LHC - Cosmology Interplay

Monday, 25 June 2007 - Friday, 10 August 2007

CERN PH-TH

Book of Abstracts

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Dark Matter in the Left-Right Twin Higgs Models

The dark matter candidate in the left-right Twin Higgs models falls in to the category of inert Higgs doublet models. We analysed the dark matter relic density and its direct and indirect detection potential.

Cosmo Coffee / **7**

Sweet Spot Supersymmetry

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We find that there is no supersymmetric flavor/CP problem, mu-problem, cosmological moduli/gravitino problem or dimension four/five proton decay problem in a class of supersymmetric theories with O(1) GeV gravitino mass. The cosmic abundance of the non-thermally produced gravitinos naturally explains the dark matter component of the universe. A mild hierarchy between the mass scale of supersymmetric particles and electroweak scale is predicted, consistent with the null result of a search for the Higgs boson at the LEP-II experiments. We propose a parametrization of the model for the purpose of collider studies. The scalar tau lepton is the next to lightest supersymmetric particle in a theoretically favored region of the parameter space. The lifetime of the scalar tau is of O(1000) seconds with which it is regarded as a charged stable particle in collider experiments. We discuss characteristic signatures and a strategy for confirmation of this class of theories at the LHC experiments.

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Gravitino dark matter at LHC and GLAST

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We consider supersymmetric theories where the gravitino is the lightest superparticle (LSP) and a charged scalar lepton the next-to-lightest superparticle (NLSP). Such a scenario can lead to spectacular signatures at the LHC, which we illustrate with several examples. A gravitino LSP can be the dominant component of dark matter. In the case of small R-parity breaking, it may first be disovered by GLAST.

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B physics, direct dark matter detection and SUSY Higgs searches at colliders

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I will discuss the connection among Higgs Physics, Flavour Physics and Cosmology in Supersymmetric Models. I will highlight the impact of radiative corrections to the Higgs-fermion couplings which can lead to relevant Flavour concerving and FCNC effects. This will allow me to show the

interplay between direct Higgs searches at the Tevatron and the LHC and the impact of present and projected experimental results for rare B decays, which can importantly contrain large regions of Supersymmetric parameter space. Finally, I will consider as well the interplay between Higgs searches at colliders and direct dark matter searches and its role in exploring Supersymetric scenarios.

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Minimal dark matter

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What will we learn from the Planck satellite?

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The Planck satellite, to be launched in 2008, is designed for measuring CMB temperature and polarization anisotropies with much better precision than the -already impressive- WMAP experiment. In this seminar, I will present the expected sensitivity of Planck to the parameters describing dark matter, dark energy, inflation, relic neutrinos, etc., which are also of great interest for particle physics. I will show how this sensitivity will increase, first, by performing a weak lensing analysis of the raw temperature map, and second, by combining Planck data with future large scale structure surveys.

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Dark Matter as a Guide to SUSY at the LHC

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If the lightest neutralino is a stable thermal relic from the Big Bang, thus comprising dark matter (DM) in the Universe, its relic abundance can be used to severely constrain the parameter space of supersymmetric models. For instance, in the paradigm mSUGRA model, each DM allowed region gives rise to distinct signatures for new physics at the LHC. We explore an array of well-motivated scenarios with non-universal soft terms –normal scalar mass hierarchy, non-universal Higgs models, mixed wino DM, bino-wino co-annihilation (BWCA) DM, low M_3 (compressed) SUSY, mixed higgsino DM, mixed moduli-AMSB DM– and show that each of these gives rise to distinct characteristics that ought to be measureable by the Atlas and CMS experiments starting next year at the LHC.

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Challenges and opportunities for the LHC era

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SUSY CPV, LHC, and dark matter

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After a brief introduction to CP violation in the MSSM, we discuss how to probe the CP-violating mixing in the neutral Higgs-boson sector at the LHC. We observe that there is an interesting possibility to have the lightest relic neutralino as light as 2.9 GeV.

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A new technique for SUSY mass determination

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A key ingredient in assessing whether or not a stable neutralino can explain the observed dark matter of the universe is the mass of the neutralino. For many SUSY decay chains, only mass differences can be well determined by conventional techniques leaving a large uncertainty in the absolute mass scale and therefore in the mass of the LSP neutralino itself. I describe a technique that can determine the neutralino mass to within a GeV or two in one of the standard SUSY decay chain scenarios for which only mass differences are well determined using other techniques.

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The entropic approach to understanding the cosmological constant

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It has recently been proposed to replace the anthropic principle with a more objective criterion: the likelihood of creating observers is proportional to the amount of entropy production within a causally connected region of the universe. This “entropic principle” does a better job of predicting the value of the cosmological constant than does its anthropic predecessor, and it is falsifiable, through its power to predict other properties of the universe to which the existence of observers is sensitive. For example, dark matter should be unstable on cosmological time scales.

