SUSY 2014

Monday 21 July 2014 - Saturday 26 July 2014

Renold Building

Book of abstracts

Table of contents

Particle Cosmology / 5

Sub or Super Planck Inflationary Model and large tensor to scalar ratio

Dr. MAZUMDAR, Anupam [1]

[1] *Lancaster University*

Corresponding Author: a.mazumdar@lancaster.ac.uk

I will show how the current data (from WMAP+PLANCK+BICEP) and the future data on CMB can discriminate super-Planckian VEV models of inflation with a sub-Planckian VEV models of inflation. I will reconstruct the inflationary potential for a sub-Planckian excursion of a single inflaton field from WMAP+PLANCL+BICEP data, and embed such sub-Planckian VEV model of inflation within SUSY flat directions of MSSM with Supergravity corrections.

6

Public Lecture

Formal SUSY and Strings / 7

Natural Supersymmetry Breaking with Meta-stable Vacua

Dr. MCGARRIE, Moritz [1]; Dr. ABEL, Steven [2]

[1] *Wits*

[2] *IPPP-Durham*

Corresponding Author: moritz.mcgarrie@desy.de

We construct a natural supersymmetry breaking model, with light third generation squarks and small radiative corrections to the Higgs up soft mass, by identifying flavour gauge messengers with magnetic quark superfields of $\mathcal{N}=1$ Supersymmetric QCD. Although these models of flavour and supersymmetry breaking are strongly coupled, through Seiberg duality we have a calculable and predictive scenario of natural supersymmetry. In this identification, the flavour breaking scale is identified with the magnetic quark vev. Supersymmetry breaking in a gauged $SU(3)_F$ flavour sector arises dynamically and in combination with the NMSSM and usual gauge mediation can generate light third generations squarks whilst keeping first and second generations above exclusions. We show that dynamical supersymmetry breaking in a long-lived meta-stable vacuum is not only phenomenologically viable but also \emph{natural} when extended to include flavour gauge mediation, and may help to explain the flavour structure of the MSSM. The Yukawa and CKM matrices arise from piece-wise Higgsing of the magnetic quarks. This setup implies that the flavour hierarchies may emerge dynamically from the various scales of magnetic SQCD. Their simplicity suggests that \emph{natural} supersymmetry (breaking) may be more generic in the landscape of string vacua than previously thought.

Formal SUSY and Strings / 8

Renormalization Group improvement of the Effective Superpotential and Dynamical Breaking of Symmetry in a Supersymmetric Chern-Simons Theory

Mr. QUINTO, Andres [1]; Dr. FERRARI, Alysson [1]; Dr. LEHUM, Andre [2]

[1] *Universidade Federal do ABC, Rua Santa Adélia, 166, 09210-170, Santo André, SP, Brazil*

[2] *Escola de Ciências e Tecnología, Universidade Federal do Rio Grande do Norte, Caixa Postal 1524, 59072-970, Natal, RN, Brazi*

Corresponding Author: andres.quinto@ufabc.edu.br

In this work, we investigate the consequences of the Renormalization Group Equation (RGE) in the determination of the effective superpotential in a supersymmetric model, and the impacts of this improved calculation in the dynamical symmetry breaking that happens in our model. We consider an N = 1 supersymmetric theory including an Abelian Chern-Simons super eld coupled to N scalar super elds in a (2+1) dimensional space-time. The classical Lagrangian presents scale invariance, which is broken by radiative corrections to the effective superpotential. We calculate perturbative corrections, up to two-loops,to the one- and two-point vertex functions, using dimensional regularization and minimal subtraction scheme. With the knowledge of the renormalization group functions, the RGE can be used to calculate an improved version of the effective superpotential, from which the dynamical symmetry breaking can be studied, and the results compared with those obtained from the unimproved effective superpotential. We show that in the supersymmetric model, the effects of the consideration of the RGE are not so dramatic as it happens in the non-supersymmetric case, but it still allows some improvement over the standard calculation.

Higgs Phenomenology / 10

Excluding a Generic Spin-2 Higgs Impostor

Dr. KOBAKHIDZE, Archil [1]; Mr. YUE, Jason [2]

[1] *University of Sydney*

[2] *The Universtity of Sydney*

Corresponding Author: j.yue@physics.usyd.edu.au

We argue that the current experimental data in conjunction with perturbative unitarity considerations exclude the possibility that the LHC 125-126 GeV resonance is a generic massive spin-2 particle of either parity. We demonstrate that perturbative unitarity breaks down at energies $\Lambda \sim 600$ GeV in tree-level Z-spin-2 elastic scattering. We further show that W-,Z-spin-2 interactions contribute to the electroweak oblique parameters in a way that is in gross disagreement with observations.

