/PI)
12:30—13:15	**Big Bang Nucleosynthesis and the Cosmological Lithium Problem** Karsten Jedamzik (Montpellier)
13:15—15:30	Lunch
16:00—20:00	Guided tour
20:00—23:00	Conference dinner (Taylor's Cellars)

THURSDAY, 25TH AUGUST

PLENARY SESSION 4—CHAIR: K. ENQVIST

09:00—09:45	**SUSY at the LHC** Howard Baer (Oklahoma)
09:45—10:30	**Beyond Standard WIMPs** Ki Young Choi (Pusan)
10:30—11:00	Coffee break
11:00—11:45	**Update on Neutrino Cosmology** Julien Lesgourgues (CERN)
11:45—12:30	**Axions** Yvonne Wong (Aachen)
12:30—14:30	Lunch
14:30—16:30	PARALLEL SESSIONS INF3+CMB3+FUT1
16:30—17:00	Coffee break
17:00—19:00	PARALLEL SESSIONS DEN3+FUT2
21:00—22:00	**Public talk** Paul Shellard

FRIDAY, 26TH AUGUST

PARALLEL SESSION 5—CHAIR: J. LESGOURGUES

09:00—09:45	**Inflation**
	Antonio Riotto (CERN)
09:45—10:30	**Reheating After Inflation**
	Juan Garcia-Bellido (Madrid)
10:30—11:00	Coffee break
11:00—11:45	**Cosmic Magnetic Fields**
	Ruth Durrer (Geneva)
11:45—12:30	**Nongaussianity**
	Paul Shellard (Cambridge)
12:30—12:45	**Prize awards and COSMO·12 announcement**
12:45—13:00	Closing remarks
13:00	End

PROGRAMME / PARALLEL SESSIONS

MONDAY, 22ND AUGUST

STRING & BRANE COSMOLOGY (STR)

SESSION STR1: 14:30—16:30

14:30—14:50 **Detection of cosmic superstrings by test particle motion**
Betti Hartmann

14:50—15:10 **Kaluza-Klein Emission from Cosmic Super-Strings**
Jean-Francois Dufaux

15:10—15:30 **Primordial perturbations from polymer inflation**
Sanjeev Seahra

15:30—15:50 **Primordial non-Gaussianity from DBI Galileons**
Shuntaro Mizuno

15:50—16:10 **Non-Gaussianities from Modulated Reheating in String Inflation**
Ivonne Zavala

16:10—16:30 **Perturbations in Lee-Wick Bouncing Universe**
Inyong Cho

PROBING PARTICLE PHYSICS WITH CMB AND LSS (CMB)

SESSION CMB1: 14:30—16:30

14:30—14:50 **The Atacama Cosmology Telescope: An Update**
Sudeep Das

14:50—15:10 **First season results from QUIET**
Sigurd Næss

15:10—15:30 **Large-scale cosmic homogeneity in the WiggleZ survey**
Morag Scrimgeour

15:30—15:50 **The 6dF Galaxy Survey: Baryon Acoustic Oscillations and the Local Hubble Constant**
Florian Beutler

15:50—16:10 **Cosmological constraints from the XMM Cluster Survey**
Martin Sahlén

16:10—16:30 **Revisiting the ISW evidence**
Robert Crittenden

STRING & BRANE COSMOLOGY (STR)

SESSION STR2: 17:00—19:00

17:00—17:20 **Inflation from a Supersymmetric Axion Model**
Masahiro Kawasaki

17:20—17:40 **Doubly-charged scalar bosons, neutrino masses and dark matter**
Mayumi Aoki

17:40—18:00 **Cosmology with negative energy**
Tomislav Prokopec

18:00—18:20 **Screening of cosmological constant for De Sitter Universe, phantom-divide crossing and finite-time**
Kazuharu Bamba

18:20—18:40 **On the Vainshtein mechanism for two body system in DGP model**
Takashi Hiramatsu

18:40—19:00 **Spectrum from the warped compactifications with the de Sitter universe**
Masato Minamitsuji

NON-GAUSSIANITIES (NGA)

SESSION NGA1: 17:00—19:00

17:00—17:20 **Maximising the scientific return from cosmic non-Gaussianity**
Christian Byrnes

17:20—17:40 **New shapes of non-Gaussianities from the effective field theory of inflation**
Matteo Fasiello

17:40—18:00 **Quasi-Feynman Rules for Calculating n-Point Correlators of the Primordial Curvature Perturbation**
Yeinzon Rodriguez Garcia

18:00—18:20 **Second Order Perturbations During Inflation Beyond Slow-roll**
Ian Huston

18:20—18:40 **On the evolution of non-Gaussianity**
David Mulryne

18:40—19:00 **Non-Gaussianities from failed trapping events during inflation**
Diana Battefeld

INFLATION & PHASE TRANSITIONS (INF)

SESSION INF1: 14:30—16:30

14:30—14:50 **Multi-field open inflation and the effect of interaction on tunneling**
Kazuyuki Sugimura

14:50—15:10 **Black hole formation by the waterfall field of hybrid inflation**
David Lyth

15:10—15:30 **Inhomogeneous inflation**
Krzysztof Bolejko

15:30—15:50 **Calm Excited States of Inflation**
Amjad Ashoorioon

15:50—16:10 **Oscillations in the inflaton potential: Exact numerical analysis and comparison with the recent and forthcoming CMB datasets**
Dhiraj Kumar Hazra

16:10—16:30 **An alternative scenario of inflation**
Erandy Ramirez

DARK ENERGY & MODIFIED GRAVITY (DEN)

SESSION DEN1: 17:00—19:00

17:00—17:20 **Resonant Dark Energy and Cosmic Magnetic Fields**
Federico Urban

17:20—17:40 **Detecting Dark Energy via Electrostatic Analogy**
Katherine Jones-Smith

17:40—18:00 **Orthogonal non-Gaussianities from Dirac-Born-Infeld Galileon inflation**
Sébastien Renaux-Petel

18:00—18:20 **Modified gravity with an extra force: Lagrangian description and stability**
Valerio Faraoni

18:20—18:40 **On Galilean invariant scalar field theories in curved space time**
Parvin Moyassari

18:40—19:00 **Nonmetricity in cosmology**
Tomi Koivisto

PARALLEL SESSIONS

TUESDAY, 23RD AUGUST

INFLATION & PHASE TRANSITIONS (INF)

SESSION INF2: 14:30—16:30

14:30—14:50	**Curvaton model completed** Rose Lerner
14:50—15:10	**Curvaton with a double well potential** Osamu Seto
15:10—15:30	**Oscillons after inflation** Mustafa Amin
15:30—15:50	**A Multiresolution View of Thermalization and Entropy Flow after Preheating** Jonathan Braden
15:50—16:10	**New Aspects of (p)Reheating** Daniel G. Figueroa
16:10—16:30	**Preheating with the Brakes On: The Effects of a Speed Limit** Johanna Karouby

DARK MATTER & OTHER RELICS (DMA)

SESSION DMA1: 14:30—16:30

14:30—14:50	**Constraining the CMSSM with dark matter direct detection results** Christopher Savage
14:50—15:10	**Probing dark matter streams with DAMA and CoGeNT** Aravind Natarajan
15:10—15:30	**Anisotropies in the diffuse gamma-ray background as measured by the Fermi-LAT** Alessandro Cuoco
15:30—15:50	**Constraints on Dark Matter from Observations of Compact Stars** Petr Tinyakov
15:50—16:10	**Asymmetric Dark Matter** Chris Kouvaris
16:10—16:30	**Photon spectra from WIMPs annihilation** Alvaro de la Cruz Dombriz

NON-GAUSSIANITIES (NGA)

SESSION NGA2: 17:00—19:00

17:00—17:20	**Non-Gaussianity in single field models without slow-roll** Johannes Noller
17:20—17:40	**Large slow-roll corrections to the bispectrum of noncanonical inflation** Raquel H. Ribeiro
17:40—18:00	**Non-Gaussian perturbations from mixed inflaton-curvaton scenario** José Fonseca
18:00—18:20	**DBI vector fluxes as curvatons and statistical anisotropy in the CMB** Konstantinos Dimopoulos
18:20—18:40	**Dominance of gauge artifact in the consistency relation for the primordial bispectrum** Yuko Urakawa
18:40—19:00	**Isocurvature perturbations in generalized gravity** Seoktae Koh

DARK MATTER & OTHER RELICS (DMA)

SESSION DMA2: 17:00—19:00

17:00—17:20	**Pangenesis in a Baryon-Symmetric Universe: Dark and Visible Matter via the Affleck-Dine Mechanism** Kalliopi Petraki
17:20—17:40	**Dark Matter, Baryogenesis and Neutrino Oscillations from Right Handed Neutrinos** Marco Drewes
17:40—18:00	**Direct Detection of Leptophilic Dark Matter in radiative seesaw model** Takashi Toma
18:00—18:20	**Thermal axion production in the primordial quark-gluon plasma** Peter Graf
18:20—18:40	**Gravitino dark matter and baryon asymmetry from Q-ball decay in gauge mediation** Shinta Kasuya
18:40—19:00	**Non spherical collapse halo mass function and the excursion set theory** Ixandra Achitouv

PROBING PARTICLE PHYSICS WITH CMB AND LSS (CMB)

SESSION CMB2: 14:30—16:30

14:30—14:50	**Structure formation with clustering quintessence** Filippo Vernizzi
14:50—15:10	**Coupled Quintessence and the Halo Mass Function** Ewan Tarrant
15:10—15:30	**Do baryons trace dark matter in the early universe?** Daniel Grin
15:30—15:50	**Bullet Cluster: A Challenge to LCDM Cosmology** Jounghun Lee
15:50—16:10	**Non-Adiabaticity from Adiabatic Perturbations** Iain Brown
16:10—16:30	**N-body simulations with generic non--Gaussian initial conditions** Christian Wagner

DARK ENERGY & MODIFIED GRAVITY (DEN)

SESSION DEN2: 17:00—19:00

17:00—17:20	**Uncertainties on LCDM through inhomogeneities** Alexander Wiegand
17:20—17:40	**Confirming large-scale homogeneity and acceleration with the CMB** James Zibin
17:40—18:00	**Probing Backreaction Effects with Supernova Data** Marina Seikel
18:00—18:20	**On the Possibility of a Poincaré Gauge Theory as an Averaged Theory of Gravity** Juliane Behrend
18:20—18:40	**Light-cone averaging in cosmology: formalism and applications** Giovanni Marozzi
18:40—19:00	**Dark goo: Bulk viscosity as an alternative to dark energy** Jean-Sebastien Gagnon

PARALLEL SESSIONS

THURSDAY, 25TH AUGUST

INFLATION & PHASE TRANSITIONS (INF)

SESSION INF3: 14:30—16:30

14:30—14:50 **Higgs Inflation—consistency and possibilities**
Fedor Bezrukov

14:50—15:10 **Higgs-Dilaton Cosmology: From the Early to the Late Universe**
Daniel Zenhaeusern

15:10—15:30 **Temperature dependence of CP-violation in the Standard Model**
Olli Taanila

15:30—15:50 **Sneutrino Hybrid Inflation and Nonthermal Leptogenesis**
Jochen Baumann

15:50—16:10 **Cosmology in natural GUT**
Nobuhiro Maekawa

16:10—16:30 **Helical magnetic fields from inflation**
Rajeev Jain

FUTURE PROBES OF FUNDAMENTAL PHYSICS (FUT)

SESSION FUT1: 14:30—16:30

14:30—14:50 **On Testing Superstring Theories with Gravitational Waves**
Jasper Hasenkamp

14:50—15:10 **Constraints on the fundamental string coupling from future B-mode experiments**
Levon Pogosian

15:10—15:30 **Probing modified gravity with Euclid-like spectroscopic surveys**
Elisabetta Majerotto

15:30—15:50 **Parametrizations of the growth index and EUCLID forecasts**
Alicia Bueno Belloso

15:50—16:10 **Effect of baryonic feedback on cosmic shear tomography**
Elisabetta Semboloni

16:10—16:30 **BAO simulation dedicated to the Large Synoptic Survey Telescope**
Alexia Gorecki

DARK ENERGY & MODIFIED GRAVITY (DEN)

SESSION DEN3: , 17:00—19:00

17:00—17:20 **Testing General Relativity using the Environmental Dependence of Dark Matter Halos**
Gongbo Zhao

17:20—17:40 **Measuring dark energy with the WiggleZ Survey**
Chris Blake

17:40—18:00 **Non-parametric Reconstruction of Dark Energy Equation of State from Diverse Datasets**
Ujjaini Alam

18:00—18:20 **Tests of Modified Gravity theories using Redshift-space distortion measurements from WiggleZ**
David Parkinson

18:20—18:40 **Power of Weak Lensing in Constraining Modified Matter and Gravity Theories**
Stefano Camera

18:40—19:00 **Halo properties in modified gravity theories with self-accelerated expansion**
Tatsuya Narikawa

FUTURE PROBES OF FUNDAMENTAL PHYSICS (FUT)

SESSION FUT2: 17:00—19:00

17:00—17:20 **Falsifying Paradigms for Cosmic Acceleration**
Dragan Huterer

17:20—17:40 **New probe of dark energy: coherent motions from redshift distortion**
Yong-Seon Song

17:40—18:00 **Precision Cosmology with Weak Gravitational Lensing**
Andrew Hearin

18:00—18:20 **Constraints on Primordial non-Gaussianity from the Large-Scale Structure**
Emiliano Sefusatti

18:20—18:40 **Primordial non-Gaussianity from the 21 cm Power Spectrum during the Epoch of Reionization**
Shahab Joudaki

18:40—19:00 **Primordial non-Gaussianity and CMB statistical anisotropies**
Nicola Bartolo

PROBING PARTICLE PHYSICS WITH CMB AND LSS (CMB)

SESSION CMB3: 14:30—16:30

14:30—14:50	**Long-lived charged SUSY particles with BBN, LSS and CMB** Kazunori Kohri	
14:50—15:10	**Light Propagation through exact non-linear inhomogeneities in LCDM cosmology** Nikolai Meures	
15:10—15:30	**Vorticity in the Early Universe** Adam Christopherson	
15:30—15:50	**Observational Challenges to the Self-accelerating DGP Model** Wenjuan Fang	
15:50—16:10	**Nonlinear Biasing and Redshift-Space Distortions in Lagrangian Resummation Theory and N-body Simulations** Masanori Sato	
16:10—16:30	**Extreme Value Theory and Primordial Non-Gaussianity** Sirichai Chongchitnan	

LIST OF POSTERS

C1 Ricardo Chavez
The Expansion History of the Universe Unveiled with H II Galaxies

C2 Guo Chin Liu
Improved ISW effect detection through the CMB polarization assistence

C3 David Oliveira
GPGPU Cosmological N-Body Particle-Particle Simulations

C4 Felipe Marin Perucci
The galaxy 3-point correlation function of WiggleZ galaxies

C5 Guido Walter Pettinari
Quantifying nonlinear contributions to the CMB bispectrum in Synchronous gauge

C6 Maresuke Shiraishi
CMB bispectrum of scalar, vector and tensor modes sourced from primordial magnetic fields

C7 Nicolas Van de Rijt
Multi-fluid renormalized perturbation theory and massive neutrinos

C8 Mei-Yu Wang
Utilizing Large-Scale Structure to Constrain Unstable Dark Matter

C9 Hu Zhan
Rees-Sciama effect and impact of foreground structures on galaxy redshifts

D1 Je-An Gu
Cosmological Perturbations in f(R) Gravity

D2 Florian Kühnel
Islands of Stability for Consistent Deformations of Einstein's Gravity

D3 Jae-Heon Lee
Roles of Dark Energy Perturbations in Dynamical Dark Energy Models: Can We Ignore Them?

D4 Archan S. Majumdar
Future deceleration due to effect of event horizon on backreaction from inhomogeneities

D5 Ariadna Montiel
Observational Constraints on bulk viscous matter-dominated models

D6 Chan-Gyung Park
Constraints on a f(R) gravity dark energy model with early scaling evolution

D7 Olga Sergijenko
Observational constraints on scalar field models of dark energy with barotropic equation of state

D8 Rafal Szepietowski
Bayesian reconstruction of the gravitational potential from weak lensing

D9 Arlindo Trindade
Impact of Primordial Non-Gaussianities (fnl) on the effective dark energy equation of state

F1 Laila Alabidi
Second Order Gravitational Waves in Hilltop Type Inflation Models

F2 Adam Becker
Projecting Constraints on Scale-Dependent Non-Gaussianity

F3 Marzieh Farhang
Semi-blind Analysis of Uncertainties in Recombination Histoy

F4 Dominic Galliano
Estimating g_{NL} for Planck

F5 Giulia Gubitosi
Testing Spacetime Symmetries with CMB polarization data

F6 Annarita Margiotta
The ANTARES neutrino telescope: status and results

F7 Tuukka Meriniemi
Gravitational Waves from Fermionic Preheating

I1 Mar Bastero-Gil
Observational CMB predictions from warm inflation

I2 Joseph Elliston
Chaotic inflation in modified gravitational theories

I3 Daniil Gelfand
Quantum theory of fermion production after inflation

I4 Jinn-Ouk Gong
Classical Non-gaussianity From Non-linear Evolution of Curvature Perturbation

I5 Kohei Kumazaki
Fine Features in the Primordial Power Spectrum

I6 Atsushi Naruko
Conservation of the nonlinear curvature perturbation in generic single-field inflation

I7 Gianmassimo Tasinato
Inflationary Correlation Functions without Infrared Divergences

I8 Jacques Wagstaff
A Compelling Vector Curvaton Model and its distinct Observational Signatures

I9 Daniel Yueker
Modeling Phase Transitions in Dynamical Environments

M1 Thorsten Battefeld
A grazing ESP encounter during Inflation

M2 Miguel Costa
SIMPLE Dark Matter Search

M3 Luiz de Viveiros
Searching for Dark Matter: The LUX Experiment

M4 Alexander Kartavtsev
Systematic analysis of leptogenesis in non-equilibrium QFT

M5 Koichi Miyamoto
Cosmological effects of decaying cosmic string loops with TeV scale width

M6 Alberto Salvio
Towards leptogenesis at NLO: the right-handed neutrino interaction rate

M7 Levent Selbuz
Sneutrino Dark Matter: Symmetry Protection and Cosmic Ray Anomalies

N1 Frederico Arroja
A note on the role of the boundary terms for the non-Gaussianity in general k-inflation

N2 Juan Carlos Bueno Sanchez
Stochastic growth of vector field condensates during inflation

N3 Mindaugas Karciauskas
The Curvature Perturbation from General non-Abelian Vector Fields

N4 Nina Kevlishvili
Renormalised multi-field hybrid inflation

N5 Stefano Orani
Non-Gaussianity from the hybrid potential

N6 Ryo Saito
Features in the primordial power spectrum from coherent scalar-field oscillations

N7 Eleftheria Tzavara
Bispectra from two-field inflation using the long-wavelength formalism

S1 Fabio Capela
Black Hole Mechanics and Massive Gravity

S2 Mafalda Dias
Inflation at the boundary of de Sitter

S3 Koushik Dutta
The Overshoot Problem in Inflation after Tunneling

S4 Jonathan Frazer
Landscape Architecture

S5 Philippe Journeau
Inflation and Universe complexity

S6 Joao Rosa
Warming up brane-antibrane inflation

S7 Danielle Wills
Statistical Anisotropy from D-brane Inflation

PLENARY SESSIONS

SUPERGRAVITY AND INFLATIONARY COSMOLOGY

Ana Achúcarro – Leiden/Bilbao

This talk will discuss various aspects of non-decoupling in inflationary cosmology, in particular the (observable) effects of very heavy fields present during inflation. There is recent progress in understanding slow roll inflation with sharp turns, which is generic in Supergravity and Superstring models. The primordial perturbations show features in the power spectrum and non-gaussianities that are correlated and potentially detectable. This opens the possibility to detect fields much heavier than the scale of inflation in the next generation of cosmic microwave background observations.