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Electroweak Baryogenesis, Dark Matter and Supersymmetry

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I will review the present status of the analyses of the possibility of implementing the mechanism of generation of the baryon-antibaryon asymmetry at the electroweak scale, in supersymmetric extensions of the Standard Model. I will discuss the interrelation of this mechanism with the origin of dark matter, as well possible tests of these scenarios at the Tevatron and the LHC, as well as in dark matter detection and electric dipole moments experiments.

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Probing models of neutrino mass and neutrino interactions with the CMB

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Loop contributions to cosmological correlations and experimental constrains on chaotic inflation

Corresponding Author: sloth@phys.au.dk

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Recent Developments in Leptogenesis

Leptogenesis via right-handed neutrino decays
is a successful mechanism to explain the matter-antimatter
asymmetry of the Universe. I will discuss some recent
developments, in particular flavour and memory effects.

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Inert Higgs DM

Discussion on light DM / **23**

Axino and gravitino DM

Corresponding Author: k.choi@sheffield.ac.uk

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Calchep and MicrOMEGAs

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The Phenclub idea

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Anniversary speach

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A Minimal Renormalizable Grand Unified Theory

We propose a renormalizable (SUSY) grand unified theory where the neutrino masses are generated through type III and type I seesaw mechanisms. Several phenomenological and cosmological aspects of this proposal are discussed.

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Flavour in the Era of the LHC

We discuss the opportunities in our search for 'new physics' beyond the standard model offered by present and future flavour experiments. We show the interplay and complementarity of collider and flavour physics by some examples. Within this talk we focus on rare B and kaon decays. Moreover, we briefly discuss the restrictive role of long-distance strong interactions in flavour physics and some tools like QCD factorisation and soft-collinear effective theories (SCET) to handle them.

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Opening

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LHC-cosmology interplay

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GUT-less supersymmetry phenomenology

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The observed properties of dark matter on small astrophysical scales, and the number of small satellites

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New dynamical studies and discovery searches for the smallest dark matter dominated galaxies will be presented. Dark matter in dSph galaxies has a mean volume mass density within the stellar distribution which always has a very low value of about 5GeV/c^2 cm^-3. The mass profiles appear cored, not cusped as predicted by Cold DM models. Galaxies are embedded in dark matter halos with these properties; small systems containing dark matter are not observed.

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SUSY interpretation of the EGRET excess of diffuse Galactic gamma rays and implementation for the LHC

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New ideas in indirect detection

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Miniworkshop / **37**

Non-thermal dark matter production and its cosmological implication

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Dark matter in the constrained NMSSM

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Gravitino DM with sneutrino NLSP

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Multi-dimensional CMSSM fits

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Dark matter from technicolour

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Dark matter and stars

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Electroweak baryogenesis

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Predictive model for dark matter, dark energy, neutrino masses and leptogenesis at the TeV scale

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A graceful exit for old inflation and a possible solution to the hierarchy problem

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Gravitino DM with a stop NLSP

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Calculating the relic density at one-loop in SUSY

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Test of EGRET hypothesis and indirect measurement of relic density at the LHC

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Discussion on fits / **50**

Combination of cosmological fits and collider constraints (1)

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Discussion on fits / **51**

Combination of cosmological fits and collider constraints (2)

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Radiative gravitino decays from R-parity violation

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Part 1: Discussion of recent papers
Part 2: Talk by S. Lola

Seminar / **53**

Growing neutrinos and cosmological selection

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The time evolution of a cosmological scalar field can be stopped by an increasing mass of the neutrinos. This leads to a transition from a cosmological scaling solution with dynamical dark energy at early time to a cosmological constant dominated universe at late time. The trigger for the transition is set at the time when the neutrinos become non-relativistic. This is a possible solution of the "why now" problem.
We present a particle physics realization of this "growing matter" scenario. It is based on the very slowly varying mass of a superheavy scalar triplet field whose expectation value dominates the light neutrino masses. A simple and realistic dark energy cosmology can be obtained in this way.

PhenClub / **54**

SUSY SO(10) and its implications for colliders and cosmology

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Part 1: Discussion of recent papers/events ***everybody is invited to contribute***
Part 2: Talk by Tomas Blazek

Seminar / **55**

Cosmology and Particle Physics with Warped Throats

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Warped compactifications provide a mechanism for generating a hierarchy of physical scales. Strongly warped regions (throats) are also ubiquitous in compactifications with stabilized moduli. In this talk, we describe some recent attempts to construct string inflationary models using warped throats, the CMB signatures of these models, and how differences in the shape of the extra dimensions can show up in the CMB data. We then turn to discuss the possibility of using the LHC to distinguish different warped extra dimensions.