Alternative Theories / 11

Generation of axionlike couplings via quantum corrections in a Lorentz-violating Background

Prof. FERRARI, ALYSSON FABIO [1]; DIAS, Alex Gomes [2]; BORGES, Luiz Henrique [2]; PETROV, Albert Yu. [3]; NASCIMENTO, José Roberto [3]

[1] *UNIVERSIDADE FEDERAL DO ABC*

[2] *UFABC*

[3] *UFPB*

Corresponding Author: alysson.ferrari@ufabc.edu.br

Axionlike particles (ALPs) are weakly interacting light pseudoscalars, much studied due to their potential relevance to the fields of particle physics, astrophysics and cosmology: axions are a specific example, involved in the solution of certain specific problems in QCD.
It is noteworthy that ALPs are also viable dark matter candidates, which is one of the main physical motivations for their theoretical and experimental study.
The most relevant coupling of ALPs from the viewpoint of current experimental searches is to the photon, which can be directly measured by light-shinning through walls experiments, for example.
In this work, we propose the generation of the ALP-photon interaction vertex as an effect of quantum corrections, originated from an underlying Lorentz-violating background. Most interestingly, we show that the dominant interactions so generated turns out to be Lorentz invariant, thus mimicking the standard ALP coupling to the photon that is considered in the experiments. This consideration implies that violations of spacetime symmetries, much studied as possible consequences of physics in very high energy scales, might infiltrate in other realms of physics in unsuspecting ways.
Additionally, we conjecture that a similar mechanism can also generate Lorentz invariant couplings involving scalar particles and photons, playing a possible role in the phenomenology of Higgs bosons.

Quark Flavour Violation / 12

Exotic fermions in a model with symmetry SU(3)SU(2)U(1)Z(4)

Mr. CAMARGO, Daniel [1]

[1] *estudent*

Corresponding Author: dacamargov@gmail.com

We present here the construction and phenomenology of a new model with chiral fermions, in which, some of them have exotic electric charges. We also open into this new framework, a possibility to get exotic quark interactions with a second heavy Higgs field.

SUSY Phenomenology / 13

Multiphoton signatures of supersymmetry at the LHC

PETERSSON, Christoffer [1]

[1] *ULB, Brussels*

Corresponding Author: christoffer.petersson@ulb.ac.be

I will discuss how the usual phenomenology of gauge mediated supersymmetry breaking can be significantly modified by the non-minimal assumption that supersymmetry is broken in more than one hidden sector. Such multiple hidden sector models give rise to light neutral fermions called pseudo-goldstini and due to the extra decay steps they provide, where soft photons are emitted, these models give rise to multiphoton plus missing energy signatures. Due to the softness of the final state spectrum, the existing LHC searches turn out to be very poorly sensitive. However, by making use of the multiplicity of final state particles, it would be possible to probe these models and I will propose some new dedicated LHC searches.

Formal SUSY and Strings / 14

Deformation in SUSY 2+1

Mr. IPIA, Carlos [1]; Prof. FERRARI, Alysson [2]

[1] *Universidade federal do ABC*

[2] *Universidade Federal do ABC*

Corresponding Author: caanpaip@gmail.com

The non-commutativity of space-time has been proposed as an attempt to incorporate in quantum mechanics and quantum field theory some properties that should be part of a consistent quantum theory of gravitation. A non-trivial aspect of this type of proposal is
the fate of spacetime symmetries in this context. Some of the most popular versions for non-commutative spaces explicitly violate Lorentz invariance. A proposal to implement non-commutativity in space-time preserving, somehow, the notion of relativistic invariance
involves the use of Hopf algebras as "deformations" of the Poincaré algebra, via the so-called Drinfel'd twist. In this paper, we study the application of the Drinfel'd twist to supersymmetric theories. It is shown that the main properties of a superalgebra can be rewritten using the language of Hopf algebras, and so we can apply the concept of twist deformation to the supersymmetric algebra of generators and super fields. After reviewing some existing approaches in the literature on non commutativity in superspace, we focus our study in the case of three-dimensional space-time. Using the formalism of Hopf algebras,
we introduce the non anticomutativity to the Grassmanian superspace coordinates,and describe the corresponding deformed superalgebra, de fining new supersymmetry generators that satisfy the usual supersymmetric algebra. Finally, we constructed an action invariant under this deformed algebra, and concluded that the terms that bear the modifi cations arising from the non anticomutativity of coordinates are the interaction terms,while the quadratic part of the action is not modi fied.

Higgs Phenomenology / 15

2HDM with Scalar Singlet Dark Matter

Mrs. DROZD, Aleksandra [1]

[1] *University of Warsaw*

Corresponding Author: ola.bej@gmail.com

We examine an extension of the Two-Higgs Doublet Model with a real gauge-singlet scalar Dark Matter candidate. This is the minimal Standard Model extension that allows for both Dark Matter and additional CP violation in the scalar sector. We have studied constraints on this model from the most recent LHC data together with Planck and direct Dark Matter searches (XENON/LUX/CRESST/CDMS). Invisible decays of light and heavy scalars have also been investigated.