SUSY AT THE LHC

Howard Baer – Oklahoma

Supersymmetric theories of particle physics fix a host of problems in the Standard Model, while receiving some indirect support from experiment. They predict a host of new matter states many of which ought to be accessible to CERN LHC searches. They also allow for at least four cold dark matter (CDM) candidates: 1. the lightest neutralino (a WIMP), 2. the gravitino (a superWIMP), 3. the axino, (superpartner to the axion) and 4. a sneutrino. I review the latest searches for SUSY from Atlas and CMS, and what these imply for supersymmetric theories and the dark matter of the universe.

GOOD THINGS FROM BRANE BACK-REACTION

Cliff Burgess – McMaster/PI

In a nutshell brane physics has had two lesson for those who worry about naturalness problems and hierarchies: having a low gravity scale reduces ultraviolet sensitivity (think large extra dimensions); and brane back-reaction can be important (think warping and Randall-Sundrum models). But the effects of back-reaction are largely unexplored, apart from for codimension-1 branes (think again of Randall Sundrum models), and one dimension rarely gives a good indication of what can be expected from higher dimensions. This talk summarizes recent progress on understanding back-reaction for higher codimension branes, together with some interesting new implications they can have for particle physics and cosmology.

BEYOND STANDARD WIMPS

Ki Young Choi – Pusan

The identification of dark matter is one of the most important problem of modern cosmology. I will talk about the candidates of dark matter beyond standard WIMPs, especially for the gravitino and axino dark matter and its relation to the early Universe and collider experiments.

DARK ENERGY THEORY

Ed Copeland – Nottingham

Abstract not available at the time of printing.

COSMIC MAGNETIC FIELDS

Ruth Durrer – Geneva

I shall review the possibilities to generate the cosmological seeds of the magnetic fields observed in galaxies and cluster in the early Universe. Besides the generation of magnetic fields with sufficient large scale structure during inflation or during phase transitions in the early Universe, I shall discuss the possibility to detect them in the cosmic microwave background or by the gravitational wave background they generate. I shall also mention new observational lower limits on intergalactic magnetic fields and the challenge these represent for the hypothesis that magnetic fields are generated at late time during the process of galaxy formation.

DARK MATTER THEORY IN LIGHT OF RECENT SEARCHES

Katherine Freese – Michigan

Theoretical particle physics has provided a number of compelling candidates for dark matter particles. After a brief review of the possibilities, I will focus on the best-motivated among them: Weakly Interacting Massive Particles. Excitement pervades the community because of anomalous results in a variety of experiments worldwide that may be hints of detection; these include both direct (DAMA, CoGeNT) and indirect detection (PAMELA, HEAT, FERMI) experiments. If the current hints of detection are right, then theorists are forced to rethink the simplest models of WIMP interactions with ordinary matter. Upcoming experiments should be able to conclusively test the WIMP hypothesis in the coming decade. Another approach to dark matter searches would be the discovery of dark stars, a phase of stellar evolution in which early stars are powered by dark matter annihilation.

REHEATING AFTER INFLATION

Juan Garcia-Bellido – Madrid

In this talk I will give a general review of the present status on the theory of preheating and reheating after inflatior, as well as the phenomenological signatures we may detect in the future from a gravitational wave background, cosmological magnetic fields and baryogenesis.

BIG BANG NUCLEOSYNTHESIS AND THE COSMOLOGICAL LITHIUM PROBLEM

Karsten Jedamzik – Montpellier

The light elements of ^{2}H, ^{3}He, ^{4}He, and ^{7}Li are synthesized in appreciable amounts during the hot Big Bang between ~ 1-1000 seconds. A comparison between observationally inferred and theoretically predicted abundances of these light elements may be used to meaningfully constrain the conditions of the early Universe and physics beyond the standard model of particle physics. Within the standard Big Bang nucleosynthesis scenario at baryon density as given by WMAP this comparison is in agreement for ^{2}H, inconclusive for ^{3}He and ^{4}He, and significantly discrepant for ^{7}Li. Astrophysical and physics beyond the standard model solution to this cosmological ^{7}Li problem are discussed. A possible cosmological ^{6}Li problem is also highligthed.

UPDATE ON NEUTRINO COSMOLOGY

Julien Lesgourgues – CERN

I will review the constraints on neutrino abundances, masses, chemical potentials and other neutrino properties, based on available cosmological data. I will also summarize progresses in modelling and computing the impact of neutrinos on cosmological observables, including in the non-linear regime. Finally I will discuss the possible impact of future data on neutrino parameter extraction.

STRING COSMOLOGY

Liam McAllister – Cornell

After presenting the motivation for using string theory to describe the very early universe, I will review recent attempts to realize inflation, or an alternative to inflation, in string theory.

DIRECT DARK MATTER SEARCHES

Antonio Melgarejo – Columbia

The existence of some missing matter in the universe was first postulated about 80 years ago. Since then we have collected very striking evidences for the existence of the so called dark matter, but it's nature remains unknown. Weakly Interacting Massive Particles are one of the most promising candidates for dark matter, and multiple experiments around the world are trying to detect them through the observation of its elastic interaction with target nuclei. In this talk we will review the challenges for any direct dark matter search and the latest results of the different direct dark matter experiments currently working.

THE EQUIVALENCE PRINCIPLE AND THE QUEST FOR NEW PHYSICS

Federico Piazza – APC, Paris

I will emphasize the role of the equivalence principle (EP) for modeling and testing the physics beyond General Relativity and the Standard Model and outline its present experimental status. Violations of the EP are in fact predicted by string-inspired scenarios and models of dark energy/modified gravity in which light degrees of freedom couple to ordinary matter. Finally, I will mention a recent attempt to modify General Relativity at large distances by enforcing an even stronger version of the EP.

INFLATION

Antonio Riotto – CERN

An overview of the phenomenology and observational status of inflation wll be given with particular emphasis on the theoretical challenges we might be facing the next few years.

DARK MATTER INDIRECT DETECTIONS

Pierre Salati – LAPTH, Annecy

Weakly interacting and massive particles (WIMP) have been suggested as plausible candidates to the astronomical dark matter (DM). Should these putative species exist, they would continuously annihilate within the Milky Way halo and yield rare antimatter particles – such as antiprotons and positrons – as well as high-energy gamma-rays and neutrinos.
The discovery three years ago of a cosmic ray letpon anomaly has raised the tremendous hope that WIMPs were not just a fantasy. Alas, the dust has now settled down and we are still hunting for them. I will review the current experimental and theoretical searches for the indirect presence of DM species inside the Milky Way halo. I will pay particular attention to the astrophysical backgrounds inside which the various signals are hidden.

NON-GAUSSIANITY

Paul Shellard – Cambridge

Some of the most stringent tests of the standard inflationary cosmology relate to its statistical properties beyond the power spectrum: primordial fluctuations are predicted to deviate from Gaussianity by less than 1 part in a million. New high resolution experiments will place standard inflation firmly in the dock, especially forthcoming data from the Planck satellite survey of the cosmic microwave background (CMB). I will describe new modal estimator methods which allow the efficient and optimal extraction of higher order correlators (the bispectrum and trispectrum) from these large datasets. I will review current polyspectra constraints from the WMAP CMB maps and forecasts for Planck, as well as applications to large-scale structure. I will discuss future prospects for uncovering non-Gaussian signatures of new physics from the early universe.

MODIFICATIONS OF GENERAL RELATIVITY AND THE EQUIVALENCE PRINCIPLE

Jean-Philippe Uzan – IAP, Paris

Most extensions of general relativity involve a violation of the equivalence principle, either in its weak or strong form. The relations between the local position invariance and the universality of free fall will be reviewed, as well as the progresses to test the equivalence principle on astrophysical scales, using fundamental constants. Mechanisms aiming at "hiding" these violations and the link with dark energy models will be discussed.

COSMOLOGICAL PARAMETERS

Licia Verde – Barcelona

The standard cosmological model, the so called ΛCDM model, is specified by 6 basic cosmological parameters. The precision on their value has steadily improved over the years with new data and observations.
More recently the focus has shifted towards modeling, and constraining or detecting possible deviations from the standard cosmological model. While for many physically motivated deviations it is relatively easy to find a suitable parameterization, add new parameters to be basic 6 and constrain these extra cosmological parameters, there are many interesting possible deviations with are not straightforwardly described by few extra cosmological parameters.
It is nevertheless a interesting avenue as deviations from the ΛCDM model have deep implications with and connection to fundamental physics. I will briefly review the status of cosmological parameters determination and show some examples of testing deviations from the standard cosmological model.

THE FINE-SCALE STRUCTURE OF DARK MATTER HALOS

Simon White – MPA, Garching

At the time of recombination, 400,000 years after the Big Bang, the structure of the dark matter distribution was extremely simple and can be inferred directly from observations of structure in the cosmic microwave background. At this time dark matter particles had small thermal velocities and their distribution deviated from uniformity only through a gaussian field of small density fluctuations with associated motions. Later evolution was driven purely by gravity and so obeyed the collisionless Boltzmann equation. This has immediate consequences for the present distribution of dark matter, even in extremely nonlinear regions such as the part of the Galaxy where the Sun resides. I will show how this structure can be followed in full generality by integrating the Geodesic Deviation Equation in tandem with the equations of motion in high-resolution N-body simulations, enhancing their effective resolution by more than 10 orders of magnitude, and permitting a detailed treatment of annihilation radiation from caustics within LCDM halos. I will also discuss how the predicted distribution at the Sun's position impacts the expectations for laboratory experiments seeking to detect the dark matter directly, in particular, the possibility of extremely narrow line signals that may be visible in axion detectors.

AXIONS

Yvonne Wong – Aachen

I review the role of the QCD axion in cosmology as a potential dark matter candidate, and discuss current cosmological and astrophysical constraints on axions and axion-like particles.

PARALLEL SESSIONS
STRING & BRANE COSMOLOGY (STR)

DETECTION OF COSMIC SUPERSTRINGS BY TEST PARTICLE MOTION

Betti Hartmann – Jacobs University Bremen

It was believed for a long time that the fundamental entities of String Theory are not observable on cosmic scales. However, inflationary models that result from String Theory almost always predict the production of cosmic superstrings at the end of inflation. The objects formed are so-called D- and F-strings, where D stands for Dirichlet and F for fundamental. Also bound states of p F- and q D-strings, so-called p-q-strings are possible. It is thus of great importance to understand how such objects can be detected in the universe. Considerable effort has been put into the prediction of cosmic superstring signatures in the Cosmic Microwave background (CMB). In this talk, I will discuss another possibility to detect cosmic superstrings, namely through the way that test particles move in their space-time. I will first present solutions to the geodesic equation in the space-time of black holes pierced by infinitely thin cosmic strings in which case the solutions can be given explicitly in terms of elliptic functions. I will then discuss our results for the space-time of finite width cosmic strings, in particular for the space-time of field theoretical p-q-strings. In the latter case, the solutions of the geodesic equation have to be computed numerically.

KALUZA-KLEIN EMISSION FROM COSMIC SUPER-STRINGS

Jean-Francois Dufaux – APC, Universite Paris 7

Cosmic super-strings, fundamental objects of string theory that grow to cosmic size and evolve as a network of cosmic strings, may open a new window to look for observational signatures of string theory, if these signatures can be distinguished from the ones of oridnary (field theory) cosmic strings. One specific aspect of cosmic super-strings is that they interact generically with relatively light and / or strongly coupled Kaluza-Klein modes associated with the geometry of the internal space. In this talk, I will discuss the production of Kaluza-Klein modes by cosmic super-strings, their cosmological consequenses and the resulting constraints on the parameters of cosmic super-strings' networks.

PRIMORDIAL PERTURBATIONS FROM POLYMER INFLATION

Sanjeev Seahra – University of New Brunswick

Inflationary perturbations provide a “Planck scale microscope” that allow us to access scales relevant to quantum gravity. One of the possible outcomes of the loop quantum gravity programme is that conventional Schrodinger quantization may be replaced by a fundamentally discrete algorithm at very small scales: namely, polymer quantization. In this talk, we determine the effects of polymer quantization on the spectrum of primordial perturbations, building on previous work that demonstrated how the polymer quantization of a massless scalar can drive inflation.

PRIMORDIAL NON-GAUSSIANITY FROM DBI GALILEONS

Shuntaro Mizuno – University of Portsmouth

We study primordial fluctuations generated during inflation in a class of models motivated by the DBI Galileons, which are extensions of the DBI action that yield second order field equations. This class of models generalises the DBI Galileons in a similar way with K-inflation. We calculate the primordial non-Gaussianity from the bispectrum of the curvature perturbations at leading order in the slow-varying approximations. We show that the estimator for the equilateral-type non-Gaussianity, f_{NL}^{equil}, can be applied to measure the amplitude of the primordial bispectrum even in the presence of the Galileon-like term although it gives a slightly different momentum dependence from K-inflation models. For the DBI Galileons, we find 0.32 < f_{NL}^{equil} < -0.16 and large primordial non-Gaussianities can be obtained when c_s is much smaller than 1 as in the usual DBI inflation. In G-inflation models, where a de Sitter solution is obtained without any potentials, the non-linear parameter is given by $f_{NL}^{equil} = 4.62\, r^{-2/3}$ where r is the tensor to scalar ratio, giving a stringent constraint on the model.

NON-GAUSSIANITIES FROM MODULATED REHEATING IN STRING INFLATION

Ivonne Zavala – Physics Institute, University of Bonn

I will discuss a concrete and successful implementation of the modulated reheating mechanism to generate large non-Gaussianities from inflation, in the Large Volume scenarios of type IIB string theory.

PERTURBATIONS IN LEE-WICK BOUNCING UNIVERSE

Inyong Cho – Seoul National University of Science & Technology

We will present numerical calculations of perturbations in the N=2 Lee-Wick bouncing universe. We analyze precisely the constant mode and the decay mode of the perturbation during the bouncing phase. We will also comment on the N>2 cases.

INFLATION FROM A SUPERSYMMETRIC AXION MODEL

Masahiro Kawasaki – Institute for Cosmic Ray Research, University of Tokyo

We show that a supersymmetric axion model naturally induces a hybrid inflation with the waterfall field identified as a Peccei-Quinn scalar. The Peccei-Quinn scale is predicted to be around 10^{15} GeV for reproducing the large-scale density perturbation of the Universe. After the built-in late-time entropy-production process, the axion becomes a dark matter candidate. Several cosmological implications are discussed.

DOUBLY-CHARGED SCALAR BOSONS, NEUTRINO MASSES AND DARK MATTER

Mayumi Aoki – Kanazawa University

We consider the extended Higgs models, in which one of the isospin doublet scalar fields carries the hypercharge Y=3/2. Such a doublet field $\Phi_{3/2}$ is composed of a doubly charged scalar boson as well as a singly charged one. We first discuss a simple model with $\Phi_{3/2}$, and study its collider phenomenology at the LHC. We then consider a new model for radiatively generating neutrino masses with a dark matter candidate, in which $\Phi_{3/2}$ and an extra Y=1/2 doublet as well as vector-like singlet fermions carry the odd quantum number for an unbroken discrete Z_2 symmetry. It is found that the doubly charged scalar bosons in these models show different phenomenological aspects from those which appear in models with a Y=2 isospin singlet field or a Y=1 triplet one. They could be clearly distinguished at the LHC.

COSMOLOGY WITH NEGATIVE ENERGY

Tomislav Prokopec – ITP and Spinoza Institute

We show that there is a class of nonlocal cosmologies consistent with many observations starting with a Universe with a negative cosmological term. These models are particularly attractive for string theory, since stable string theory vacua have negative energy.

SCREENING OF COSMOLOGICAL CONSTANT FOR DE SITTER UNIVERSE, PHANTOM-DIVIDE CROSSING AND FINITE-TIME FUTURE SINGULARITIES IN NON-LOCAL GRAVITY

Kazuharu Bamba – Kobayashi-Maskawa Institute for the Origin of Particles and the Universe, Nagoya University

We investigate de Sitter solutions in non-local gravity as well as in non-local gravity with Lagrange constraint multiplier. We examine a condition to avoid a ghost and discuss a screening scenario for a cosmological constant in de Sitter solutions. Furthermore, we explicitly demonstrate that three types of the finite-time future singularities can occur in non-local gravity and explore their properties. In addition, we evaluate the effective equation of state for the universe and show that the late-time accelerating universe may be effectively the quintessence, cosmological constant or phantom-like phases. In particular, it is found that there is a case in which a crossing of the phantom divide from the non-phantom (quintessence) phase to the phantom one can be realized when a finite-time future singularity occurs. Moreover, it is demonstrated that the addition of an R^2 term can cure the finite-time future singularities in non-local gravity. It is also suggested that in the framework of non-local gravity, adding an R^2 term leads to possible unification of the early-time inflation with the late-time cosmic acceleration.

