"Tests and theories of Lorentz symmetry violations"

APC Paris, 2nd March 2012

PROGRAMME AND ABSTRACTS OF SHORT CONTRIBUTIONS

Chair: Federico Piazza

15.30 – 16.00	Elias Kiritsis	TBD
16.00 – 16.30	*Coffee break*	
16.30 – 16.45	Alessandro Gruppuso	Tests of fundamental symmetries through the CMB: from WMAP to Planck.
16.45 – 17.00	Diego Chialva	Signatures of Lorentz-violation at high-energy in the non-Gaussianities of the Cosmic Microwave Background and Large Scale Structure.
17.00 – 17.15	Camille Couturier	Search for LIV with Cherenkov telescopes using AGNs.
17.15 – 17.30	Yves Sacquin	The GBAR experiment, a test of the Weak Equivalence Principle with antimatter.
17.30 – 17.45	Subodh Patil	A field theoretic representation of a stringy minimal length, applied to inflation.
17.45 – 18.00	Discussion	

TBD

Elias Kiritsis

Tests of fundamental symmetries through the CMB: from WMAP to Planck.

Alessandro Gruppuso – INAF/IASF Bologna, Italy.

I will review the claimed Parity anomaly found in the TT spectrum by Kim and Naselsky in 2010. Using an optimal estimator and supported by realistic Monte-Carlo realizations we have confirmed this anomaly in WMAP 7 data. No anomalies have been found in the other spectra (EE, TE, BB and TB, EB) for the same data set. Planck capabilities are forecasted in probing Parity violations on low-resolution maps.
In addition I will review the current CMB constraints on the birefringence angle α, which is a standard tracer of CPT violations.
I will focus on large angular scales of WMAP 7 data and provide a new constraint which is based on an optimal estimator for the angular power spectra.
This has allowed to build, for the first time at low multipoles, an angular power spectrum for α in search of a possible scale dependence of the birefringence effect. Our findings are compatible with no detection at all angular scales probed here. We finally forecast the capabilities of Planck in tightening the present constraints.

Signatures of Lorentz-violation at high-energy in the non-Gaussianities of the Cosmic Microwave Background and Large Scale Structure.

Diego Chialva – University of Mons, Belgium.

In this talk we set out to investigate whether the non-Gaussianities, which will be much more accurately observed in the next future by experiments such as Planck or the LSS surveys, are sensitive to new physics at high scales such as Lorentz breaking (modified dispersion relations, higher-derivative corrections to the effective theory).

The analysis will be general but detailed, and we will learn what kind of signatures could arise (from enhancements to particular dependences on the observed scales), which conditions are necessary to have such signatures, which aspects of the different models and of the pattern of Lorentz breaking could be told apart, and what differences appear compared to the results one would obtain in presence of other kind of modifications of the standard theory of high-energy physics and cosmological perturbations.

Search for LIV with Cherenkov telescopes using AGNs.

Camille Couturier – LPNHE Paris, France.

The search for LIV using astrophysical sources such as GRBs (Gamma-Ray Bursts) and flares of AGNs (Active Galaxy Nuclei) have been performed over the last decade with satellite detectors and ground-based Cherenkov telescopes.
I will focus on the search for LIV effects with AGNs, detailing the methods used in their analysis. I will then present the application of these methods and the results obtained with Mkn 501 by MAGIC and PKS 2155-304 by H.E.S.S.
Further prospects with ground-based telescopes will be discussed.

The GBAR experiment, a test of the Weak Equivalence Principle with antimatter.

Yves Sacquin – CEA Saclay, France.

The Gbar experiment aims at measuring the gravitational acceleration induced by Earth on antihydrogen atoms. The experiment has recently been recommended by the Cern SPSC and will use the antiprotons provided by the new ELENA ring being built at the Antiproton decelerator AD, in line for final commissioning in 2016. Its originality consists in preparing positively ionized antihydrogen atoms which can be cooled at ultra-low temperature (below mK).
The project will be the first measurement of gravitation on antimatter ever made, and as such provides an unprecedented test of the Weak Equivalence Principle. A violation of this principle would need extension of the Standard model violating Lorentz and CPT symmetries.
A review of the different steps needed for this pluridisciplinary experiment will be done, with their present status, and the present planning.

A field theoretic representation of a stringy minimal length, applied to inflation.

Subodh Patil – CPHT Ecole Polythecnique, France

If strings are our only effective probes of spacetime geometry, an effective minimal length (commensurate with the string scale) is emergent at high energies. As implied by several independent analyses, this minimal length is encapsulated by the stringy (generalized) uncertainty principle, which one would like to represent on physical fields to study its potential low energy consequences. After briefly reviewing earlier approaches, we present a new representation of the generalized uncertainty principle on scalar fields which readily permits a low energy description in terms of a Lorentz violating (non-local) effective field theory. On de Sitter backgrounds, analytic expressions for the correlation functions of the deformed scalar field theory are available, and imply $H^2 l_s^2$ corrections to the usual correlation functions. We discuss the prospects for observing such corrections in CMB observables in the fortunate circumstance that our universe is described by a very weakly coupled string theory.