Particle Cosmology / 17

Constraining N=1 supergravity inflationary framework with non-minimal Kähler operators

Mr. CHOUDHURY, Sayantan [1]; Dr. MAZUMDAR, Anupam [2]

[1] *Senior Research Fellow, Physics & Applied Mathematics Unit, Indian Statistical Institute,Kolkata,India*

[2] *Lancaster University*

Corresponding Author: sayanphysicsisi@gmail.com

In this work we will illustrate how to constrain unavoidable K\"ahler corrections for N=1 supergravity (SUGRA) inflation from the recent Planck data. We will show that the non-renormalizable K\"ahler operators will induce in general non-minimal kinetic term for the inflaton field, and two types of SUGRA corrections in the potential - the Hubble-induced mass (c_{H}), and the Hubble-induced A-term (aH) correction. The entire SUGRA inflationary framework can now be constrained from (i) the speed of sound, c_{s}, and (ii) from the upper bound on the tensor to scalar ratio, r_{*}. We will illustrate this by considering a heavy scalar degree of freedom at a scale, Ms, and a light inflationary field which is responsible for a slow-roll inflation. We will compute the corrections to the kinetic term and the potential for the light field explicitly. As an example, we will consider a visible sector inflationary model of inflation where inflation occurs at the point of inflection, which can match the density perturbations for the cosmic microwave background radiation, and also explain why the universe is filled with the Standard Model degrees of freedom. We will scan the parameter space of the non-renormalizable K\"ahler operators, which we find them to be order ${\cal O}(1)$, consistent with physical arguments. While the scale of heavy physics is found to be bounded by the tensor-to scalar ratio, and the speed of sound, ${\cal O}(10^{11}\leq M_{s}\leq 10^{16})$ GeV, for $0.02\leq c_{s}\leq 1$ and $10^{-22}\leq r_{*}\leq 0.12$. In particular we study the nonlinear evolution of cosmological perturbations on large scales which enables us to compute the curvature perturbation, ζ, without solving the exact perturbed field equations. Further we compute the non-Gaussian parameters f_{NL} , τ_{NL} and g_{NL} for local type of non-Gaussianities and CMB dipolar asymmetry parameter, A_{CMB}, using the δN formalism. Hence by using multi parameter scan we will fix the lower as well as the upper bound of the non-Gaussian parameters within, ${\cal O}(1–5)\leq f_{NL}\leq 8.5$, ${\cal O}(75–150)\leq \tau_{NL}\leq 2800$ and ${\cal O}(17.4–34.7)\leq g_{NL}\leq 648.2$, and CMB dipolar asymmetry parameter within the range, $0.05\leq A_{CMB}\leq 0.09$.

Quark Flavour Violation / 20

Electroweak penguin decays to leptons at LHCb

LEROY, Olivier [1]

[1] *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Rare decays of beauty and charm hadrons test the flavour structure of the underlying theory at the level of quantum corrections. They provide information on the couplings and masses of heavy virtual particles appearing as intermediate states. A review of recent results obtained by LHCb on these topics will be presented.

Quark Flavour Violation / 21

Radiative decays at LHCb

LEROY, Olivier [1]

[1] *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Radiative decays allow the measurement of the photon polarisation and thus test the left-handed couplings in weak interactions. Recent LHCb measurements have shown a non-zero polarisation. The interpretation of this result in terms of right-handed couplings requires more theoretical input. Other recent results from $b \to s\gamma$ and $c \to u\gamma$ transitions are also reviewed.

SUSY Phenomenology / 22

Displaced Axinos at LHC

Mr. REDINO, Christopher [1]

[1] *SUNY Buffalo*

Corresponding Author: csredino@buffalo.edu

SUSY models with a modified dark sector require constraints to be reinterpreted, which may allow for scenarios with low tuning. A modified dark sector can also change the phenomenology greatly. The addition of the QCD axion to the MSSM solves the strong CP problem and also modifies the dark sector with new dark matter candidates. This talk describes scenarios where the axion's superpartner, the axino may be detectable at the LHC in the decays of neutralinos displaced from the primary vertex. Distinguishing this scenario from other models with displaced decays to dark matter is discussed.

Lepton Flavour Violation and Neutrinos / 23

Neutrino masses in RPV models with extra pairs of Higgs doublets

Ms. PESET, Clara [1]

[1] *IFAE*

Corresponding Author: peset@ifae.es

We study the generation of neutrino masses and mixing in supersymmetric R-parity violating models containing two pairs of Higgs doublets. In these models, new RPV terms HHE arise in the superpotential, as well as new soft terms. Such terms give new contributions to neutrino masses. We identify the different parameters and suppression/enhancement factors that control each of these contributions, and could therefore constrain the parameter space of this class of models.