ON THE VAINSHTEIN MECHANISM FOR TWO BODY SYSTEM IN DGP MODEL

Takashi Hiramatsu – Yukawa Institute for Theoretical Physics, Kyoto University

We study the Vainshtein mechanism for a two-body system like the Earth-Moon system in the DGP model. It is well known that the dynamical scalar d.o.f. in the model, so-called the brane-bending mode, plays an important role on the orbit of a bounded system, for example, the precession of the Moon orbit around the Earth predicted in GR is modified. However, in such stdies so far, we have not considered the strong non-linear interaction of the scalar field around the objects, which promotes to recover GR around the objects (the Vainshtein mechanism). In our presentation, we show that the effect of a small object (like the Moon) around a massive object (like the Earth) cannot be treated in a perturbative way, and thus the observational predictions we have known so far may be corrected.

SPECTRUM FROM THE WARPED COMPACTIFICATIONS WITH THE DE SITTER UNIVERSE

Masato Minamitsuji – Kyoto University

We discuss the spectrum of the tensor metric perturbations and the stability of warped compactifications with the de Sitter spacetime in the higher-dimensional gravity with and without matter fields. The spacetime structure is given in terms of the warped product of the noncompact direction, the spherical internal dimensions and the four-dimensional de Sitter spacetime. To realize the finite bulk volume, we construct the brane world model by the cut-copy-paste method. We compactify the spherical directions on the brane. In any case, we ensure the existence of the massless zero mode and the mass gap with the Kaluza-Klein (KK) continuum due to the warp. Although the brane involves the spherical dimensions, no light mode is excited. We also investigate the scalar perturbations, and show that the model is unstable due to the tachyonic bound state which seems to have the universal negative mass square, irrespective of the number of spacetime dimensions and kinds of the bulk matter. We also discuss the four-dimensional effective theory and the moduli stabilization.

PARALLEL SESSIONS

INFLATION & PHASE TRANSITIONS (INF)

MUTLI-FIELD OPEN INFLATION AND THE EFFECT OF INTERACTION ON TUNNELING

Kazuyuki Sugimura – YITP

In a multi-field open inflation model, the inflaton starts slow-rolling after tunneling of another field. In previous studies, they assumed that the inflaton field does not affect the tunneling. It was not known whether multi-field instanton with gravity exists when we consider the interaction between the inflaton and the tunneling field. We find that there exists a solution for multi-field instanton. We use this solution to describe tunneling in multi-field open inflation, and solve the evolution of the universe after tunneling to make sure that slow-roll inflation lasts more than 60 e-foldings. We find a solution which realizes the multi-field open inflation scenario. We also investigate the effect of the interaction on false vacuum decay rate. Decay rate tends to increase when the effect of the interaction is taken into consideration.

BLACK HOLE FORMATION BY THE WATERFALL FIELD OF HYBRID INFLATION

David Lyth – Lancaster University

A contribution to the curvature perturbation will be generated by the waterfall field of hybrid inflation. Following our earlier work (arXiv:1012.4617), we identify the region of parameter space within which this contribution leads to the overproduction of primordial black holes. Our finding is applied to well-motivated models, including GUT hybrid inflation.

INHOMOGENEOUS INFLATION

Krzysztof Bolejko – University of Oxford

At the beginning of 1990s it was realized that inflation cannot begin if the degree of inhomogeneity is too large. In was shown that in order to start, inflation requires a homogeneous patch of at least the horizon size. During my talk I will discuss the problems related to inflation within inhomogeneous backgrounds. I will also present solutions to this problem showing how, under specific conditions, one can start inflation even if initially the degree of inhomogeneity is large.

CALM EXCITED STATES OF INFLATION

Amjad Ashoorioon – Uppsala University

We identify a two-parameter family of excited states within slow-roll inflation for which either the corrections to the two-point function or the characteristic signatures of excited states in the three-point function – i.e. the enhancement for the flattened momenta configurations– are absent. These excited states may nonetheless violate the adiabaticity condition maximally. We dub these initial states of inflation calm excited states. We show that these two sets do not intersect, i.e., those that leave the power-spectrum invariant can be distinguished from their bispectra, and vice versa. The same set of calm excited states that leave the two-point function invariant for slow-roll inflation, do the same task for DBI inflation. However, at the level of three-point function, the calm excited states whose flattened configuration signature is absent for slow-roll inflation, will lead to an enhancement for DBI inflation generally, although the signature is smaller than what suggested by earlier analysis. This example also illustrates that imposing the Wronskian condition is important for obtaining a correct estimate of the non-Gaussian signatures.

OSCILLATIONS IN THE INFLATON POTENTIAL: EXACT NUMERICAL ANALYSIS AND COMPARISON WITH THE RECENT AND FORTHCOMING CMB DATASETS

Dhiraj Kumar Hazra – Harish-Chandra Research Institute, Allahabad, India

Amongst the multitude of inflationary models currently available, models that lead to features in the primordial scalar spectrum are drawing increasing attention, since certain features have been found to provide a better fit to the CMB data than the conventional, nearly scale-invariant, power law, primordial spectrum. In this work, we carry out an exact numerical analysis of two models that lead to oscillations over all scales in the scalar power spectrum. We consider the model described by a quadratic potential which is superposed by a sinusoidal modulation and the recently popular axion monodromy model. Since the oscillations continue even onto smaller scales, in addition to the WMAP data, we also compare the models with the small scale data from the Atacama Cosmology Telescope. Though, both the models, broadly, result in oscillations in the spectrum, interestingly, we find that, while the monodromy model leads to a considerably better fit to the data in comparison to the standard, power law spectrum, the quadratic potential superposed with a sinusoidal modulation does not improve the fit to a similar extent. We also carry out forecasting of the parameters using simulated PLANCK data for both the models. We show that the mock data performs better in constraining the model parameters as compared to the presently available CMB datasets

AN ALTERNATIVE SCENARIO OF INFLATION

Erandy Ramirez – Technische Universitaet Muenchen

We propose a version of chaotic inflation, in which a fundamental scale M, well below the Planck scale M_P, fixes the initial value of the effective potential. If this scale happens to be the scale of grand unified theories, there are just enough e-foldings of inflation. An initial epoch of fast-roll breaks scale-invariance at the largest observable scales.

CURVATON MODEL COMPLETED

Rose Lerner – Helsinki University

In an inflationary cosmology, the observed primoridal density perturbation could come from the quantum fluctuations of another light 'curvaton' field, rather than the inflaton. In this case, it is essential that the curvaton decays, converting its perturbation to an adiabatic perturbation. For the first time, we consistently account for this decay in the simplest curvaton model $V(\sigma) = \frac{1}{2} m^2 \sigma^2$ and point out that it gives rise to an important logarithmic correction to the potential. Moreover, the potential will also receive a correction from the thermal bath. As a consequence, the dynamics of the curvaton are substantially altered compared to the original model in the majority of the parameter space. It will therefore be necessary to re-calculate all the predictions of the original model.

CURVATON WITH A DOUBLE WELL POTENTIAL

Osamu Seto – Hokkai-Gakuen University

We study the density perturbation by a curvaton with a double well potential and estimate the nonlinear parameters for non-Gaussianity and the amplitude of gravitational wave background generated during inflation. The predicted nonlinear parameters strongly depend on the size of a curvaton self-coupling constant as well as the reheating temperature after inflation for a given initial amplitude of the curvaton.

OSCILLONS AFTER INFLATION

Mustafa Amin – MIT

Oscillons are massive, long-lived, localized excitations of a scalar field. We show that in a class of well-motivated models, inflation is followed by copious oscillon generation and a lengthy period of oscillon domination. In these models the full inflaton has a quadratic minimum at the origin and is shallower than quadratic away from from minimum: this set includes both monodromy models and a large class of supergravity inspired scenarios, and matches the current central values of the concordance cosmology. We assume that the inflaton is weakly coupled to other fields, so as not to quickly drain energy from the oscillons or prevent them from forming. An oscillon dominated phase is effectively matter dominated which aids gravitational growth of perturbations. Given the large subhorizon perturbations generated during resonance as well as subsequent gravitational and non-gravitational interactions between oscillons, structure formation can proceed efficiently in this phase, potentially forming primordial blackholes. In addition, like any long matter dominated phase, this phase would modify the observed spectrum of fluctuations compared to that obtained by prompt radiation domination at the end of inflation.

A MULTIRESOLUTION VIEW OF THERMALIZATION AND ENTROPY FLOW AFTER PREHEATING

Jonathan Braden – University of Toronto / CITA

After inflation the coherent energy of the inflaton field must ultimately be transferred into the incoherent energy density of Standard Model particles to begin the hot big bang. In many models, the early stages of this energy transfer are very efficient due to instabilities that arise when the inflaton couples to other fields. This rapid transfer of energy, known as preheating, leads to energy distributions that are sharply peaked in the infrared. In order to connect the end of inflation to the standard hot big bang, we need to understand the evolution from this highly nonequilibrium state to thermal equilibrium. Here, we study thermalization in a preheating model driven by parametric resonance using large parallel lattice simulations. Shortly after nonlinear effects terminate the resonance, the fields enter into a slowly evolving phase during which the one-point distributions of the stress-energy tensor are nearly constant. Concurrently, the power spectrum of energy density fluctuations develops a slowly moving peak whose height increases linearly with time as the overall fluctuations in the system grow and the coherent energy of the inflaton is converted into incoherent excitations. We introduce a nonequilibrium entropy with contributions from all wavenumbers in order to measure the growing complexity of the system. We also use a hierarchical coarse-graining via block smoothing (essentially Wilsonian Renormalization on a lattice) to study the scale dependence of the energy density and find a rapid buildup of fluctuations in an intermediate range of scales. This is followed by a much slower and longer buildup of fluctuations on smaller scales. Our results suggest that despite the complex nature of the system prior to thermalization, there is a simple underlying principle guiding the dynamics of the system whose universality remains to be explored.

NEW ASPECTS OF (P)REHEATING

Daniel G. Figueroa – HU/HIP Helsinki

Between the end of Inflation and primordial Nucleosynthesis, the Universe goes through non-linear, non-perturbative and out-of-equilibrium stages, like Reheating or Phase Transitions (PhT). In this talk I will cover some phenomenological consequences recently discovered of these periods: like the generation of Gravitational Wave (GW) backgrounds, the production of Non- Gaussianity (NG) or Baryogenesis. I will consider studying global and gauge scenarios (including fermions), both at sub- and super-horizon scales.

PREHEATING WITH THE BRAKES ON: THE EFFECTS OF A SPEED LIMIT

Johanna Karouby – McGill University

We study preheating in models where the inflaton has a non-canonical kinetic term, containing powers of the usual kinetic energy. The inflaton field oscillating about its potential minimum acts as a driving force for particle production through parametric resonance. Non-canonical kinetic terms can impose a speed limit on the motion of the inflaton, modifying the oscillating inflaton profile. This has two important effects: it turns a smooth sinusoidal profile into a sharp saw-tooth, enhancing resonance, and it lengthens the period of oscillations, suppressing resonance. We show that the second effect dominates over the first, so that preheating with a non-canonical inflaton field is less efficient than with canonical kinetic terms, and that the expansion of the Universe suppresses resonance even further.

HIGGS INFLATION – CONSISTENCY AND POSSIBILITIES

Fedor Bezrukov – LMU, München

I will discuss the consistency of the inflation in the Standard Model with large non-minimal coupling to gravity. I will argue, that due to the background dependent cutoff scale (or scale of unitarity violation in the scattering processes) the theory can be consistent both at inflation and present Unverse, However, the good properties of the theory, especially possibility to connect presently measured particle properties to the inflationary parameters, depend on the assumptions made of the UV completion. I will discuss the different requirements on the UV complete theory, and analyse possible impact of the details of the UV completion on the phenomenology of the model.

HIGGS-DILATON COSMOLOGY: FROM THE EARLY TO THE LATE UNIVERSE

Daniel Zenhaeusern – EPFL Lausanne, Switzerland

We consider a minimal scale-invariant extension of the Higgs-Inflation model. The resulting model is able to describe not only an inflationary stage, but also a late period of dark energy domination. All parameters can be fixed by inflationary physics, allowing to make specifc predictions for any subsequent period. In particular, we derive a relation between the tilt of the primordial spectrum of scalar fluctuations, n_s, and the present value of the equation of state parameter of dark energy, w_{DE}. Within the Higgs-Dilaton scenario we find upper bounds for the scalar tilt, $n_s < 0.97$ and for the scalar-to-tensor ratio, $r < 0.0035$, which will be critically tested by the results of the Planck mission. For the equation of state of dark energy, the model predicts $w_{DE} > -1$. The relation between n_s and w_{DE} allows us to translate the current observational constraints on n_s into a prediction for the dark energy equation of state, $0 < 1 + w_{DE} < 0.0014$, which will be rather challenging to test in the near future.

TEMPERATURE DEPENDENCE OF CP--VIOLATION IN THE STANDARD MODEL

Olli Taanila – Helsinki Institute of Physics

In Cold Electroweak Baryogenesis the baryon asymmetry is produced by out-of-equilibrium dynamics when the electroweak symmetry is broken at very low temperatures. This mechanism offers an explanation of the origin of the cosmic baryon asymmetry using only Standard Model physics and a low temperature initial condition. To address the question of the temperature dependence of the process, the temperature dependence of the effective CP-violating terms need to be calculated. For the first time, we calculate the temperature dependence of effective CP-violation in the Standard Model to leading order and generalize the calculation to higher order as well.

SNEUTRINO HYBRID INFLATION AND NONTHERMAL LEPTOGENESIS

Jochen Baumann – Max-Planck - Institut für Physik, München

In sneutrino hybrid inflation the superpartner of one of the right-handed neu- trinos involved in the seesaw mechanism plays the role of the inflaton field. It obtains its large mass after the ìwaterfallî phase transition which ends hybrid inflation. After this phase transition the oscillations of the sneutrino inflaton field may dominate the universe and efficiently produce the baryon asymmetry of the universe via nonthermal leptogenesis. We investigate the conditions under which inflation, with primordial perturbations in accordance with the latest WMAP re- sults, as well as successful nonthermal leptogenesis can be realized simultaneously within the sneutrino hybrid inflation scenario. We point out which requirements successful inflation and leptogenesis impose on the seesaw parameters, i.e. on the Yukawa couplings and the mass of the right-handed (s)neutrino, and derive the predictions for the CMB observables in terms of the right-handed (s)neutrino mass and the other relevant model parameters.

COSMOLOGY IN NATURAL GUT

Nobuhiro Maekawa – Nagoya Univ.

It has been studied that the anomalous U(1) gauge symmetry plays an important role not only in explainingthe various hierarchies of quark and lepton masses and mixings but also in solving serious problems of SUSY GUT, the doublet-triplet splitting problem, under the natural assumption that all the interactions which are allowed by the symmetry are included with O(1) coefficients. We would like to discuss the cosmology in the natural GUT scenario. We discuss some of the following topics, the vacuum selection by particle production, possibility of warm inflation, baryogenesis, and dark matter production.

HELICAL MAGNETIC FIELDS FROM INFLATION

Rajeev Jain – Department of Theoretical Physics, University of Geneva

I shall discuss the generation of helical magnetic fields in single field inflation induced by an axial coupling of the electromagnetic field to the inflaton. In slow roll inflation, such a coupling always leads to a blue spectrum of the magnetic fields with $P_B \sim k$. Moreover, even a short deviation from slow roll does not result in strong modifications to the shape of the spectrum. I shall also discuss the subsequent evolution of the spectrum during the inverse cascade and viscous damping of the helical magnetic fields in the radiation era after inflation. Although the power is transferred from small to large scales, the magnetic fields generated in this scenario are too weak to provide the seeds for the observed fields in galaxies and clusters; except for low scale inflation with very strong axial coupling, a case where the perturbative treatment of the theory may break down.

PARALLEL SESSIONS

NON-GAUSSIANITIES (NGA)

MAXIMISING THE SCIENTIFIC RETURN FROM COSMIC NON-GAUSSIANITY

Christian Byrnes – University of Bielefeld

The model of local non-Gaussianity, parameterised by the constant non-linearity parameter f_{NL}, is an extremely popular description of non-Gaussianity. However, a mild scale-dependence of f_{NL} is natural. This scale dependence is a new observable, potentially detectable with the Planck satellite, which helps to further discriminate between models of inflation. It is sensitive to properties of the early universe which are not probed by the standard observables. In a complementary way, the trispectrum also contains important information about non-Gaussianity which the bispectrum does not capture. Using simple models, I will demonstrate how scale-dependence and the trispectrum provide a powerful probe of the early universe.

NEW SHAPES OF NON-GAUSSIANITIES FROM THE EFFECTIVE FIELD THEORY OF INFLATION

Matteo Fasiello – University of Milan Bicocca

Effective field theory techniques are employed in order to obtain a unified and comprehensive description of a very large set of inflationary models. We find distinctive signatures in the form of their non-Gaussianities. Special attention is devoted to models with higher derivative interactions which are naturally accounted for in this setup.

QUASI-FEYNMAN RULES FOR CALCULATING N-POINT CORRELATORS OF THE PRIMORDIAL CURVATURE PERTURBATION

Yeinzon Rodriguez Garcia – Universidad Antonio Narino & Universidad Industrial de Santander

A diagrammatic approach to calculate n-point correlators of the primordial curvature perturbation ζ was developed a few years ago following the spirit of the Feynman rules in Quantum Field Theory. The methodology is very useful and time-saving, as it is for the case of the Feynman rules in the particle physics context, but, unfortunately, is not very well known by the cosmology community. In the present work, we extend such an approach in order to include not only scalar field perturbations as the generators of ζ, but also vector field perturbations. The purpose is twofold: first, we would like the diagrammatic approach (which we would call the quasi-Feynman rules) to become widespread among the cosmology community; second, we pretend to give an easy tool to formulate any correlator of ζ for those cases that involve vector field perturbations and that, therefore, generate important levels of statistical anisotropy. Indeed, the usual way of formulating such correlators, using the Wick's theorem, may become very clutter and time-consuming.

SECOND ORDER PERTURBATIONS DURING INFLATION BEYOND SLOW-ROLL

Ian Huston – Queen Mary, University of London

Cosmological perturbation theory is well established as a tool for probing the inhomogeneities of the early universe. In this talk I will motivate the use of perturbation theory and outline the mathematical formalism. Perturbations beyond linear order are especially interesting as non-Gaussian effects can be used to constrain inflationary models. I will show how the Klein-Gordon equation at second order, written in terms of scalar field variations only, can be numerically solved. This procedure allows the evolution of second order perturbations in general without the need for any slow roll approximation. The numerical software is being extended to deal with multiple fields and I will describe how this will increase the range of models which can be tested.