Lepton Flavour Violation and Neutrinos / 24

Lepton flavour violating lepton decays in the supersymmetric inverse seesaw

Dr. WEILAND, Cedric [1]; Prof. ABADA, Asmaa [2]; Mr. KRAUSS, Manuel [3]; Prof. POROD, Werner [3]; Dr. STAUB, Florian [4]; Dr. VICENTE, Avelino [5]

[1] *Universidad Autonoma de Madrid*

[2] *Universite Paris Sud 11*

[3] *Universitat Wurzburg*

[4] *Universitat Bonn*

[5] *Universite de Liege*

Corresponding Author: cedric.weiland@uam.es

In previous works (JHEP03(2012)100, JHEP09(2012)015), we have highlighted that the Higgs and Z-mediated penguin diagrams contributing to lepton flavour violating (LFV) observables like tau->3mu are strongly enhanced in the supersymmetric inverse seesaw model. It has recently been pointed out that an error in the literature for the Z-penguins form factors would lead to a non-physical non-decoupling behaviour (1312.5318). This work is devoted to the study of LFV lepton decays and mu-e conversion in the supersymmetric inverse seesaw, taking all contributions into account with the corrected form factors. We explicitly distinguish various regimes depending on the dominant contribution and give predictions for various observables, some of them already within reach of the current experiments.

Particle Cosmology / 25

Flavour Covariant Transport Equations for Resonant Leptogenesis

Mr. TERESI, Daniele [1]; Prof. PILAFTSIS, Apostolos [1]; Dr. DEV, Bhupal [1]; Dr. MILLINGTON, Peter [1]

[1] *University of Manchester*

Corresponding Author: daniele.teresi@hep.manchester.ac.uk

Flavour effects play an important role in the statistical evolution of particle number densities in several particle and astroparticle physics phenomena. A fully flavour-covariant formulation of transport phenomena is presented, with a Resonant Leptogenesis (RL) scenario in mind, in order to capture all flavour effects, both in the heavy-neutrino and charged-lepton sectors. For concreteness, we consider the Standard Model accompanied by quasi-degenerate heavy Majorana neutrinos, even though the formalism can be easily applied to study flavour effects in other physical situations. Flavour covariance requires one to consider generically off-diagonal number densities, as well as rank-4 rate tensors in flavour space. Particular emphasis is put on the non-trivial generalization of the discrete symmetries C, P and T in the flavour-covariant formalism.

The flavour-covariant transport equations provide an unified description of RL, capturing three relevant phenomena: coherent heavy-neutrino oscillations, quantum decoherence in the charged-lepton sector, and the standard resonant CP violation due to heavy-neutrino mixing. We show quantitatively, in a minimal electroweak-scale RL model, that the final asymmetry predicted by the flavour-covariant rate equations is enhanced of even an order of magnitude, as compared to that obtained from flavour-diagonal or partially flavour off-diagonal equations.

Models of SUSY / 26

Electroweak breaking with Custodial Triplets

Prof. QUIRÓS, Mariano [1]; Dr. VEGA-MORALES, Roberto [2]; Dr. GORI, Stefania [3]; Dr. YU, Tien-Tien [4]; Prof. VEGA, Roberto [5]; Mr. GARCÍA PEPIN, Mateo [6]

[1] *IFAE / ICREA*

[2] *LPT Orsay*

[3] *Perimeter Institute for theoretical physics*

[4] *Yang Institute for theoretical Physics -Stony Brook University*

[5] *Department of Physics, Southern Methodist University, Dallas, TX*

[6] *IFAE / UAB*

Corresponding Author: mgarcia@ifae.es

As it has been shown in the literature, triplet extended Higgs sectors suffer from fine tuning issues not present in the usual SM. These problems were solved in the Georgi-Macachek (GM) model by introducing a custodially invariant triplet extended Higgs sector. The quadratic divergences that arise in the corrections to the rho parameter in the GM model disappear when making it supersymmetric. Since the theory is expected to be custodially invariant at the SUSY breaking scale, we discuss how the breaking induced by the top Yukawa coupling and g' will affect the features of this model at the Electroweak scale.

Models of SUSY / 27

Auxiliary Gauge Mediation and Mini-Split Supersymmetry

Mr. KAHN, Yonatan [1]; Dr. THALER, Jesse [1]; Dr. MCCULLOUGH, Matthew [1]

[1] *Massachusetts Institute of Technology*

Corresponding Author: ykahn@mit.edu

The discovery of a standard-model-like Higgs at 126 GeV and the absence of squark signals thus far at the LHC both point towards a mini-split spectrum for supersymmetry, but realizing this spectrum in a simple, concrete model is nontrivial. I will describe a complete model for mini-split supersymmetry based on gauge mediation with the auxiliary group, the group of anomaly-free continuous symmetries of the Standard Model in the limit of vanishing Yukawas. Crucially, this group contains a U(1) factor acting on the Higgs doublets, allowing the generation of Higgs sector soft terms at the correct scale to realize electroweak symmetry breaking. I will present some benchmark spectra obtained from auxiliary gauge mediation, and comment on the role of A- and B-terms both in auxiliary gauge mediation and in the general framework of Higgsed gauge mediation.