ON THE EVOLUTION OF NON-GAUSSIANITY

David Mulryne – Queen Mary, University of London

We study the evolution of of non-Gaussianity in multiple-field models of inflation. We discuss how particular features such as ridges and valleys can cause the magnitude of f_{NL} to grow to significant values during the evolution, showing the expected sign of f_{NL} in these cases and giving simple estimates for the peak value. Using numerical simulations as well as analytic arguments, we further discuss the fate of f_{NL} as an adiabatic limit is reached. We consider a number of examples which illustrate different possibilities for when and how this limit is established – including potentials which allow a natural convergence within the slow-roll phase, and potentials for which no natural convergence is possible and reheating is required to establish an adiabatic limit – and which exhibit a large limiting value of non-Gaussianity.

NON-GAUSSIANITIES FROM FAILED TRAPPING EVENTS DURING INFLATION

Diana Battefeld – University of Goettingen

A close encounter with an Extra Species Point during multi-field inflation can provide the dominant contribution to the power-spectrum. I compute the accompanying non-Gaussianities based on the δ_N formalism. The primary, potentially observable contribution originates from a temporary decrease in speed due to back-reaction of produced particles.

NON-GAUSSIANITY IN SINGLE FIELD MODELS WITHOUT SLOW-ROLL

Johannes Noller – Imperial College London

In inflationary theories, single field models are typically considered subject to slow-roll conditions. However, as I will show in this talk, current observational constraints allow significant violations of these conditions. Focusing on non-Gaussian signals, I will discuss a variety of new observational signatures that can be found for fast-rolling single fields.

LARGE SLOW-ROLL CORRECTIONS TO THE BISPECTRUM OF NONCANONICAL INFLATION

Raquel H Ribeiro – DAMTP, University of Cambridge

Nongaussian statistics are a powerful discriminant between inflationary models, particularly those with noncanonical kinetic terms. Focusing on theories where the Lagrangian is an arbitrary Lorentz-invariant function of a scalar field and its first derivatives, I report the calculation of the observable three-point function. I obtain quantitative estimates of their magnitude in DBI and power-law k-inflation. In the DBI case these results enable an estimate corrections from the shape of the potential and the warp factor: these can be of order several tens of percent. I also identify a new bispectrum shape available at next-order, which is similar to a shape encountered in Galileon models. If f_{NL} is sufficiently large this shape may be independently detectable provided a new template for CMB analysis is devised.

NON-GAUSSIAN PERTURBATIONS FROM MIXED INFLATON-CURVATON SCENARIO

José Fonseca – Institute of Cosmology and Gravitation – University of Portsmouth

We consider a scenario where both curvaton and inflaton perturbations contribute to the primordial power spectrum. The predicted scale dependence of the power spectra and of the non-linearity parameters change. We will present the results for linear and non-linear perturbation and the observational consequences. We will study the allowed parameter space and explore how different observational quantities can be used to put complementary contraints on different model parameters within this mixed scenario.

DBI VECTOR FLUXES AS CURVATONS AND STATISTICAL ANISOTROPY IN THE CMB

Konstantinos Dimopoulos – Lancaster University

I discuss the vector curvaton mechanism which allows a vector field to contribute to or even generate the observed curvature perturbation in the Universe. The effects of such a contribution can have distinct observational signatures such as correlated statistical anisotropy in the power spectrum and bispectrum (i.e. angular dependence of non-Gaussianity) of the curvature perturbation, soon to be probed by the Planck satellite. After presenting the generic mechanism I will show how it can be implemented in the context of DBI inflation, where the vector fluxes on a D3-brane (stationary or not) can play the role of vector curvatons.

DOMINANCE OF GAUGE ARTIFACT IN THE CONSISTENCY RELATION FOR THE PRIMORDIAL BISPECTRUM

Yuko Urakawa – University of Barcelona

The conventional cosmological perturbation theory has been performed under the assumption that we know the whole spatial region of the universe with infinite volume. This is, however, not the case in the actual observations because observable portion of the universe is limited. To give a theoretical prediction to the observable fluctuations, gauge-invariant observables should be composed of the information in our local observable universe with finite volume. From this point of view, we reexamine the primordial non-Gaussianity in single-field and multi-field models, focusing on the bispectrum in the squeezed limit. In single field models, a conventional prediction states that the bispectrum in this limit is related to the power spectrum through the so-called consistency relation. However, it turns out that, if we adopt a genuine gauge invariant variable which is naturally composed purely of the information in our local universe, the leading term for the bispectrum in the squeezed limit predicted by the consistency relation vanishes.

ISOCURVATURE PERTURBATIONS IN GENERALIZED GRAVITY

Seoktae Koh – Jeju National University

We consider the isocurvature perturbations as well as the adiabatic perturbation during inflation with multiple scalar fields in generalized gravity theoreis. The evolution of adiabatic perturbation can be sourced by the generalized gravity parameters as well as by the isocurvature perturbations due to the multiple scalar fields. However, the term which is given by the generalized gravity parameters seems to be suppressed on the super-Hubble scales.

PARALLEL SESSIONS
DARK MATTER & OTHER RELICS (DMA)

CONSTRAINING THE CMSSM WITH DARK MATTER DIRECT DETECTION RESULTS

Christopher Savage – Oskar Klein Centre, Stockholm University

We examine how well direct detection experiments can constrain SUSY models, using the CMSSM as an example. Various issues that affect those constraints are examined, such as our limited knowledge of the local dark matter halo and uncertainties in the parameters describing the proton & neutron structures. We discuss difficulties that arise in scanning the theoretical parameter space.

PROBING DARK MATTER STREAMS WITH DAMA AND COGENT

Aravind Natarajan – Carnegie Mellon University

I discuss the DAMA and CoGeNT dark matter direct detection experiments and show that the annual modulation effect is an excellent probe of cold dark matter streams. Such streams are expected due to late infall of dark matter on to the Galaxy, and also due to the breakup of satellite halos. I show that alternatives to the Maxwellian halo are consistent with the DAMA results both in amplitude and in phase, for large WIMP masses. Different halo models may be distinguished using the results from two different experiments such as DAMA and CoGeNT. I also discuss the prospects for detecting streams using future results from CoGeNT.

ANISOTROPIES IN THE DIFFUSE GAMMA-RAY BACKGROUND AS MEASURED BY THE FERMI-LAT

Alessandro Cuoco – Stockholm University- Oskar Klein Center

The diffuse gamma-ray background is expected to exhibit small scale anisotropies which can carry information on the underlying sources contributing to it. Astrophysical sources as well as more exotic processes like galactic or extragalactic DM annihilation are expected to leave their imprint in the pattern of the gamma-ray anisotropies. I will present the results of an angular power spectrum analysis of the high-latitude diffuse emission measured by the Fermi-LAT, and discuss the implications of the measured angular power spectrum for gamma-ray source populations that may provide a contribution to the diffuse background.

CONSTRAINTS ON DARK MATTER FROM OBSERVATIONS OF COMPACT STARS

Petr Tinyakov – ULB

Constraints on Dark Matter from Observations of Compact Stars We argue that observations of neutron stars and white dwarfs can impose constraints on dark matter candidates even with very small elastic and/or inelastic cross section, and small or even zero self-annihilation cross section, thus probing regions of parameters which are inaccessible for direct searches.

ASYMMETRIC DARK MATTER

Chris Kouvaris – CP3-Origins Center, Un. of Southern Denmark

Asymmetric dark matter has recently gained a lot of interest especially because light candidates favored by DAMA and CoGeNT can link baryogenesis to dark matter production. In particular, interfering asymmetric dark matter can accommodate the DAMA/CoGeNT results without being excluded by other experiments. I will talk about this possibility as well as about severe astrophysical constraints on asymmetric dark matter emerging from observations of neutron stars and other compact objects.

PHOTON SPECTRA FROM WIMPS ANNIHILATION

Alvaro De La Cruz-Dombriz – Cosmology and Gravitation Group, University of Cape Town

If the present dark matter in the Universe annihilates into Standard Model particles, it must contribute to the fluxes of cosmic rays that are detected on the Earth, and in particular, to the observed gamma ray fluxes. The magnitude of such contribution depends on the particular dark matter candidate, but certain features of the produced photon spectra may be analyzed in a rather model-independent fashion. In this work we provide the complete photon spectra coming from WIMP annihilation into Standard Model particle-antiparticle pairs obtained by extensive Monte Carlo simulations. We present results for each individual annihilation channel and provide analytical fitting formulae for the different spectra for a wide range of WIMP masses.

PANGENESIS IN A BARYON-SYMMETRIC UNIVERSE: DARK AND VISIBLE MATTER VIA THE AFFLECK-DINE MECHANISM

Kalliopi Petraki – University of Melbourne

The similarity of the observed visible and dark matter abundances indicates that they may originate via the same mechanism. If the dark and the visible matter are charged under a common symmetry, then the baryonic asymmetry of the visible sector may be compensated by an asymmetry in the dark sector. The separation of baryonic and antibaryonic number can originate in the vacuum, via the Affleck-Dine mechanism, due to spontaneous symmetry breaking and a 2nd-order phase transition in the post-inflationary era. Symmetry restoration in the current epoch guarantees the individual stability of the two sectors.

DARK MATTER, BARYOGENESIS AND NEUTRINO OSCILLATIONS FROM RIGHT HANDED NEUTRINOS

Marco Drewes – Ecole Polytechnique Fédérale de Lausanne

Dark Matter, Baryogenesis and Neutrino Oscillations from Right Handed Neutrinos We study in detail under which circumstances three generations of right handed neutrinos with masses below the electroweak scale, coupled to the Standard Model via the usual type-I seesaw Lagrangian, can simultaneously explain neutrino oscillations, dark matter and the baryon asymmetry of the universe. In large parts of the allowed parameter space all three new particles can be detected directly or indirectly using present day experimental and observational techniques. Our results provide a guideline for experimental searches.

DIRECT DETECTION OF LEPTOPHILIC DARK MATTER IN RADIATIVE SEESAW MODEL

Takashi Toma – Kanazawa University

In general it seems to be difficult to detect leptophilic dark matter in direct detection such as CDMSII, XENON100, CoGeNT, DAMA/LIBRA etc, since leptophilic dark matter has only interaction with leptons at tree level. Such a leptophilic dark matter candidate is included in the radiative seesaw model which has an interesting feature that the existence of dark matter and neutrino masses are related each other. We show that the direct detection rate is enhanced through the interaction with photon at 1-loop which intermediates between dark matter and quarks and has small transfer momentum.

THERMAL AXION PRODUCTION IN THE PRIMORDIAL QUARK-GLUON PLASMA

Peter Graf – Max-Planck-Institute for Physics, Munich

We calculate the rate for thermal production of axions via scattering of quarks and gluons in the primordial quark-gluon plasma. To obtain a finite result in a gauge-invariant way that is consistent to leading order in the strong gauge coupling, we use systematic field theoretical methods such as hard thermal loop resummation and the Braaten-Yuan prescription. The thermally produced yield, the decoupling temperature, and the density parameter are computed for axions with a mass below 10 meV. In this regime, with a Peccei-Quinn scale above 6×10^8 GeV, the associated axion population can still be relativistic today and can coexist with the axion cold dark matter condensate.

GRAVITINO DARK MATTER AND BARYON ASYMMETRY FROM Q-BALL DECAY IN GAUGE MEDIATION

Shinta Kasuya – Kanagawa University

We investigate production of gravitino dark matter and baryon asymmetry from the Q-ball decay in gauge-mediation. We argue that BBN constrains the GeV gravitino mass region severely. We find the successful scenario in natural parameter regions.

NON SPHERICAL COLLAPSE HALO MASS FUNCTION AND THE EXCURSION SET THEORY

Ixandra Achitouv – Observatoire de Paris-LUTh

We compute the dark matter halo mass function in the context of the Excursion Set formalism for a diffusive barrier model with linearly drifting average, which captures the main features of the ellipsoidal collapse. We use a path-integral method to evaluate the corrections due to the sharp filtering of the linear density fluctuation field in real space. This allows us to consistently confront the model predictions with N-body simulation data. We find a remarkable agreement with the numerical results of Tinker et al. with deviations no greater than 5% over the range of masses probed by the simulations. This indicates that the Excursion Set in combination with an accurate modelling of the halo collapse threshold can provide a robust estimation of the mass function.

PARALLEL SESSIONS

DARK ENERGY & MODIFIED GRAVITY (DEN)

RESONANT DARK ENERGY AND COSMIC MAGNETIC FIELDS

Federico Urban – UBC

Oscillating Dark Energy Fields have the potential to generate Cosmic Magnetic fields at the largest scales in the late history of the Universe through a non-standard coupling to Electromagnetism: I will review some theoretical models and their signatures.

DETECTING DARK ENERGY VIA ELECTROSTATIC ANALOGY

Katherine Jones-Smith – Washington University in St Louis

In recent years, scalar-tensor modifications of gravity have become a prominent alternative to the cosmological constant as the cause of cosmic acceleration. In such models, scalar fields couple to matter with gravitational strength or greater--naively one would expect such strongly coupled fields to interfere with precision tests of gravity but "screening mechanisms" can provide recourse. One screening mechanism of great interest is the thin shell suppression effect, wherein the scalar field forms very thin shell just under the surface of a dense body. This was first described in the context of chameleon models of dark energy, but the thin shell effect also appears in symmetron models, and plays a central role in viable f(R) theories. We present an analogy between scalar fields in the thin shell regime and electrostatics, which follows from noting that the same equations govern both the electrostatic potential and the chameleon field in the thin shell regime. This analogy enriches our understanding of the thin shell screening and enables us to solve for the chameleon profile in geometries other than the spherically symmetric ones typically assumed. We find that the chameleon field is enhanced towards the end of a pointed or elongated object– a lightning rod style effect that could be used to leverage the thin shell suppression. We also find that an elongated object such as an ellipsoid would experience a torque in the presence of a chameleon field with a uniform gradient, and that the magnitude of the torque is comprable to the sensitivity of existing experiments. This novel effect could be used to unveil the presence of a screened scalar field, even in the experimentally unfavorable thin shell regime.

ORTHOGONAL NON-GAUSSIANITIES FROM DIRAC-BORN-INFELD GALILEON INFLATION

Sébastien Renaux-Petel – DAMTP, University of Cambridge

We consider the relativistic extension of the Galileon model. We derive the conditions under which this model can sustain a phase of quasi de-Sitter expansion. We analyze the linear perturbations about a homogeneous cosmological solution and demonstrate the existence of a critical background energy density above which cosmological fluctuations become ghosts. Finally, in the inflationary context, we show that this is the first concrete early Universe model where the orthogonal shape can be the dominant contribution to the primordial non-Gaussianities.

FORCE: LAGRANGIAN DESCRIPTION AND STABILITY

Valerio Faraoni – Bishop's University

We revisit the issue of the correct Lagrangian description of a perfect fluid in theories of modified gravity with an extra force, in which galactic luminous matter couples nonminimally to the Ricci scalar and explains away dark matter. Two alternative Lagrangians (giving dark matter phenomenology or zero effects, respectively) are shown to be inequivalent when the fluid couples minimally to gravity; in the presence of nonminimal coupling they give rise to two distinct theories with completely different predictions. A necessary and sufficient criterion to avoid the notorious Dolgov-Kawasaki instability is also presented. (Based on V. Faraoni, Phys. Rev. D 80, 124040; Phys. Rev. D 76, 127501.)

MODIFIED GRAVITY WITH AN EXTRA ON GALILEAN INVARIANT SCALAR FIELD THEORIES IN CURVED SPACE TIME

Parvin Moyassari – Ludwig-Maximilians-University (LMU)

The Gravitationally enhanced friction (GEF) is a mechanism that drastically increases the friction acting on a scalar field making even steep potential good enough for inflation. In this talk I will show that the Lagrangian producing the GEF is the unique Galilean invariant theory in curved spacetime. Finally, I shall show that the curved spacetime Galilean symmetry protects the GEF Lagrangian under quantum corrections.

NONMETRICITY IN COSMOLOGY

Tomi Koivisto – ITF Utrecht

Novel approaches to nonmetricity in gravity are presented. Considering a nontrivial relation of the metric and the spacetime connection within the framework of C-theories provides a unified perspective on all Einstein and Palatini gravities. Furthermore, considering the spacetime connection to be generated by an independent metric enriches GR by allowing the torsion to propagate and by introducing new nonmetric degrees of freedom. These have a role in cosmology – this is what we'll discuss in the talk.

UNCERTAINTIES ON LCDM THROUGH INHOMOGENEITIES

Alexander Wiegand – Universitaet Bielefeld

Despite its global homogeneity and isotropy, the matter distribution in the late universe is manifestly inhomogeneous. Cosmological backreaction suggests a link between the structure formation, that lead to this inhomogeneity, and the expansion history of the Universe. In order to quantitatively examine this connection there have been many studies using cosmological perturbation theory. While the global acceleration turns out to be small, we expect sizable effects on the evolution of our local volume and its cosmic parameters. This talk examines in which case there is a global effect and when there are only domain dependent contributions. For these latter it is shown on which scales they become important and how they, therefore, restrict our ability to measure the average local cosmic parameters. To this end the corresponding uncertainties for recent galaxy surveys are presented. As especially the curvature parameter is affected, it will be analyzed whether the resulting degeneracy with the cosmological constant will influence our ability to measure its equation of state.

CONFIRMING LARGE-SCALE HOMOGENEITY AND ACCELERATION WITH THE CMB

James Zibin – University of British Columbia

A fundamental assumption in cosmology is that of large-scale homogeneity. The CMB trivially demonstrates isotropy, but homogeneity is surprizingly difficult to verify. Indeed, models with extremely large spherical voids in EdS backgrounds have received substantial attention as alternatives to accelerating dark energy or modified gravity models. In this talk I will discuss the crucial role that observations of the CMB play in ruling out very large classes of these void models, and hence in confirming homogeneity and demonstrating the reality of acceleration.

PROBING BACKREACTION EFFECTS WITH SUPERNOVA DATA

Marina Seikel – University of Cape Town

As the Einstein equations are non-linear, spatial averaging and temporal evolution do not commute. Therefore, the evolution of the averaged universe is affected by local inhomogeneities. It is, however, highly controversial how large these cosmological backreaction effects are. Using Buchert's averaging formalism and perturbation theory up to second order, one can calculate the effects of backreaction on the measurements of the Hubble rate in the nearby universe. The size of the effect depends on the size and shape of the volume that is averaged over. The theory is then compared to actual measurements of the Hubble rate using the supernova data of the Constitution set up to a redshift of 0.1.

ON THE POSSIBILITY OF A POINCARÉ GAUGE THEORY AS AN AVERAGED THEORY OF GRAVITY

Juliane Behrend – Institute for Theoretical Physics, Utrecht University

Despite the effort that has been devoted to the averaging problem of general relativity, it still remains unresolved. The reason might be that the framework of general relativity is too restrictive to take account of the averaging effects. In this talk I want to discuss a novel approach to the problem which starts from the teleparallel equivalent of general relativity (TEGR) and in which the averaged theory is described as a Poincré gauge theory. This will be illustrated with an example of cosmological relevance.

LIGHT-CONE AVERAGING IN COSMOLOGY: FORMALISM AND APPLICATIONS

Giovanni Marozzi – College de France, Paris

I will show a general gauge invariant formalism for defining cosmological averages that are relevant for observations based on light-like signals. Such averages involve either null hypersurfaces corresponding to a family of past light-cones or compact surfaces given by their intersection with timelike hypersurfaces. Generalized Buchert-Ehlers commutation rules for derivatives of these light-cone averages will be also shown. To conclude, after introducing some adapted geodesic light-cone coordinates, I will give explicit expressions for averaging the redshift to luminosity-distance relation and the so-called redshift drift in a generic inhomogeneous Universe.

DARK GOO: BULK VISCOSITY AS AN ALTERNATIVE TO DARK ENERGY

Jean-Sebastien Gagnon – TU Darmstadt

We present a simple (microscopic) model in which bulk viscosity plays a role in explaining the present acceleration of the universe. The effect of bulk viscosity on the Friedmann equations is to turn the pressure into an "effective" pressure containing the bulk viscosity. For a sufficiently large bulk viscosity, the effective pressure becomes negative and could mimic a dark energy equation of state. Our microscopic model includes self-interacting spin-zero particles (for which the bulk viscosity is known) that are added to the usual energy content of the universe. We study both background equations and linear perturbations in this model. We show that a dark energy behavior is obtained for reasonable values of the two parameters of the model (i.e. the mass and coupling of the spin-zero particles) and that linear perturbations are well-behaved. There is no apparent fine tuning involved. We also discuss the conditions under which hydrodynamics holds, in particular that the spin-zero particles must be in local equilibrium today for viscous effects to be important.

TESTING GENERAL RELATIVITY USING THE ENVIRONMENTAL DEPENDENCE OF DARK MATTER HALOS

Gongbo Zhao – ICG, Portsmouth, UK

We investigate the environmental dependence of dark matter halos in theories that attempt to explain the accelerated expansion of the Universe by modifying general relativity (GR). Using high-resolution N-body simulations in f(R)gravity models which recover GR in dense environments by virtue of the chameleon mechanism, we find a strong environmentally-dependent difference between the lensing mass and dynamical mass estimates of dark matter halos. This environmental dependence of the halo properties can be used as a smoking gun to test GR observationally.

MEASURING DARK ENERGY WITH THE WIGGLEZ SURVEY

Chris Blake – Swinburne University

We present new measurements of the cosmic expansion history and growth history over the last 7 billion years, using data from the WiggleZ Dark Energy Survey of 200,000 galaxy redshifts. We have used baryon acoustic oscillations in the galaxy distribution as a standard ruler to measure the distance-redshift relation at z=0.6, and redshift-space distortions in the clustering pattern to determine the growth rate with 10% accuracy to redshift z=0.9. We show that a cosmological constant model of dark energy is able to simultaneously fit both the expansion and growth data.

NON-PARAMETRIC RECONSTRUCTION OF DARK ENERGY EQUATION OF STATE FROM DIVERSE DATASETS

Ujjaini Alam – Los Alamos National Laboratory

Understanding the origin of the accelerated expansion of the Universe poses one of the greatest challenges in physics today. Lacking a compelling fundamental theory to test, observational efforts are targeted at a better characterization of the underlying cause. If dark energy is driving the acceleration, the redshift evolution of the equation of state parameter w(z) will hold essential clues as to its origin. To best exploit data from observations it is necessary to develop a robust and accurate reconstruction approach, with controlled errors, for w(z). In this talk I outline a new, nonparametric method for reconstructing w(z) based on Gaussian Process modeling. Using this method on diverse datasets such as Type Ia supernovae and baryon acoustic oscillations, it is possible to obtain strong constraints on non-trivial behaviour of w(z).

TESTS OF MODIFIED GRAVITY THEORIES USING REDSHIFT-SPACE DISTORTION MEASUREMENTS FROM WIGGLEZ

David Parkinson – University of Queensland

The mysterious dark energy that drives the acceleration can be seen either as a failure of Einstein's theory of General Relativity, or the requirement of (yet another) dark fluid to reconcile the theory with observations. However, both explanations make similar or identical predictions for the distances as a function of redshift. In order to break this degeneracy new data is needed, such as measurements of the growth of structure on large scales by redshift-space distortions. WiggleZ has provided us with just such a data set to test these theories. I will describe the procedure for generating predictions for the different theories, the WiggleZ redshift-space distortion data set, and the constraints this data places on the different theories.

POWER OF WEAK LENSING IN CONSTRAINING MODIFIED MATTER AND GRAVITY THEORIES

Stefano Camera – CENTRA, Istituto Superior Técnico, Lisboa

I present how weak gravitational lensing effects can be used to test and constrain alternative cosmological models. Specifically, I show the promising results obtained by applying the cosmic shear statistics to three alternative cosmologies. These models, which well represent the landscape of modified matter and gravity theories, are: 1) a model of unified DM and DE; 2) a phenomenological extension of the DGP brane-world; and 3) two viable modified-action f(R) Lagrangians.

HALO PROPERTIES IN MODIFIED GRAVITY THEORIES WITH SELF-ACCELERATED EXPANSION

Tatsuya Narikawa – Hiroshima University

I will discuss nonlinear aspects of modified gravity by constructing simple halos with the spherical symmetry. We investigate the structure of halos in the sDGP (self--accelerating branch of the Dvali-Gavadadze-Porrati braneworld gravity) model and the galileon modified gravity model on the basis of the static and spherically symmetric solutions of the collisionless Boltzmann equation, which reduce to the singular isothermal sphere model and the King model in the limit of Newtonian gravity. In my presentation, I will review common feature of these halos in the modified gravity theories.

PARALLEL SESSIONS

PROBING PARTICLE PHYSICS WITH CMB AND LSS (CMB)

THE ATACAMA COSMOLOGY TELESCOPE: AN UPDATE

Sudeep Das – UC Berkeley

Over the coming decade, tiny fluctuations in temperature and polarization of the Cosmic Microwave Background (CMB) will be mapped with unprecedented resolution. These new arc-minute resolution observations are shedding new light on the physics of the early universe and the neutrino sector. These observations are also allowing us to measure the gravitational lensing of the CMB by intervening large scale structure. CMB lensing will probe the growth of structure over cosmic time, helping constrain the total mass of neutrinos and the behavior of dark energy. In the first part of the talk, I will review the recent progress made with Atacama Cosmology Telescope. In the second part, I will discuss the first internal detection and the scientific potential of the CMB lensing signal.

FIRST SEASON RESULTS FROM QUIET

Sigurd Næss – Intitute of theoretical astrophysics, University of Oslo

Inflationary cosmology predicts the excitation of gravitational waves during inflation, and these will leave a unique signature in the divergence-free part of the CMB polarization (B-modes). The Q/U Imaging ExperimenT (QUIET) is a coherent polarimeter experiment observing the CMB polarization at 43 GHz and 90 GHz in four 250 square degree low-foreground patches on the sky, with overlaps with POLARBEAR and ABS. The analysis of the 43 GHz data was recently completed, measuring the E- and B-mode power spectra in the multipole moment range l = 25-475. We confirm BICEP\'s detection of the first E-mode acoustic peak, while the B-mode spectrum is consistent with zero, giving a tensor-to-scalar ratio of r = 0.35 (+1.06 -0.87), with the lowest level of systematic contamination in the B-mode power so far reported. The 90 GHz data analysis is currently under way, and will significantly improve on the 43 GHz limits.

LARGE-SCALE COSMIC HOMOGENEITY IN THE WIGGLEZ SURVEY

Morag Scrimgeour – University of Western Australia

The most fundamental assumption of LCDM is that the universe is homogeneous on large scales. This is clearly not true on small scales, where clusters and voids exist, and some studies seem to suggest that galaxies follow a fractal distribution up to very large scales (~200 h-1 Mpc or more), whereas the LCDM model predicts transition to homogeneity at scales of ~ 100 h-1 Mpc. The Friedmann-Robertson-Walker (FRW) metric is only valid for a homogeneous distribution, so any large inhomogeneities could affect our distance measurements and distort our measurements of cosmology. Also, inhomogeneities in the matter distribution have been proposed as an alternative explanation of the accelerated expansion, through the backreaction mechanism (a general relativistic effect whereby the evolution of an averaged, inhomogeneous matter distribution is different from the evolution of a homogeneous distribution, and can actually give rise to an accelerating global expansion rate). It is therefore very important to quantify the scale of homogeneity in the Universe. We have made a measurement of homogeneity of the large-scale galaxy distribution using the WiggleZ Dark Energy Survey, a UV-selected spectroscopic survey of ~200,000 luminous blue galaxies up to z=1, with the Anglo-Australian Telescope. We have corrected for survey incompleteness using random catalogues that account for the various survey selection criteria. The large volume and depth of WiggleZ allows us to probe the transition of the galaxy distribution to homogeneity on large scales, and see if this is consistent with a LCDM prediction.

THE 6DF GALAXY SURVEY: BARYON ACOUSTIC OSCILLATIONS AND THE LOCAL HUBBLE CONSTANT

Florian Beutler – ICRAR

The large-scale correlation function of the 6dF Galaxy Survey (6dFGS) allows the detection of a Baryon Acoustic Oscillation (BAO) signal. The low effective redshift of 6dFGS makes it a competitive and independent alternative to Cepheids and low-z supernovae in constraining the Hubble constant. It also depends on very different (and arguably smaller) systematic uncertainties. We found a Hubble constant of H_o = 67 +/- 3.2 km/s/Mpc. The sensitivity to H_o can also be used to break the degeneracy in the CMB data e.g. to determine the dark energy equation of state w.

COSMOLOGICAL CONSTRAINTS FROM THE XMM CLUSTER SURVEY

Martin Sahlén – The Oskar Klein Centre, Stockholm University

We present new cosmological and galaxy cluster scaling-relation constraints based on the latest data release from the XMM Cluster Survey (XCS), and forecast expectations for the full survey – the largest-ever X-ray cluster catalogue – in conjunction with other concurrent surveys.

REVISITING THE ISW EVIDENCE

Robert Crittenden – ICG, Portsmouth

The integrated Sachs-Wolfe effect provides an important independent constraint on models of dark energy, and is particularly useful in constraining modified gravity. Recently, the detections of the ISW cross correlations have come under question from a number of groups. I will discuss these criticisms, and give an update with the most recent large scale structure surveys. If time allows, I will also discuss the issue of how ISW information relates to redshift space distortion measurements, a probe which is similarly sensitive to the time derivative of the growth function.

STRUCTURE FORMATION WITH CLUSTERING QUINTESSENCE

Filippo Vernizzi – IPhT – CEA Saclay

I present a study of large-scale structure formation in the presence of a scalar field dark energy with zero speed of sound. This model is motivated by stability properties of the field. After a short review on the phenomenology of clustering quintessence in linear perturbations, I discuss the nonlinear aspect. First I compute the bispectrum of the density field and show that it is modified by the clustering of quintessence at low redshift, which can potentially be used to detect or rule out our model. I will then study the nonlinear regime using the spherical collapse model. Quintessence contributes to the mass of virialized objects, which represents an observational signature for future galaxies and cluster surveys

COUPLED QUINTESSENCE AND THE HALO MASS FUNCTION

Ewan Tarrant – University of Nottingham

A sufficiently light scalar field slowly rolling in a potential can account for the dark energy density that presently dominates the universe. This quintessence field is expected to couple directly to matter components, unless some symmetry of a more fundamental theory protects or suppresses it. Such a coupling would leave distinctive signatures in the background expansion history of the universe and on cosmic structure formation, particularly at galaxy cluster scales. With the arrival of greatly improved high redshift cluster surveys such as the Dark Energy Survey (DES) and Planck, the mass distribution of the most massive objects in the Universe is a powerful tool which may be used to distinguish between different models of dark energy. Using semi-- analytic expressions for the CDM halo mass function we make predictions for halo abundance in coupled quintessence cosmologies. We find that, depending on the form of the quintessence potential and the strength of the coupling, the predicted number of haloes at a given epoch of a given mass, can lie above or below that of ΛCDM.

DO BARYONS TRACE DARK MATTER IN THE EARLY UNIVERSE?

Daniel Grin – Institute for Advanced Study

Measurements of cosmic microwave background (CMB) anisotropies constrain isocurvature fluctuations between photons and non-relativistic particles to be sub-dominant to adiabatic fluctuations. Perturbations in the relative number densities of the baryonic and dark matter components, however, are surprisingly poorly constrained. In fact, baryon-density perturbations of fairly large amplitude may exist if they are compensated by dark-matter perturbations, so that the total density remains unchanged. At linear order in the usual line-of-sight formalism, these compensated isocurvature (CI) perturbations leave no imprint on the CMB at observable scales. Big-bang nucleosynthesis and galaxy cluster constraints allow the amplitudes of CI perturbations to be as large as ~10%. Here it is shown that CI fluctuations actually induce off-diagonal correlations between temperature/polarization spherical-harmonic coefficients, and cause additional B-mode polarization of the CMB, once higher order terms are accounted for. Using these correlations, it is in principle possible to detect CI perturbations and reconstruct the power spectrum of spatial fluctuations in the ratio of baryon and dark matter number densities, at the CMB surface of last scattering. We calculate the magnitude of these correlations, show how they may be measured, and estimate the sensitivity of ongoing and future experiments to these fluctuations. We find that Planck, ACT, SPT, and Polarbear are sensitive to fluctuations with amplitude ~1%, while SPTPol, ACTPol, and future space-based polarization methods will probe amplitudes as low as ~0.1%.

BULLET CLUSTER: A CHALLENGE TO LCDM COSMOLOGY

Jounghun Lee – Seoul National University

To quantify how rare the bullet-cluster-like high-velocity merging systems are in the standard LCDM cosmology, we use a large-volume 27 $(Gpc/h)^3$ MICE simulation to calculate the distribution of infall velocities of subclusters around massive main clusters. The infall-velocity distribution is given at (1-3)R_{200} of the main cluster (where R_{200} is similar to the virial radius), and thus it gives the distribution of realistic initial velocities of subclusters just before collision. These velocities can be compared with the initial velocities used by the non-cosmological hydrodynamical simulations of 1E0657-56 in the literature. The latest parameter search carried out recently by Mastropietro and Burkert showed that the initial velocity of 3000 km/s at about 2R_{200} is required to explain the observed shock velocity, X-ray brightness ratio of the main and subcluster, and displacement of the X-ray peaks from the mass peaks. We show that such a high infall velocity at 2R_{200} is incompatible with the prediction of a LCDM model: the probability of finding 3000 km/s in (2-3)R_{200} is between 3.3×10^{-11} and 3.6×10^{-9}. It is concluded that the existence of 1E0657-56 is incompatible with the prediction of a LCDM model, unless a lower infall velocity solution for 1E0657-56 with < 1800 km/s at 2R_{200} is found.

NON-ADIABATICITY FROM ADIABATIC PERTURBATIONS

Iain Brown – Institute for Theoretical Astrophysics, University of Oslo

Observations of the CMB suggest that the initial perturbations generated during inflation were predominantly adiabatic in nature. However, in a multifluid system adiabaticity is not conserved and the differing evolutions of density perturbations gives rise to a non-adiabatic pressure perturbation which could have consequences at higher orders in perturbation theory. We present the non-adiabatic pressure perturbation generated in the concordance cosmology and examine the main contributors and the scaling behaviours in redshift and wavenumber.

N-BODY SIMULATIONS WITH GENERIC NON-GAUSSIAN INITIAL CONDITIONS

Christian Wagner – Insitut de Ciencies del Cosmos, Universitat de Barcelona

The statistical nature of the initial conditions of the universe can be most directly probed by observations of the early universe, e.g. by the cosmic microwave background. However, primordial non-Gaussianity can also leave measurable signatures in the large-scale structure of the late-time universe. Observables like the galaxy cluster mass function, the galaxy bias and bispectrum are affected by the departures from Gaussianity in distinctive ways. In order to derive constraints on primordial non-Gaussianity from upcoming data of large--scale structure surveys, accurate theoretical modeling is needed. To this end, N-body simulations are indispensable, since the non-linear gravitational evolution has to be taken into account. Here, we provide a prescription for setting up non-Gaussian initial conditions for N-body simulations, where the departures from Gaussianity are specified by a given primordial bispectrum. Using this technique, we are able to run N-body simulations for the local and non-local types of non-Gaussianity. Results of these simulations regarding the halo mass function and the halo bias are presented and implications for large-scale structure probes of non-Gaussianity are discussed. In addition, a new and efficient code to generate non-Gaussian initial conditions for N-body simulations is introduced (Wagner et. al in preparation).

LONG-LIVED CHARGED SUSY PARTICLES WITH BBN, LSS AND CMB

Kazunori Kohri – KEK

When charged particles constitute a dominant non-relativistic component, density fluctuations of matter cannot grow due to the acoustic damping. This results in the suppression of matter power spectrum from which a severe constraint can be obtained. By arguing constraints from other aspects of cosmology, we show that the constraint from large scale structure gives most stringent one in some representative cases.

LIGHT PROPAGATION THROUGH EXACT NON-LINEAR INHOMOGENEITIES IN LCDM COSMOLOGY

Nikolai Meures – ICG, Portsmouth

At a time when galaxy surveys and other observations are reaching unprecedented sky coverage and precision, it is becoming crucial to investigate the non-linear effects of General Relativity on the growth of structures and on observations. Analytic inhomogeneous cosmological models are indispensable to investigate and understand these effects in a simplified context. In this talk, I will present an exact inhomogeneous solution to Einsteinís equations (including dust and a cosmological constant), which can be used to model an arbitrary initial matter distribution along one line of sight. In particular, I will demonstrate how to split the dynamics of this model into background and deviations. In the limit of small deviations, the equations governing the growth of structure link up exactly with standard perturbation theory. I will present our work on numerical light tracing within this framework, demonstrating the effects of non-linear structure on the distance-redshift relation and hence on our interpretation of observations.