SUSY Phenomenology / 29

Checkmating your favourite BSM model

Mr. SCHMEIER, Daniel [1]; Dr. KIM, Jong Soo [2]; Prof. DREINER, Herbert [1]; Prof. DREES, Manuel [1]; Dr. TATTERSALL, Jamie [3]

[1] *Bonn*

[2] *IFT Madrid*

[3] *Heidelberg*

Corresponding Author: jongsoo.kim@tu-dortmund.de

In the first three years of running, the LHC has delivered a wealth of new data that is now being analysed. With over 20 fb−1 of integrated luminosity, both ATLAS and CMS have performed many searches for new physics that theorists are eager to test their model against. However, tuning the detector simulations, understanding the particular analysis details and interpreting the results can be a tedious task. CheckMATE (Check Models At Terascale Energies) is a program package which accepts simulated event files in many formats for any model. The program then determines whether the model is excluded or not at 95% C.L. by comparing to many recent experimental analyses. Furthermore the program can calculate confidence limits and provide detailed information about signal regions of interest. It is simple to use and the program structure allows for easy extensions to upcoming LHC results in the future.

Quark Flavour Violation / 30

Flavour in Dirac gauginos

Dr. TZIVELOGLOU, Pantelis [1]; Dr. GOODSELL, Mark [2]; Prof. DUDAS, Emilian [3]; Mr. HEURTIER, Lucien [3]

[1] *IIHE - VUB*

[2] *LPTHE, UPMC*

[3] *Ecole Polytechnique*

Corresponding Author: pantelis.tziveloglou@vub.ac.be

LHC8 raised doubts on using naturalness as a guide in our quest for physics beyond the Standard Model. In MSSM fine tuning enters through the Higgs mass and in non-minimal extensions through the negative superpartner searches. One non-minimal theory with a less severe missing superpartner problem, is MSSM with Dirac gauginos. Dirac gauginos are also known to lead to much milder flavour violation bounds. We quantify bounds in well motivated flavour models and find out that this is true but only for a very restricted class of flavour patterns. Also, in investigating Dirac gaugino models, we identified a new way of suppressing quark - “gluino” couplings with novel phenomenological features.

Alternative Theories / 31

Some Fermionic UV completions of Composite Higgs models

FERRETTI, Gabriele [1]

[1] *Chalmers University*

Corresponding Author: ferretti@chalmers.se

We present some four-dimensional purely fermionic gauge theories that give a UV completion of composite Higgs models. We start at the group theoretical level, addressing the necessary (but not sufficient) conditions for the viability of these models, such as the existence of top partners and custodial symmetry. We then study the dynamics of some of the most promising models in more detail. Part of the work is based on 1312.5330.

Alternative Theories / 32

A naturally light and bent dilaton

Dr. SERRA, Javi [1]

[1] *Cornell University*

Corresponding Author: js993@cornell.edu

We present a non-supersymmetric theory with non-vanishing 4D curvature with a naturally light dilaton. It is based on a 5D holographic description of a conformal theory perturbed by a close-to-marginal operator of dimension 4-epsilon, which develops a condensate. As long as the dimension of the perturbing operator remains very close to marginal in the IR, and there is no large contribution to the 4D curvature from UV physics, a stable minimum at hierarchically small scales is achieved, where the dilaton mass squared is suppressed by epsilon. At the same time the cosmological constant in this sector is also suppressed by epsilon.

Models of SUSY / 33

Large D-terms in minimal SUSY SO(10)

Mr. GONZALO, Tomas [1]; Dr. DEPPISCH, Frank [1]

[1] *University College London*

Corresponding Author: tomas.gonzalo.11@ucl.ac.uk

After the first run of the LHC and the last results on direct supersymmetry searches from ATLAS and CMS, the lack of evidence of new particles is causing some tension for several minimal models of supersymmetry. The current limits push the masses of most supersymmetric particles above the TeV scale, which requires a troubling amount of fine tuning in order for SUSY to be a solution to the stability of the Higgs mass. However, moving away from the simplest models, one can find regions of parameter space where these limits are relaxed, such are scenarios with a compressed spectrum or where part of the spectrum is decoupled. Using a simple SUSY SO(10) model, one can obtain these type of scenarios in a very natural way. The splitting provided by use of the SO(10) D-terms can be exploited to obtain very light third generation squarks, light enough to be quasi-degenerate with the LSP and thus fall into the compressed spectrum scenarios, which do not suffer from high levels of fine tuning and whose limits are much less constrained that other models. In this presentation I will discuss the effect of large D-terms in the well motivated minimal SUSY SO(10) model which can predict a viable MSSM spectrum that survives the current exclusion limits provided by the LHC experiments.