VORTICITY IN THE EARLY UNIVERSE

Adam Christopherson – Queen Mary, University of London

Vorticity is ubiquitous in nature however, to date, studies of vorticity in cosmology and the early universe have been quite rare. In this talk, I will consider vorticity generation from cosmological perturbations of a perfect fluid system. I show that, at second order in perturbation theory, vorticity generation is sourced by energy density and entropy gradients, and hence solely scalar perturbations. Such vorticity will likely be important for future CMB B-mode experiments.

OBSERVATIONAL CHALLENGES TO THE SELF-ACCELERATING DGP MODEL

Wenjuan Fang – Physics Department, University of Michigan

We conduct a Markov Chain Monte Carlo study of the Dvali-Gabadadze-Porrati self-accelerating braneworld scenario given the cosmic microwave background (CMB) anisotropy, supernovae and Hubble constant data by implementing an effective dark energy prescription for modified gravity into a standard Einstein-Boltzmann code. We find no way to alleviate the tension between distance measures and horizon-scale growth in this model. Growth alterations due to perturbations propagating into the bulk appear as excess CMB anisotropy at the lowest multipoles. In a flat cosmology, the maximum likelihood Dvali-Gabadadze-Porrati model is nominally a 5.3σ poorer fit than ΛCDM. Curvature can reduce the tension between distance measures but only at the expense of exacerbating the problem with growth leading to a 4.8σ result that is dominated by the low multipole CMB temperature spectrum. While changing the initial conditions to reduce large-scale power can flatten the temperature spectrum, this also suppresses the large angle polarization spectrum in violation of recent results from the five-year Wilkinson Microwave Anisotropy Probe. The failure of this model highlights the power of combining growth and distance measures in cosmology as a test of gravity on the largest scales.

NONLINEAR BIASING AND REDSHIFT-SPACE DISTORTIONS IN LAGRANGIAN RESUMMATION THEORY AND N-BODY SIMULATIONS

Masanori Sato – Nagoya University, Japan

Understanding a behavior of galaxy biasing is crucial for future galaxy redshift surveys, one of whose aims is to measure the baryon acoustic oscillations (BAOs) within the precision of a few percent level. Using 30 large cosmological N-body simulations for a standard ΛCDM cosmology, we study the halo biasing over a wide redshift range. We compare the simulation results with theoretical predictions proposed by Matsubara (2008) which naturally incorporate the halo bias and redshift-space distortions into their formalism of perturbation theory with a resummation technique via the Lagrangian picture. The power spectrum and correlation function of haloes obtained from Lagrangian resummation theory (LRT) well agree with N-body simulation results on scales of BAOs. Especially nonlinear effects on the baryon acoustic peak of the halo correlation function are accurately explained both in real and redshift space. We find that nonlinearity and scale dependence of bias are fairly well reproduced by 1-loop LRT up to $k=0.35$ $hMpc^{-1}$ ($z=2$ and 3) within a percent level in real space and up to $k=0.1$ $hMpc^{-1}$ ($z=2$) and 0.15 ($z=3$) in redshift space. Thus, the LRT is very powerful for accurately extracting cosmological information in upcoming high redshift BAOs surveys.

EXTREME VALUE THEORY AND PRIMORDIAL NON-GAUSSIANITY

Sirichai Chongchitnan – Oxford University

What is the size of the most massive object one expects to find in a survey of a given volume and redshift? In this talk, I present a solution to this problem using Extreme Value Theory (EVT). Though EVT has long been used in finance and engineering, there have only been a handful of cosmological applications, and none in the context of primordial non-Gaussianity. I show how EVT naturally gives the probability density function (pdf) of maximum-mass clusters in a survey volume, and how primordial non-Gaussianity shifts the peak of this pdf. The non-Gaussian effects on the pdf of extreme-mass objects are shown to be greatly enhanced at high redshifts. The dependence of our results on the mass functions and critical overdensity will also be discussed. In addition, I show that the probability distribution of the most massive clusters are well described by the so-called Fréchet family of distribution, regardless of the presence of non-Gaussianity. Finally, I discuss an extension of our technique to calculate the size of the largest void one expects to find in a given volume and redshift.

PARALLEL SESSIONS
FUTURE PROBES OF FUNDAMENTAL PHYSICS (FUT)

ON TESTING SUPERSTRING THEORIES WITH GRAVITATIONAL WAVES

Jasper Hasenkamp – Hamburg U.

We provide a simple transfer function that considers the impact of an early matter dominated era on the gravitational wave background and show that a large class of string theories might be tested by observations of the gravitational wave background from inflation. For large enough reheating temperatures, e.g., $> 10^9$ GeV the test applies to all theories containing at least one scalar with mass $< 3\times10^{12}$ GeV that aquires a large initial oscillation amplitude after inflation and interacts only with gravitational strength; like moduli.

CONSTRAINTS ON THE FUNDAMENTAL STRING COUPLING FROM FUTURE B-MODE EXPERIMENTS

Levon Pogosian – Simon Fraser University

We study signatures of cosmic superstring networks containing strings of multiple tensions and Y-junctions, on the cosmic CMB temperature and polarization spectra. We focus on the crucial role of the string coupling constant g_s, and show that the number density and energy density of the scaling network are dominated by different types of string in the $g_s \sim 1$ and $g_s \ll 1$ limits. This can lead to a potentially observable shift in the position of the B-mode peak – a distinct signal that could allow one to constrain g_s. We forecast the bounds from upcoming and future CMB polarization experiments on the value of g_s.

PROBING MODIFIED GRAVITY WITH EUCLID-LIKE SPECTROSCOPIC SURVEYS

Elisabetta Majerotto – INAF-OAB

We explore the ability of future redshift surveys of galaxies to estimate the growth rate of structure from measurements of the amplitude and redshift-space anisotropy of galaxy clustering, probing in this way the possibility that gravity is modified on large scales. We do this in the context of a survey which measures in addition the expansion history of the Universe, using the power spectrum (and its baryonic features) as a standard ruler, and explore the relative degeneracies of measurements of expansion and growth. We forecast an error on σ8 between 1.6% and 4.8%, depending on model assumptions. We investigate the important aspect of how sensitive the optimal survey configuration is to the way we parameterize growth and to the cosmological model we assume, stressing how specific parameterizations could actually drive the design towards artificially restricted regions of a survey's parameter space. If however we use the growth index parameter, our reference survey, the current baseline of the planned Euclid slitless spectroscopic survey, should be able to distinguish modified gravity models having |γ – 0.55| greater than 0.12.

PARAMETRIZATIONS OF THE GROWTH INDEX AND EUCLID FORECASTS

Alicia Bueno Belloso – Instituto de Física Teórica (UAM/CSIC)

We provide exact solutions to the cosmological matter perturbation equation in a homogeneous FLRW universe with a vacuum energy that can be parametrized with a variable equation of state parameter $w(a) = w_o + w_a (1 - a)$. We compute the growth index $\gamma = \log f(a)/\log \Omega_m(a)$, and its redshift dependence, using the exact solutions in terms of Legendre polynomials and show that it can be parametrized as $\gamma(a) = \gamma_o + \gamma_a (1 - a)$. We then compare four different types of dark energy (DE) models: ΛCDM, DGP, f(R) and a LTB-large-void model, which have very different behaviors at z ~> 1. This allows us to study the possibility to differentiate between different DE alternatives using wide and deep surveys like EUCLID, which will measure both photometric and spectroscopic redshifts for several hundreds of millions of galaxies up to redshift z = 2. We do a Fisher matrix analysis for the prospects of differentiating among the different DE models in terms of the growth index, taken as a given function of redshift or with a principal component analysis, with a value for each redshift bin. We use as observables the complete and marginalized power spectrum of galaxies P(k) and the Weak Lensing (WL) power spectrum. We find that, using P(k), one can reach (2%, 5%) errors in (w0,wa), and (4%, 12%) errors in (γ_o, γ_a), while using WL we get errors at least twice as large. These estimates allow us to differentiate easily between DGP, f(R) models and ΛCDM, while it would be more difficult to distinguish the latter from a variable equation of state parameter or LTB models using only the growth index.

EFFECT OF BARYONIC FEEDBACK ON COSMIC SHEAR TOMOGRAPHY

Elisabetta Semboloni – Leiden University/Leiden Observatory

The deflection of light by large scale structure, i.e. cosmic shear, is a powerful cosmological proof.However, to date, the interpretation of cosmic shear measurements relies on models which have been developed and refined using dark matter only simulations. Using a set of hydrodynamical simulations, we explore the effect of various mechanisms such as, cooling, star formation, metal enrichment, Supernovae and AGN outflows on the weak lensing power spectrum. We show that the interpretation of two-point shear statistics for a space-based mission such as Euclid, using dark-matter only models can lead to a bias on the equation of state w_o as high as 40%. We suggest a model which can be adjusted using scaling relations and account for real baryonic feedback. We show that this model is able to significantly reduce the bias on the cosmological parameters.

BAO SIMULATION DEDICATED TO THE LARGE SYNOPTIC SURVEY TELESCOPE

Alexia Gorecki – LPSC/IN2P3/CNRS/Université de Grenoble

The LSST project (Large Synoptic Survey Telescope) will produce one of the main Large Scale Structures surveys of the next decade. Such galaxy catalogs will be used to study the baryonic acoustic oscillations (BAO) that are known to be a powerful probe of the detailed features of the accelerated expansion of the Universe. I will present the LSST experiment, as well as the simulation and analysis pipeline that we have developed. I will focus specially on the photometric redshifts reconstruction. The validation of the photometric redshifts computation with CFHTLS real data will be presented. The photo-z uncertainties impact on the BAO scale determination and the resulting constrain on dark energy parameters will finally be shown.

FALSIFYING PARADIGMS FOR COSMIC ACCELERATION

Dragan Huterer – University of Michigan

How can we rule out whole classes of dark energy models? And what quantities, at what redshift, and with what accuracy, should be measured in order to rule out these classes of models? I present answers to these questions by discussing an approach that utilizes the principal component parametrization of dark energy. I show results based on current data, and future forecasted data from a space--based dark energy mission and Planck. Finally, using the same basic framework I present a quantitative analysis motivated by recent claims that the number of high-redshift, high-mass galaxy clusters (the 'pink elephant' clusters) is in disagreement with the standard cosmological model predictions.

NEW PROBE OF DARK ENERGY: COHERENT MOTIONS FROM REDSHIFT DISTORTION

Yong-Seon Song – Korea Institute for Advanced Study

The next generation of cosmological observations will be launched to scan inhomogeneity at large scales, such as SDSS3, EUCLID and Big-BOSS. These experiments be optimally designed to answer the question whether our understanding of nature on the earth is universal or not. Using coherent motion measurement from redshift distortion, we introduce how to read signatures of our fundamental knowledge of nature imprinted on large scale structure formation, how to falsify different approaches – dark materials or violation of fundamental laws – and how to develop computational and observational techniques to transform raw data sets into understandable physical knowledge.

PRECISION COSMOLOGY WITH WEAK GRAVITATIONAL LENSING

Andrew Hearin – University of Pittsburgh

Forthcoming projects such as DES, LSST, Euclid, and WFIRST aim to measure weak lensing shear correlations with unprecedented precision. These data sets have the potential to illuminate the nature of the cosmic acceleration by constraining the dark energy equation of state at the percent level and providing precision tests of the consistency of general relativity. We address several of the leading challenges to this program. Because the weak lensing signal is most sensitive to scales from 0.2-100 Mpc/h, percent-level uncertainty in predicting the matter power on nonlinear scales is a threatening source of systematic error. Another major source of uncertainty for these surveys derives from their reliance on photometrically determined redshifts. Cosmological parameter estimation depends quite sensitively on the redshift distribution of sources: current estimates are that both the bias and scatter of the photo-z distribution must be controlled to 0.003 or better in order to avoid degrading dark energy constraints by ~50% or more. Meanwhile, uncalibrated "catastrophic" redshift outliers must be controlled at a level of 10^{-3} or less or their associated systematic errors will dominate the error budget. We present a new analysis of these stringent calibration requirements that addresses the interplay between photo-z uncertainty and errors in the calibration of the matter power spectrum. We find that including galaxy clustering statistics in a joint analysis with cosmic shear not only strengthens the survey's constraining power but can also have a profound impact on the calibration demands. For contemporary levels of uncertainty in the photo-z distribution of galaxies, a joint analysis can improve upon the cosmic shear constraints on w_0 by ~50%. We also study the potential to exploit the complementarity of these statistics to detect and calibrate the most damaging sources of systematic error. Finally, we compare these calibration requirements to the contemporary state-of-the-art in predictions of the lensing power spectrum and photometric redshift estimation and suggest strategies to utilize forthcoming data optimally.

CONSTRAINTS ON PRIMORDIAL NON-GAUSSIANITY FROM THE LARGE-SCALE STRUCTURE

Emiliano Sefusatti – IPhT CEA/Saclay

I will discuss how future large-scale structure observations can confirm or improve CMB contraints from Planck on primordial non-Gaussianity. I will focus on a complete analysis of galaxy correlators, that is a joint analysis of the galaxy power spectrum and bispectrum, taking into account different models for the primordial curvature bispectrum.

PRIMORDIAL NON-GAUSSIANITY FROM THE 21 CM POWER SPECTRUM DURING THE EPOCH OF REIONIZATION

Shahab Joudaki – University of California, Irvine

Primordial non-Gaussianity is a crucial test of inflationary cosmology. We consider the impact of non-Gaussianity on the ionization power spectrum from 21 cm emission at the epoch of reionization. We focus on the power spectrum on large scales at redshifts of 7 to 8 and explore the expected constraint on the local non-Gaussianity parameter f_{NL} for current and next-generation 21 cm experiments. We show that experiments such as SKA and MWA could measure f_{NL} values of order 10. This can be improved by an order of magnitude with a fast-Fourier transform telescope like Omniscope.

PRIMORDIAL NON-GAUSSIANITY AND CMB STATISTICAL ANISOTROPIES

Nicola Bartolo – Physics Department "G. Galilei", University of Padova, Italy

Motivated by some CMB observational hints of statistical isotropy breaking and recent theoretical developments of primordial (inflationary) vector field models, we will discuss how to extract statistical anisotropy information from the three-point correlation function of CMB anisotropies. Such anisotropic features can be imprinted by a primordial non-Gaussianity whose amplitude is modulated by some preferred spatial directions. We will show how present and future CMB experiments could be sensitive to such signatures at a level of a few percent. Our results are complementary to power spectrum analyses, and particularly relevant for those models where statistical anisotropy turns out to be suppressed in the power spectrum but is not negligible in the CMB bispectrum.

LIST OF POSTERS

C1

THE EXPANSION HISTORY OF THE UNIVERSE UNVEILED WITH H II GALAXIES

Ricardo Chavez – Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE)

We propose to use the known H II galaxies redshift – distance relation, measured by means of their $L(H_\beta)$ – σ correlation, in order to determine the Hubble relation to intermediate and high redshifts, in an attempt to constrain the solution space of the dark energy equation of state parameters, as an independent alternative to the cosmological use of type Ia supernovae. We present the local value of H_o determined by means of the proposed method.

C2

IMPROVED ISW EFFECT DETECTION THROUGH THE CMB POLARIZATION ASSISTENCE

Guo Chin Liu – Department of physics, Tamkang University

Integrated Sachs-Wolfe (ISW) effect can be estimated by cross-correlating the cosmic microwave background (CMB) sky with tracers of the local matter distribution. At late cosmic time, the dark energy induced decay of gravitation potential generates a cross-correlation signal on large angular scales. The dominant noise of this detection are the intrinsic CMB anisotropies from the inflationary epoch. The CMB polarization can be used to reduce the noise. Applying the idea to WMAP 7-year data and NVSS radio source catalog, we find the ISW detection is improved by about 10%.

C3

GPGPU COSMOLOGICAL N-BODY PARTICLE-PARTICLE SIMULATIONS

David Oliveira – CAUP

We explore the new emerging technique of GPGPU (General-Purpose computing on Graphics Processing Units) and its low-cost commodity high computing capacity, in the context of N-Body cosmological simulations. We have implemented a standard Particle-Particle (PP), direct summation solver in the style of the well-known Hydra cosmological simulation code in a GPGPU, GLSL over OpenGL 2.1 environment. This results in a GPU hardware vendor independent, platform-agnostic, complete PP direct-summation code with all steps and the full simulation iterative loop running on the graphics hardware in its entirety – fully leveraging the performance potential of the GPGPU framework. This endeavour required the reengineering and recasting of the known algorithm in a parallel, vectorial form in order to fully exploit the GPU hardware. Therefore, a novel implementation of the traditional PP algorithm was developed to address the particularities of this vector processing paradigm, opposed to the standard sequential processing based one. We perform an analysis of the performance gains of this novel approach, compared to a "classical" implementation of the same algorithm in a traditional x86 architecture CPU. Finally, we show that by using a GPGPU approach in PP direct-summation simulations, we transform the algorithm runtime scaling from O(N^2) to O(~N) for the surveyed problem sizes, enabling us to perform PP simulations of scales not practical before.

C4

THE GALAXY 3-POINT CORRELATION FUNCTION OF WIGGLEZ GALAXIES

Felipe Marin Perucci – Swinburne University of Technology

The 3-point correlation function (3PCF) is a complementary measure of clustering which adds important information about galaxy bias, cosmological parameters and galaxy population models. We present results of the 3-point correlation function of galaxies from the WiggleZ galaxy survey. At a median redshift of z=0.6, the highest redshift where the 3PCF has been measured to date, the 3PCF allow us to obtain independent estimations of the galaxy bias, which combined with the 2-point correlation function measurements, provides constraints in the normalization of the dark matter power spectrum and the growth rate, which can be compared with the LCDM expectations.

C5

QUANTIFYING NONLINEAR CONTRIBUTIONS TO THE CMB BISPECTRUM IN SYNCHRONOUS GAUGE

Guido Walter Pettinari – Institute of Cosmology and Gravitation

The upcoming PLANCK experiment will allow us to test models of inflation with unprecedented accuracy. In particular, the measurement of the CMB bispectrum will provide a stringent constraint on the amount of non-Gaussianity in the initial conditions of our Universe. The detection of primordial non-Gaussianity would be a direct probe of the early Universe physics, and would provide information on the particle fields present at the time. However, a recent paper by Pitrou, Bernardeau, Uzan (2010) points out that the non-linear evolution coming from Einstein equations significantly contributes to the observed non-Gaussianity, even for completely Gaussian initial conditions. We aim to quantify this "noise" over the primordial signal by means of a full integration of the Boltzmann-Einstein system of equations at second-perturbative order. During the talk, I shall highlight the differences with the first--order approach, discuss gauge issues, show the relevant equations, and present some preliminary results.