SUSY Phenomenology / 34

Displaced vertices and long-lived charged particles in the NMSSM with right-handed sneutrinos

Mr. MARTIN-LOZANO, Victor [1]; Dr. CERDENO, David G. [1]; Dr. SETO, Osamu [2]

[1] *IFT-UAM/CSIC*

[2] *Hokkai-Gakuen University*

Corresponding Author: victor.martinlozano@uam.es

We study LHC signatures of displaced vertices and long-lived charged particles within the context of the Next-to-Minimal Supersymmetric Standard Model with right-handed (RH) sneutrinos. In this construction the RH neutrino can be produced directly from Higgs decays or in association with a RH sneutrino when the latter is the lightest supersymmetric particle. The RH neutrino is generally long-lived, since its decay width is proportional to the neutrino Yukawa, a parameter which is predicted to be small. The RH neutrino late decay can therefore give rise to displaced vertices at the LHC, which can be identified through the decay products, which involve two leptons (2l+ MET) or a lepton with two jets (ljj). We simulate this signal for the current LHC configuration (a centre of mass of 8 TeV and an integrated luminosity of L=20 fb^-1), and a future one (13 TeV and L=100 fb^-1). We show that a region of the parameter space of this model can be probed and that the RH neutrino mass can be reconstructed from the end-point of the two-lepton invariant mass distribution or the central value of the mass distribution for two jets plus one lepton. Another exotic signature of this construction is the production of a long-lived stau. If the stau is the next-to-lightest supersymmetric particle, it can decay through diagrams involving the small neutrino Yukawa, and would escape the detector leaving a characteristic trail. We also simulate this signal for various benchmark points and show that the model can be within the reach of the future run of the LHC. (This work is based on arXiv:1311.7260)

Formal SUSY and Strings / 35

Renormalization of SUSY Yang-Mills-Chern-Simons in (2+1)D through the Background Field Method

Mr. MARQUES, Fabricio [1]; Prof. DA SILVA, Adilson José [1]; Prof. GALLEGOS, Enrique Alberto [2]

[1] *University of São Paulo*

[2] *Universidade Federal de Ouro Preto*

Corresponding Author: fcarmo@fma.if.usp.br

The Background Field Method is a quantization procedure which preserves the gauge invariance of a theory in each intermediate step. It was introduced by DeWitt and others for 1-loop calculations. It was then extended for 2-loops by 'tHooft and improved by DeWitt, Boulware and Abbott [1]. In this work the method is applied to quantize the SUSY Yang-Mills-Chern-Simons N=1 model in the absence of matter in (2+1) space-time dimensions. This model was already studied by Ruiz-Ruiz and van Nieuwenhuizen [2] using component fields. Here we use superfields formalism. The divergent supergraphs are classified up to 2-loops using an extended version of A. F. Ferrari's Mathematica package SusyMath [3]. In a next step, matter fields are going to be included as well.

[1] L. F. Abbott, Acta. Phys. Pol. B13 (1982) 33-50.
[2] F. Ruiz-Ruiz and, P. van Nieuwenhuizen, Lectures on Supersymmetry and Supergravity in 2+1 Dimensions and Regularization of Supersymmetric Field Theories, Mexican School on Gravitation and Mathematical Physics, Tlaxcala, Mexico, 1 (1996) 7, physics-2.
[3] Ferrari, A. F., SusyMath: A Mathematica package for quantum superfield calculations, Comput. Phys. Commun. 176 (2007) 334.

Alternative Theories / 36

Gauge Mediation of Exact Scale Breaking and Logarithmic Higgs Potentials

Dr. MARIOTTI, Alberto [1]; Prof. ABEL, Steven [1]

[1] *IPPP Durham*

Corresponding Author: alberto.mariotti@durham.ac.uk

I will present a gauge mediation principle for BSM theories where exact UV scale invariance is broken in a hidden sector: the relevant configurations are those in which the Standard Model and a hidden sector emanate from a scale invariant pair of UV theories that communicate only via gauge interactions. I will show that in such configurations, once scale invariance is broken in the hidden sector, relevant operators are generated in the Higgs potential, leading to electroweak symmetry breaking. Moreover, the resulting Higgs potential contains logarithmic mass-squared terms which lead to unusual low energy Higgs self-couplings, and I will discuss the corresponding phenomenologies.

SUSY Phenomenology / 37

Closing in on the Tip of the CMSSM Coannihilation Strip

Dr. DESAI, Nishita [1]

[1] *ITP, Heidelberg University*

Corresponding Author: n.desai@thphys.uni-heidelberg.de

Near the tip of the stau coannihilation strip in the CMSSM with a neutralino LSP, the astrophysical cold dark matter density constraint forces the stau-neutralino mass difference to be small. If this mass difference is less than the mass of the tau lepton, the stau may decay either in the outer part of an LHC detector -- giving a "disappearing track" signature -- or be sufficiently long-lived to leave the detector before decaying, thus giving the long-lived massive charged-particle signature. We combine limits from searches for these signatures with those from conventional missing ET searches during LHC Run 1, identifying the small remaining parts of the CMSSM stau-coannihilation strip region that have not yet been excluded, and discussing how they may be explored during Run 2 of the LHC.