C6

CMB BISPECTRUM OF SCALAR, VECTOR AND TENSOR MODES SOURCED FROM PRIMORDIAL MAGNETIC FIELDS

Maresuke Shiraishi – Nagoya University

If the seed magnetic fields exist in the early Universe, their anisotropic stresses generate additional fluctuations of the cosmic microwave background (CMB) radiation. Because these fluctuations deviate largely from the Gaussian statistics due to the quadratic dependence on the strength of the Gaussian magnetic field, not only the power spectrum but also the higher-order correlations have reasonable signals. With these motives, we calculate the CMB bispectrum of scalar, vector and tensor modes induced from the seed magnetic fields. By comparing these results with the current observational constraint on the primordial non-Gaussianity, we find that the upper bound on the PMF strength is 2.6nG when the magnetic spectrum has nearly scale-invariant shape. This value is tighter than the current bounds obtained by the CMB power spectra. In this talk, I present our calculation and results.

C7

MULTI-FLUID RENORMALIZED PERTURBATION THEORY AND MASSIVE NEUTRINOS

Nicolas Van de Rijt – CEA/IPhT

We consider the generalization of renormalized perturbation theory to fluids with multiple components. We explore the possibility of doing such calculations in presence of massive neutrinos.

C8

UTILIZING LARGE-SCALE STRUCTURE TO CONSTRAIN UNSTABLE DARK MATTER

Mei-Yu Wang – Department of Physics & Astronomy, University of Pittsburgh

We study the effects of decaying dark matter on large-scale structure and the ability of forthcoming experiments to probe interesting models of unstable dark matter. Here we consider two types of decay model. In one scenario dark matter decay into two non-interacting relativistic particles. In the second type of model dark matter decays into a slightly less massive, but stable, dark matter particle accompanied by a relativistic daughter particle. We solve for the linear perturbative evolution of the matter power spectrum and the spectra of the metric potentials. In addition, we implement a number of corrections to account for nonlinear evolution on relevant scales. We then proceed to study the imprint of unstable dark matter on the galaxy and lensing power spectra. In the next decade weak gravitational lensing will become a powerful tool for studying cosmology as future large imaging survey like DES, LSST, Euclid, and WFIRST provide data of unprecedented utility. We show that weak lensing shear correlations will provide restrictive constraints on the lifetime or fraction of unstable dark matter. Indeed we show that such constraints should compete with limits from other techniques even under pessimistic assumptions about the utility of the survey data and the progress of theoretical modeling. In more optimistic scenarios, we show that lensing shear correlations will likely provide the strongest, model-independent constraints on unstable dark matter while simultaneously providing the sought-after, percent-level constraints on the dark energy equation of state, and strong constraints on neutrino mass.

C9

REES-SCIAMA EFFECT AND IMPACT OF FOREGROUND STRUCTURES ON GALAXY REDSHIFTS

Hu Zhan – National Astronomical Observatories of China

Using toy models of super structures and the LTB metric solution, we find that both superclusters and supervoids can decrease the temperature of the CMB by several micro Kelvin in the central region due to the RS effect. This is significant compared to the linear integrated Sachs-Wolfe (ISW) effect, and, hence, may need to be taken into account when interpreting the ISW data. We also find that super structures can induce changes to galaxy redshifts at the percent level of large-scale rms bulk velocities. This effect can be a source of systematic error in precision measurements of the redshift-space galaxy correlations for dark energy studies.

D1

COSMOLOGICAL PERTURBATIONS IN F(R) GRAVITY

Je-An Gu – LeCosPA Center, National Taiwan University

We investigate the evolution of the cosmological perturbations in f(R) gravity, an alternative of dark energy. In many cases one invokes approximated evolution equations, e.g., those in general relativity for the early times and those with the sub-horizon and matter-dominated approximations for the late times. We examine the validity of these approximations and develop a new method for calculating the evolution of the perturbed quantities, in particular the matter density perturbation and the metric perturbations.

D2

ISLANDS OF STABILITY FOR CONSISTENT DEFORMATIONS OF EINSTEIN'S GRAVITY

Florian Kühnel – LMU Munich

We study consistency of the most relevant extension to Einstein's gravity at quadratic order in the fluctuation around a general background. Based on unitarity requirements, we show that these deformation have unique symmetries. For cosmological backgrounds we demonstrate explicitly that there exists a region in parameter space where the quadratic system is always stable. Any sensible nonlinear completion must incorporate this self--stabilizing aspect already at lowest order in perturbation theory. Our findings include the possibility of consistently deforming general relativity solely on curved backgrounds. The latter might be relevant for issues related consistency arguments by Boulware and Deser.

D3

ROLES OF DARK ENERGY PERTURBATIONS IN DYNAMICAL DARK ENERGY MODELS: CAN WE IGNORE THEM?

Jae-Heon Lee – Department of Astronomy and Atmospheric Sciences, Kyungbook National University

We show the importance of properly including the perturbations of the dark energy component in the dynamical dark energy models based on a scalar field and modified gravity theories in order to meet with present and future observational precisions. Based on a simple scaling scalar field dark energy model, we show that observationally distinguishable substantial differences appear by ignoring the dark energy perturbation. By ignoring it the perturbed system of equations becomes inconsistent and deviations in (gauge-invariant) power spectra depend on the gauge choice.

D4

FUTURE DECELERATION DUE TO EFFECT OF EVENT HORIZON ON BACKREACTION FROM INHOMOGENEITIES

Archan S. Majumdar – S. N. Bose National Centre for Basic Sciences

The present acceleration of the universe leads to the formation of a cosmological future event horizon. We explore the effects of the event horizon on cosmological backreaction due to inhomogeneities in the universe. Beginning from the onset of the present accelerated era, we show that backreaction in presence of the event horizon causes acceleration to slow down in the subsequent evolution. Our results indicate that even if the cause for the present acceleration is unrelated to any effect due to cosmological inhomogeneities, backreaction from them in the presence of the event horizon could lead to a transition to deceleration eventually, ensuring avoidance of a big rip.

D5

OBSERVATIONAL CONSTRAINTS ON BULK VISCOUS MATTER-DOMINATED MODELS

Ariadna Montiel – Centro de Investigación y Estudios Avanzados del IPN

In this work, we study the range of consistency of a constant bulk viscosity model where the dark sector of the cosmic substratum is a viscous fluid with pressure $p= - \zeta \theta$, with θ the fluid-expansion scalar and ζ the coefficient of bulk viscosity. We found that the best fit for the viscosity parameter $\tilde{\tilde{\zeta}}$ is in the range $0 < \tilde{\tilde{\zeta}} < 3$, in agreement with the prediction of the model and previous probes. In this analysis, we also include the CMB5-year data and CMB7-year data, as well as with the baryonic acoustic peak BAO. We use the updated sample of 59 high-redshift GRBs reported by Wei (2010) calibrated at low redshifts with the Union 2 sample of SNe Ia. From the statistics with CMB it turns out that the model is only in very good concordance for epochs as far as $z \sim 8.1$ till present.

D6

CONSTRAINTS ON A F(R) GRAVITY DARK ENERGY MODEL WITH EARLY SCALING EVOLUTION

Chan-Gyung Park – Kyungpook National University

The modified gravity with $f(R) = R^{1+\varepsilon}$ ($\varepsilon > 0$) allows a scaling solution where the density of gravity sector follows the density of the dominant fluid. We present initial conditions of background and perturbation variables during the scaling evolution regime in the modified gravity. As a possible dark energy model we consider a gravity with a form $f(R) = R^{1+\varepsilon} + qR^{-n}$ ($-1 < n \leq 0$).

D7

OBSERVATIONAL CONSTRAINTS ON SCALAR FIELD MODELS OF DARK ENERGY WITH BAROTROPIC EQUATION OF STATE

Olga Sergijenko – Astronomical Observatory of Ivan Franko National University of Lviv

We constrain the parameters of dynamical dark energy in the form of a classical or tachyonic scalar field with barotropic equation of state jointly with other cosmological ones using the combined datasets which include the CMB power spectra from WMAP7, the baryon acoustic oscillations and the power spectrum of luminous red galaxies from SDSS DR7, the light curves of SN Ia from 2 different compilations: Union2 (SALT2 light curve fitting) and SDSS (SALT2 and MLCS2k2 light curve fittings). We discuss the role of different datasets in determination of the dark energy parameters. It has been found that the initial value of dark energy equation of state parameter is constrained very weakly by most of the data while the rest of main cosmological parameters are well constrained: their likelihoods and posteriors are similar, have the forms close to Gaussian (or half-Gaussian) and their confidential ranges are narrow. The most reliable determinations of the best fitting value and 1σ confidence range for the initial value of dark energy equation of state parameter were obtained from the combined datasets including SN Ia data from the full SDSS compilation with MLCS2k2 fitting of light curves. In all such cases the best fitting value of this parameter is lower than the value of corresponding parameter for current epoch. Such dark energy loses its repulsive properties and in future the expansion of the Universe will change into contraction. We also perform an error forecast for the Planck mock data and show that they narrow essentially the confidential ranges of cosmological parameters values, moreover, their combination with SN SDSS compilation with MLCS2k2 light curve fitting may exclude the fields with initial equation of state parameter > -0.1 at 2σ confidence level.

D8

BAYESIAN RECONSTRUCTION OF THE GRAVITATIONAL POTENTIAL FROM WEAK LENSING

Rafal Szepietowski – Institute of Cosmology and Gravitation, Univeristy of Portsmouth

Mass mapping using weak lensing has been a very successful technique in cosmology as proven by the indication of a Dark Matter component in the Bullet Cluster. In addition, if combined with information from clustering and peculiar velocities, it can be a promising probe of Dark Energy and Modified Gravity. Here, I review the Bayesian approaches to weak lensing potential reconstruction and propose a Maximum-Probability method. I discuss how to incorporate prior information in the reconstruction process of 2D and 3D maps of the gravitational potential due to large scale structure and show the results of applying this method to N-body simulations.

D9

IMPACT OF PRIMORDIAL NON-GAUSSIANITIES (FNL) ON THE EFFECTIVE DARK ENERGY EQUATION OF STATE

Arlindo Trindade – CAUP

Primordial Non-Gaussianities constitute a powerful tool to test different inflationary scenarios, as well as to probe the physical processes in the early Universe. The abundance of galaxy clusters is very sensitive to deviation from Gaussianity in the primordial density perturbations, making it a powerful tool to test non-Gaussian initial conditions. Making use of this fact, we have investigated the effect that Primordial Non-Gaussianities may have on the reconstruction of the effective dark energy equation of state.

F1

SECOND ORDER GRAVITATIONAL WAVES IN HILLTOP TYPE INFLATION MODELS

Laila Alabidi – Yukawa Inst. of Theoretical Physics

Expected data sets from the upcoming PLANCK satellite will further bound the cosmological parameters, specifically the tensor fraction, spectral index and the running of the spectral index. As previous works have shown, relying on these parameters alone will still leave us with a degree of degeneracy between the many models of Inflation. As such, we need to expand the pool of observable parameters in order to further narrow the field. In this work we focus on Hilltop type models of inflation which have been shown to lead to an enhanced spectrum on small scales. Whether the spectrum on small scales can be measured in the future is debatable, and so we look to another signature of the enhanced spectrum. It has been shown that the gravitational wave spectrum sourced by first order scalar perturbations may be within reach of gravitational wave detectors, and so we calculate this signature for these models; comparing the theoretical expectation of the gravitational wave amplitude to the sensitivity of gravitational wave detectors.

F2

PROJECTING CONSTRAINTS ON SCALE-DEPENDENT NON--GAUSSIANITY

Adam Becker – University of Michigan

Non-Gaussianity is one of the few available probes of inflation, and arguably the most powerful one. Future results from Planck and from large-scale structure surveys will place tight constraints on many of the most popular models of non-Gaussianity. We have projected the constraints that will be placed on a simple physically-motivated scale-dependent form of non-Gaussianity (a generalization of the local model) from CMB and LSS data in the near (and not-so-near) future.

F3

SEMI-BLIND ANALYSIS OF UNCERTAINTIES IN RECOMBINATION HISTOY

Marzieh Farhang – CITA

The standard model for recombination history, describing how the universe transitioned from an ionized to a neutral state, is a basic assumption for modeling the CMB sky which is to be compared to data to measure the cosmological parameters. The current model is fairly well explored and understood in the realm of standard physical processes relevant at the epoch of recombination. However, there is the possibility that some processes beyond the standard scenario, such as energy injection by annihilating dark matter, have also shaped the recombination history, which, if ignored, could lead to biases in the measurement of cosmological parameters. Moreover, studying these potential deviations could hint to some unknown physics playing role at that epoch. In this work we perform a semi-blind analysis of the uncertainties in the recombination model by constructing patterns which are maximally informative about the perturbations in the ionization history based on simulated CMB data. We demonstrate how the inclusion of these modes affect the measurements of other cosmological parameters. We also show how to achieve the model best explained by data through an iterative approach if deviations from the standard scenario is detected by real data.

F4

ESTIMATING G_{NL} FOR PLANCK

Dominic Galliano – Institute of Cosmology and Gravitation – University of Portsmouth

With Planck's more precise measurements of the CMB Anisotropies at small scales, new independent measures of non-Gaussianity are being developed which are based on 4 point correlation functions, such as g_{NL}. So far, g_{NL} estimators have been derived for the local form, the equilateral form and isocurvature modes. However measuring g_{NL} brings new challenges in data processing. An extra correlation point gives more degrees of freedom, which together with Planck's precision at small scales means a lot more data needs reducing. How will this affect the variance on g_{NL} estimators? In this talk I will go through problems with estimating the variance of these estimators for Planck, and talking about how high performance computing is helping us solve this. I will also give the estimates for the variance of different g_{NL} estimators we can expect when using them on Planck data.

F5

TESTING SPACETIME SYMMETRIES WITH CMB POLARIZATION DATA

Giulia Gubitosi – UC Berkeley, LBL, Berkeley, CA and PCCP APC Lab Univ. Paris Diderot

Lorentz symmetry violations are expected to emerge when spacetime is probed on very short distance scales, of the order of the Planck length scale $l_P \sim 10^{-35}$ m. CMB photons provide a way to test spacetime on these very small scales thanks to their very long propagation time, that amplifies the anomalies of light behavior due to the breakdown of classical symmetries. These kind of anomalies would show up as a birefringent behavior of light (rotation of the polarization direction during propagation), which can depend on the direction of propagation if space isotropy is also violated. We show that polarization data gathered by the PLANCK satellite will reach the sensitivity required to test spacetime symmetries up to the Planck-scale, and that in particular the availability of a full-sky coverage can allow to perform also accurate tests on non-isotropic birefringence effects.

F6

THE ANTARES NEUTRINO TELESCOPE: STATUS AND RESULTS

Annarita Margiotta – INFN and Universita

The ANTARES detector is the largest underwater neutrino telescope. It is located at 2.5 km under the Mediterranean sea level, in front of the Southern French coast. The main goal of the experiment is the search for high-energy neutrinos from astrophysical sources. The apparatus is optimized for the detection of muon neutrinos at energies above 1 TeV. The status of the experiment will be presented, including a broad target-of-opportunity program. The ongoing physics studies will be reviewed. In particular the results of a search for point-like sources and for diffuse flux of VHE neutrinos will be discussed.

F7

GRAVITATIONAL WAVES FROM FERMIONIC PREHEATING

Tuukka Meriniemi – University of Helsinki

I will present fresh numerical results for the gravitational wave spectrum produced during fermionic preheating. In our model, the inflaton is coupled to a fermionic field via Yukawa interaction. After inflation, the inflaton decays into fermionic species at preheating. During preheating the inflaton oscillates coherently around its minimum. The effective mass of the fermionic field is proportional to the inflatons amplitude and is therefore time-dependent. When the effective mass is near to its minimum the amplitude of the fermionic field changes rapidly and non-adiabatically. This gives rise to large inhomoginities which produces gravitational waves. Gravitational wave production from bosonic preheating has been studied by several groups previously, but this is the very first time that gravitational wave production from fermionic preheating has been explored.

I1

OBSERVATIONAL CMB PREDICTIONS FROM WARM INFLATION

Mar Bastero-Gil – Universidad de Granada

We review the calculation of the primordial curvature spectrum generated during warm inflation, including shear viscous effects. The primordial spectrum is dominated by the thermal fluctuations of the radiation bath, sourced by the dissipative term of the inflaton field. The dissipative coefficient Y computed from first principles in the close-to-equilibrium approximation depends in general on the temperature T, and this dependence renders the system of the linear fluctuations coupled, inducing a growing mode in the fluctuations before horizon crossing. However, dissipation intrinsically means departures from equilibrium, and therefore the presence of a shear viscous pressure in the radiation fluid. This in turn acts as an extra friction term for the radiation fluctuations which tends to damp the growth of the perturbations. Independently of the T functional dependence of the dissipation and the shear viscosity, we find the condition under which the shear effect kills the growing mode in the spectrum. We also discuss the implications of the shear for non-gaussianity.

I2

CHAOTIC INFLATION IN MODIFIED GRAVITATIONAL THEORIES

Joseph Elliston – Queen Mary, University of London

We study chaotic inflation in the context of modified gravitational theories and apply up-to-date constraints from WMAP 7yr combined with other observations. Our analysis covers models based on (i) a field coupling to the kinetic energy and nonmimimal coupling with the Ricci scalar R, (ii) Brans-Dicke (BD) theories, (iii) Gauss-Bonnet (GB) gravity, and (iv) gravity with a Galileon correction. We investigate the effects of these terms on the scalar and tensor spectral indices as well as the tensor to scalar ratio. The self-coupling inflationary potential, ruled out by current observations, is shown to be compatible with data in a variety of such generalised settings. The ability for such theories to generate large non-Gaussianitites is also discussed.

I3

QUANTUM THEORY OF FERMION PRODUCTION AFTER INFLATION

Daniil Gelfand – Institut für Kernphysik, TU Darmstadt

We show that quantum effects dramatically influence the production of fermions following preheating after inflation in the early universe. As a consequence fermions rapidly approach a quasi-stationary distribution with a thermal occupancy in the infrared, while the inflaton enters a turbulent scaling regime. The failure of standard semi-classical descriptions based on the Dirac equation with a homogeneous background field is caused by non-perturbatively high boson occupation numbers. During preheating the inflaton occupation number increases, thus leading to a dynamical mechanism for the enhanced production of fermions from the rescattering of the inflaton quanta. This mechanism is studied by using two-particle irreducible (2PI) effective action techniques, which we compare to results from lattice simulations.

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CLASSICAL NON-GAUSSIANITY FROM NON-LINEAR EVOLUTION OF CURVATURE PERTURBATION

Jinn-Ouk Gong – CERN

We show that in a single component situation all perturbation variables in the comoving gauge are conformally invariant to all perturbation orders. Generally we identify a special gauge, the uniform-conformal transformation gauge, where all perturbations are again conformally invariant to all perturbation orders. We apply this result to the delta N formalism, and show its conformal invariance. We argue that we can discuss the conformal invariance in the gauge transformations.

15

FINE FEATURES IN THE PRIMORDIAL POWER SPECTRUM

Kohei Kumazaki – Nagoya University

A possible origin of the anomalous dip and bump in the primordial power spectrum, which are reconstructed from WMAP data corresponding to the multipole l = ~140 by using the inversion method, is investigated as a consequence of modification of scalar field dynamics in the inflation era. Utilizing an analytic formula to handle higher order corrections to the slow-roll approximation, we evaluate the relation between a detailed shape of inflaton potential and a fine structure in the primordial power spectrum. We conclude that it is unlikely to generate the observed dip and bump in the power spectrum by adding any features in the inflaton potential. Though we can make a fine enough shape in the power spectrum by controlling the feature of the potential, the amplitude of the dip and bump becomes too small in that case.

16

CONSERVATION OF THE NONLINEAR CURVATURE PERTURBATION IN GENERIC SINGLE-FIELD INFLATION

Atsushi Naruko – Yukawa Institute for Theoretical Physics

It is known that the curvature perturbation on uniform energy density (or comoving or uniform Hubble) slices on superhorizon scales is conserved to full nonlinear order if the pressure is only a function of the energy density (i.e. if the perturbation is purely adiabatic), independent of the gravitational theory. Here, we explicitly show that the same conservation holds for a universe dominated by a single scalar field provided that the field is in an attractor regime, for a very general class of scalar-field theories. However, we also show that if the scalar-field equation contains a second time derivative of the metric, as in the case of the Galileon (or kinetic braiding) theory, one has to invoke the gravitational-field equations to show the conservation.

17

INFLATIONARY CORRELATION FUNCTIONS WITHOUT INFRARED DIVERGENCES

Gianmassimo Tasinato – ICG

Inflationary correlation functions are potentially affected by infrared divergences. For example, the two-point correlator of curvature perturbation at momentum k receives corrections ~ln(kL), where L is the size of the region in which the measurement is performed. I will present infrared-safe correlation functions which have no sensitivity to the size L of the box used for the observation. The conventional correlators with their familiar log-enhanced corrections (both from scalar and tensor long-wavelength modes) are easily recovered from these IR-safe correlation functions. Among other examples, I will illustrate this by calculating the corrections to the non-Gaussianity parameter f_{NL} *coming from long-wavelength tensor modes. In our approach, the IR corrections automatically emerge in a resummed, all--orders form. For the scalar corrections, the resulting all-orders expression can be evaluated explicitly.*

18

A COMPELLING VECTOR CURVATON MODEL AND ITS DISTINCT OBSERVATIONAL SIGNATURES.

Jacques Wagstaff – Lancaster University

A vector curvaton model with a Maxwell kinetic term and varying kinetic function and mass during inflation is presented. It is shown that, if light until the end of inflation, the vector field can generate statistical anisotropy in the curvature perturbation spectrum and bispectrum, with the latter being predominantly anisotropic. If by the end of inflation the vector field becomes heavy, then particle production is isotropic and the vector curvaton can alone generate the curvature perturbation.

19

MODELING PHASE TRANSITIONS IN DYNAMICAL ENVIRONMENTS

Daniel Yueker – Frankfurt Institute for Advanced Studies (FIAS)

An interesting way of testing the standard model is to look for possible consequences of predicted phase transitions in the early universe. Particularly, electro-weak and deconfinement/chiral phase transitions are often discussed in this context. Even stronger dynamical effects are expected in the fireballs created in relativistic heavy-ion collisions. Because of the fast expansion one should expect non-equilibrium effects, such as nucleation, spinodal decomposition, supercooling and reheating, to be important. Due to theoretical uncertainties, we consider different possibilities regarding the type of a phase transition, the mechanism of the phase transformation and dynamics of the expansion. Since the early universe is almost baryon-antibaryon symmetric, its baryochemical potential is close to zero. As well established by lattice calculations, in this case the deconfinement phase transition occurs at a temperature below 200 MeV at time of 10^{-5} seconds after the big bang. We use an effective field-theoretical model to describe the QCD phase transition for different expansion rates. It is assumed that the formation of a new phase proceeds via thermal fluctuations. For the case of cosmological expansion a iterative scheme is formulated where the Hubble parameter is determined self-consistently with the order parameter. A possibility of "small inflation" scenario is discussed.

M1

A GRAZING ESP ENCOUNTER DURING INFLATION

Thorsten Battefeld – University of Goettingen, Inst. of astrophysics

I investigate consequences of a grazing encounter with an Extra Species Point during the last sixty e-folds of inflation in a two dimensional field space. Back-reaction causes a bending of the trajectory and a temporary decrease in speed, both of which are sensitive to initial conditions. As a consequence, dominant contributions to the power-spectrum can arise if the encounter is close, with observably large non-Gaussianities.

M2

SIMPLE DARK MATTER SEARCH

Miguel Costa – Instituto Tecnológico e Nuclear

SIMPLE is a superheated liquid-based dark matter experiment, sited at the LSBB in southern France. I describe the recent effort results which provide considerable sensitive limits against a spin-dependent WIMP interaction with protons from a direct search experiment.

M3

SEARCHING FOR DARK MATTER: THE LUX EXPERIMENT

Luiz de Viveiros – LIP-Coimbra

The Large Underground Xenon (LUX) is a dark matter direct detection experiment being deployed at the Homestake Mine in South Dakota, USA. The LUX detector is a dual-phase Xe TPC, with a total liquid Xe mass of 350 kg. It leverages the dual-phase Xe technology and expertise from the XENON and ZEPLIN-III experiments, while adding improvements in key areas, such as shielding and cryogenics, to support the increase in mass and to improve backgrounds. It aims at a sensitivity of 7×10^{-46} cm^2 for the WIMP-nucleon cross-section for a 100 GeV/cm^2 WIMP, an order of magnitude better than existing detectors. The detector is currently running at a surface facility at Homestake, undergoing calibration and testing of all subsystems before final deployment underground by the end of 2011. In this talk, we present the experiment and its status, with a focus on the design elements that make the detector a major competitor in the field of dark matter detection.

M4

SYSTEMATIC ANALYSIS OF LEPTOGENESIS IN NON-EQUILIBRIUM QFT

Alexander Kartavtsev – Max-Planck Institut for Nuclear Physics

We apply the formalism of non-equilibrium QFT to study resonant leptogenesis and find that the canonical expression for the CP-violating parameter is only applicable in the hierarchical case. In the resonant regime medium corrections modify the canonical expression for the CP-violating parameter. Furthermore, the medium enhancement of the decay widths leads to a faster decay of the heavy neutrinos and an increased washout of the asymmetry. We also investigate the role of the two-body scattering processes and show that they do not contain contributions from the real intermediate states and are CP-violating.

M5

COSMOLOGICAL EFFECTS OF DECAYING COSMIC STRING LOOPS WITH TEV SCALE WIDTH

Koichi Miyamoto – Institute for Cosmic Ray Research, University of Tokyo

In supersymmetric theories, cosmic strings produced in the early Universe often have a width of TeV scale, while the tension is much larger. In a scaling regime, an infinite cosmic string releases significant fraction of its energy in the form of string loops. These thick string loops lose their energies efficiently by particle emissions, and hence it may have effects on cosmological observations. We study cosmological implications of string loops with TeV scale width in detail and derive constraints on the tension of the string. Implications on future gravitational wave detectors are also discussed.

M6

TOWARDS LEPTOGENESIS AT NLO: THE RIGHT-HANDED NEUTRINO INTERACTION RATE

Alberto Salvio – Scuola Normale Superiore di Pisa

We compute quantum and thermal corrections to the right-handed neutrino interaction rate in the early universe at next-to-leading order in all the relevant SM couplings (gauge, top Yukawa and higgs couplings). Previous computations considered 2 → 2 scatterings, finding infra-red divergences. The Kinoshita-Lee-Nauenberg (KLN) theorem demands that infra-red divergences cancel in the full result: after adding 1 → 3 processes and one-loop virtual corrections that enter at the same order we find a simple result.

M7

SNEUTRINO DARK MATTER: SYMMETRY PROTECTION AND COSMIC RAY ANOMALIES

Levent Selbuz – Ankara University

We present an R-parity conserving model of sneutrino dark matter within a Higgs-philic U(1)' extension of the minimal supersymmetric standard model. In this theory, the mu parameter and light Dirac neutrino masses are generated naturally upon the breaking of the U(1)' gauge symmetry. One of the right--handed senutrinos is the LSP. The leptonic and hadronic decays of another sneutrino, taken to be the next-to-lightest superpartner, allow for a natural fit to the recent results reported by the PAMELA experiment. We perform a detailed calculation of the dark matter relic density in this scenario, and show that the model is consistent with the ATIC and FERMI-LAT experiments.

N1

A NOTE ON THE ROLE OF THE BOUNDARY TERMS FOR THE NON-GAUSSIANITY IN GENERAL K-INFLATION

Frederico Arroja – Institute for the Early Universe

In this short talk we clarify the role of the boundary terms in the calculation of the leading order tree-level bispectrum in a fairly general minimally coupled single field inflationary model, where the inflaton's Lagrangian is a general function of the scalar field and its first derivatives. This includes k-inflation, DBI-inflation and standard kinetic term inflation as particular cases. These boundary terms appear when simplifying the third order action by using integrations by parts. We perform the calculation in the comoving gauge obtaining explicitly all total time derivative interactions and show that a priori they cannot be neglected. The final result for the bispectrum is equal to the result present in the literature which was obtained using the field redefinition.

N2

STOCHASTIC GROWTH OF VECTOR FIELD CONDENSATES DURING INFLATION

Juan Carlos Bueno Sanchez – Universidad Complutense de Madrid

In recent years, vector fields have been shown to be capable of generating a nearly scale-invariant spectrum of the curvature perturbation, hence alleviating the need to find fundamental scalar fields to fulfill the task. When generated by vector fields, the primordial curvature perturbation possesses observationally interesting features like statistical anisotropy and non-gaussianity, whose magnitude is determined by the expectation value of the quasi-homogeneous vector field produced during inflation. I study the stochastic growth of vector fields in the context of some supergravity theories using the Fokker-Planck approach to compute the typical magnitude of the vector condensate and its probability distribution function. Remarkably, and unlike the stochastic growth of scalar field condensates during inflation, the vector condensate obtains its expectation values according to an out-of equilibrum distribution function which remains frozen after a few e-foldings of inflation. The implications of this result for the statistical anisotropy and non-gaussianity generated by the vector field are discussed.

N3

THE CURVATURE PERTURBATION FROM GENERAL NON-ABELIAN VECTOR FIELDS

Mindaugas Karciauskas – Granada University

We consider the generation of the primordial curvature perturbation by non-Abelian vector fields without committing to a particular group. We show that correlators of the field perturbation are anisotropic and dominated by the contribution from the classical evolution of fields. Self-interactions of non-Abelian fields make these correlators non-Gaussian too. We present a scenario in which the curvature perturbation is generated at the end of inflation by the covariant derivative term which couples Higgs fields to gauge fields. The resulting anisotropy in the power spectrum is suppressed by the number of massive vector fields after the phase transition. We show that current WMAP constraints on such anisotropy is satisfied with reasonably large gauge groups, i.e. SU(3) or SU(7) depending on the constraint. Such groups also result in the angular dependence of the power spectrum which can be detected by the Planck satellite.

N4

RENORMALISED MULTI-FIELD HYBRID INFLATION

Nina Kevlishvili – Georg-August-Universität Göttingen

We investigate the non-equilibrium dynamics of the system of coupled scalar fields n FRW universe. The effects of quantum fluctuations including their backreaction are studies in the one-loop approximation. Special attention is payed to the non-minimal gravitational coupling and higher curvature gravity terms. We briefly discuss the renormalisation procedure there the additional finite terms ln(a(t)) appear. Their crucial rôle for the consistence is discussed. Furthermore, we present the results of numerical simulations. Special attention is payed to the initial conditions during the inflationary era.

N5

NON-GAUSSIANITY FROM THE HYBRID POTENTIAL

Stefano Orani – Imperial College London

I will present a study of the hybrid inflationary potential in a regime where the defect field is light, and more than 60 e-folds of accelerated expansion occur after the symmetry breaking transition. Using analytic and numerical techniques, parameter values are identified within this regime such that nthe statistics of the primordial curvature perturbation are nsignificantly non-Gaussian. Focusing on this range of parameters, nspecific examples which lead to an observationally consistent power spectrum, and a level of non-Gaussianity within reach of the PLANCK satellite are provided. An interesting feature of these examples is that no fine tuning of initial conditions is required, in contrast to other two-field models which exhibit a large non-Gaussianity.

N6

FEATURES IN THE PRIMORDIAL POWER SPECTRUM FROM COHERENT SCALAR-FIELD OSCILLATIONS

Ryo Saito – Yukawa Institute for Theoretical Physics, Kyoto University

We investigate a possible effect of a heavy scalar field on primordial fluctuations. A scalar field whose mass exceeds the Hubble scale can oscillate even in the inflationary era, and could modulate a dispersion relation of the inflaton field through derivative couplings. This modification leads to parametric resonance and generates a feature in the primordial power spectrum.

N7

BISPECTRA FROM TWO-FIELD INFLATION USING THE LONG-WAVELENGTH FORMALISM

Eleftheria Tzavara – Universite Paris Sud-11

The future detection of, or improved constraints on, the non-Gaussianity of the CMB sky is one of the most promising observational tests of inflation, capable of narrowing down the immense number of models in the literature. In this talk I will introduce a formalism to compute the non-Gaussianity parameter fNL produced during two-field inflation, using as only assumption the long-wavelength approximation. This formalism allows for a simple physical interpretation of the different parts of fNL in terms of adiabatic and isocurvature modes, providing insight into the behaviour of the different transient and persistent contributions. I will present both exact and approximated slow-roll results and compare with the delta-N formalism where possible.

S1

BLACK HOLE MECHANICS AND MASSIVE GRAVITY

Fabio Capela – ULB

We consider black hole mechanics in massive gravity. Using explicit black hole solutions, we discuss black hole merger processes in which i) total entropy of the system decreases ii) the zero-temperature extremal black hole is created. Thus, both second and third laws of thermodynamics are violated. In both cases, the violation can be traced back to the presence of negative-mass black holes, which, in turn, is related to the violation of the null energy condition. The violation of the third law of thermodynamics implies, in particular, that a naked singularity may be created as a result of the evolution of a singularity-free state. Wether the formation of negative-mass black holes can be forbidden dynamically will be discussed.

S2

INFLATION AT THE BOUNDARY OF DE SITTER

Mafalda Dias – University of Sussex

Using the dS/QFT correspondence in the context of inflation allows for the study of interesting, otherwise inaccessible physics. In particular, by studying inflation via its dual field theory at the boundary of the de Sitter space, it may be possible to study a regime of strongly coupled gravity at early times. The purpose of this talk is to present this framework and, by comparing its predictions with WMAP data, study the limits of its validity.

S3

THE OVERSHOOT PROBLEM IN INFLATION AFTER TUNNELING

Koushik Dutta – DESY, Hamburg

In the 'landscape' paradigm of String Theory, our observable Universe may originate via a tunneling event from a nearby metastable false vacuum, followed by sufficient amount of inflation. We discuss the overshoot problem in this set-up and show explicitly that there is no overshoot problem for higher order monomial potentials. The results substantially alleviate the initial value problem for "small-field" inflation models.

S4

LANDSCAPE ARCHITECTURE

Jonathan Frazer – University of Sussex

We explore inflationary trajectories within randomly-generated multi-field potentials, considered as a toy model of the string landscape. Sufficient inflation is a rare event but after taking basic anthropic arguements into consideration, we find that the majority of runs satisfy current constraints from WMAP.

S5

INFLATION AND UNIVERSE COMPLEXITY

Philippe Journeau – Discinnet Labs

Relationships between space and time dimensions are complex. Time is measured through "light emitting signals" in Robertson's grounding papers but covariant at gravitational space-time level while on the contrary space inflates versus time at inflation or even pre-inflationary eras, such as discussed by Sanchez & de Vega. We propose a ladder of time measures precisely related to complexity levels evolving through universe classical major phase transitions, each of which may be interpreted as a universe specific topology. We briefly show that this solution, which appears compatible with most of the standard model of cosmology, brings a novel interpretation and elements of solutions to several current cosmological questions, such as singularity, thermal state, flatness, matter creation, CMB quadrupole, homogeneity, density fluctuations and cosmological constant issues.

S6

WARMING UP BRANE-ANTIBRANE INFLATION

Joao Rosa – University of Edinburgh

We show that, in constructions with additional intersecting D-branes, brane-antibrane inflation may naturally occur in a warm regime, such that strong dissipative effects damp the inflaton's motion, greatly alleviating the associated eta-problem. We illustrate this for D3-antiD3 inflation in flat space with additional flavor D7-branes, where for both a Coulomb-like and a quadratic potential a sufficient number of e-folds may be obtained for perturbative couplings and O(10-100) branes. This in clear contrast with the corresponding cold scenarios, thus setting the stage for more realistic constructions within fully stabilized compactifications. Such models generically predict a negligible amount of tensor perturbations and non-gaussianity f_{NL}***~O(10).***

S7

STATISTICAL ANISOTROPY FROM D-BRANE INFLATION

Danielle Wills – Bethe Center for Theoretical Physics

I discuss the possibility to naturally generate statistical anisotropy in the curvature perturbation from D-brane models of inflation in Type IIB string theory. The U(1) gauge field that exists on the world volume of D-branes acts as a vector curvaton, giving a subdominant contribution to the curvature perturbation such that it acquires statistical anisotropy within the observational bounds.

NOTES