Quark Flavour Violation / 38

Beyond Randall-Sundrum: The Flavour of Warped Backgrounds

Mr. GRANGER, Andrew [1]

[1] *PhD Student Sussex University*

Corresponding Author: ag408@sussex.ac.uk

While the Randall-Sundrum scenario provides a solution to both the gauge and fermion hierarchy problems, stringent constraints from flavour physics and EW precision data have been shown to force the KK scale to about 20-30 TeV. This can be ameliorated, to some extent, by modifications to the background, and conversely, flavour observables can probe the geometry of the extra dimension. Of particular interest are flavour changing interactions that are mediated by Kaluza Klein modes of the neutral gauge bosons, since these provide tree level corrections to processes which are loop suppressed in the Standard Model. I will present an approach to calculating two-point correlation functions of the KK bosons in a way which is easily adaptable to modifications of the gravitational background. I will then present results calculated using these methods with selected warped metrics, for observables related to \Delta F=1 and \Delta F=2 processes. I will conclude with comments on their implications.

SUSY Phenomenology / 39

Multilepton signals of gauge mediated supersymmetry breaking at the LHC

DE CAUSMAECKER, Karen [1]

[1] *VUB*

Corresponding Author: karen.de.causmaecker@vub.ac.be

I will discuss multilepton signals at the LHC arising from electroweak processes involving sleptons. I focus on models in general gauge mediation where the low-mass region of the superpartner spectrum consists of the charged sleptons and the nearly massless gravitino. Such models can provide an explanation for the anomalous four lepton events recently observed by the CMS Collaboration. Our setup also allows us to set strong bounds on the stau mass. [arXiv:1310.0018]

Particle Cosmology / 40

One-loop corrections to gaugino (co-)annihilation into quarks in the MSSM

STEPPELER, Patrick [1]; HARZ, Julia [2]; HERRMANN, Björn [3]; KOVARIK, Karol [1]; KLASEN, Michael [1]; MEINECKE, Moritz [1]

[1] *Universität Münster*

[2] *University College London*

[3] *LAPTh / Université de Savoie*

Corresponding Author: herrmann@lapth.cnrs.fr

I will present the full one-loop supersymmetric QCD corrections for gaugino annihilation and co-annihilation into light and heavy quarks in the Minimal Supersymmetric Standard Model (MSSM). I will show that these channels are phenomenologically relevant within the so-called phenomenological MSSM. Numerical results for the (co-)annihilation cross sections and the predicted neutralino relic density are presented. I will in particular show that the impact of including the radiative corrections on the cosmologically preferred region of the parameter space is larger than the current experimental uncertainty from Planck data. The presentation will include a few technical details as well as a discussion of the theoretical uncertainty due to scale variation in the calculation.

Reference: arXiv:1404.2931 [hep-ph]

Quark Flavour Violation / 41

A SU(5) footprint in the up-squarks sector

Mr. STOLL, Yannick [1]; Dr. HERRMANN, Bjorn [1]; Dr. FICHET, Sylvain [2]

[1] *Laboratoire d'Annecy le Vieux de physique théorique*

[2] *International Institute of Physics, Natal Brazil*

Corresponding Author: stoll@lapth.cmrs.fr

We investigate the consequences at low energies of a MSSM-SU(5) induced symmetry relation in the up-squark sector. We show that this relation is not too much spoiled by the RGE running down to the electroweak scale and is kept relatively model independent. Therefore, it could bring us information on the possibility that a SU(5) symmetry holds at high energies assuming that the LHC will detect squarks and access, at least partially, to their flavour decomposition.
In that purpose, we set up a statistical test based on a Bayesian approach and consider several cases, depending on the amount of flavour information the LHC will be able to collect on the up-squarks.
We also derive an effective theory for the case of two light squarks which in turn allows us to find interesting relations among decay rates which should be of interest for experimentalist at LHC during its coming run at 14 TeV.
The relevant low energies flavour constraints will also be included in the study in order to restrict our parameter space to a realistic case.
The talk will be based on arXiv:1403.3397

Quark Flavour Violation / 42

Squarks beyond minimal flavour violation at the LHC: Signatures, limits, reconstruction.

HERRMANN, Björn [1]; FUKS, Benjamin [2]; GININA, Elena [3]; EBERL, Helmut [3]; MAJEROTTO, Walter [3]; BARTL, Alfred [4]; HIDAKA, Keisho [5]; MAHMOUDI, Nazila [2]; POROD, Werner [6]; DE CAUSMAECKER, Karen [7]; STROBBE, Nadja [8]; SEKMEN, Sezen [2]; O'LEARY, Ben [6]

[1] *LAPTh / Université de Savoie*

[2] *CERN*

[3] *HEPHY Wien*

[4] *Universität Wien*

[5] *Tokyo Gakugei University*

[6] *Universität Würzburg*

[7] *Vrije Universiteit Brussel / CERN*

[8] *Ghent University / CERN*

Corresponding Author: herrmann@lapth.cnrs.fr

I will discuss the MSSM with non-minimal flavour violation in the squark sector, considering new sources of generation mixing, which are not related to the CKM matrix. After an introduction to the model, I will review the production and decay of squarks and gluinos as well as the typical signatures of such flavour-violating scenarios at the LHC, focusing on the case of additional stop-scharm mixing. Then two applications will be discussed: First, I will show how current limits on squark and gluino masses can be modified when assuming a non-minimal flavour structure. Finally, I will discuss to which extend the squark flavour structure of the MSSM could be reconstructed based on observations related to squarks at the LHC.

SUSY Phenomenology / 43

U(1)-extensions of the MSSM in light of the Higgs discovery

Mr. SFONDILIS, Agamemnon [1]; Dr. JAEGER, Sebastian [1]

[1] *University of Sussex*

Corresponding Author: a.sfondilis@sussex.ac.uk

Motivated by the discovery of a Higgs particle, with a
relatively large mass and many production and decay modes under study,
I consider a phenomenological U(1)-extension of the MSSM. Such extensions, while maintaining all the benefits of the MSSM such as unification, give extra contributions to the Higgs mass, as well as extra D-term contributions to the stop masses,
which can improve naturalness. They can also serve as benchmarks
for experiments in searching for SUSY beyond the MSSM.

I describe a bottom-up approach allowing for generic charge
assignments, where one has more complementarity between the
various experimental constraints compared to top-down models such as the E6SSM.
For example, decay modes of the Z' that are neglected in the
standard searches can become important.
I will combine and contrast constraints from visible and invisible Higgs branching fractions, precision tests, and Z' searches. I will show allowed regions in parameter space and discuss prospects with the upcoming run 2 of the LHC.

SUSY Phenomenology / 44

Multileptonic signatures of left-right supersymmetric models at the LHC

FUKS, Benjamin [1]

[1] *CERN / IPHC Strasbourg*

Corresponding Author: fuks@cern.ch

We present a complete and extensive analysis of associated chargino and neutralino production in the framework of a supersymmetric theory augmented by left-right symmetry. This model provides additional gaugino and higgsino states in both the neutral and charged sectors, thus potentially enhancing new physics signals at the LHC. For a choice of benchmark scenarios, we simulate events expected to be produced at the LHC, and classify them according to the number of leptons in the final state. We devise methods to reduce the background and compare the signals with consistently simulated events for the Minimal Supersymmetric Standard Model. We pinpoint promising scenarios where left-right symmetric supersymmetric signals can be distinguished both from background and from the Minimal Supersymmetric Standard Model events.

Particle Cosmology / 45

Falsifying Leptogenesis at the LHC

Dr. HARZ, Julia [1]; Dr. DEPPISCH, Frank [1]; Dr. HIRSCH, Martin [2]

[1] *University College London*

[2] *C.S.I.C./Universitat de Valencia*

Corresponding Author: j.harz@ucl.ac.uk

The viability of thermal leptogenesis scenarios can be investigated model independently at the LHC. We show that once a non-zero cross section of a lepton number violating process is measured, a strong lower limit can be set on the washout factor for the effective lepton number density in the early universe at times close to the electroweak phase transition. We further demonstrate that this in turn leads to severe constraints on high-scale models for the generation of the observed baryon asymmetry based on lepton number violation.
Especially for right-handed neutrinos heavier than the mass scale at which lepton number violation is observed at the LHC, the resulting washout factor will reduce any pre-existing lepton asymmetry exponentially, rendering leptogenesis ineffective.

Precision SUSY / 46

Phenomenology of Neutralino-Stop Coannihilation considering SUSY-QCD Corrections

Dr. HARZ, Julia [1]; Dr. HERRMANN, Björn [2]; Prof. KLASEN, Michael [3]; Dr. KOVARIK, Karol [3]

[1] *University College London*

[2] *LAPTh / Université de Savoie*

[3] *Universität Münster*

Corresponding Author: j.harz@ucl.ac.uk

After the discovery of a 125 GeV Higgs boson, light stop scenarios are strongly motivated. With currently having only weak constraints from the LHC for almost degenerate neutralino and stop masses, supersymmetry could still hide in this corner.
In this region of the MSSM parameter space, neutralino-stop coannihilation can also play an important role in order to meet the experimentally determined value for the dark matter relic density. For this reason, we have calculated the full next-to-leading order SUSY-QCD corrections to neutralino-stop coannihilation and have studied their effect on the relic density.
We will show that the impact of these corrections is larger than current experimental uncertainties and are important for a first uncertainty estimation. Taking into account these corrections, more precise exclusion limits on the MSSM parameter space can be set.

Quark Flavour Violation / 47

Lightest Higgs decay to a charm quark pair in the MSSM at full one loop level with flavour violation

Dr. GININA, Elena [1]; Dr. EBERL, Helmut [1]; Prof. BARTL, Alfred [2]; Prof. MAJEROTTO, Walter [1]; Prof. HIDAKA, Keisho [3]

[1] *HEPHY, Vienna*

[2] *University of Vienna*

[3] *Tokyo Gakugei University*

Corresponding Author: elena.ginina@oeaw.ac.at

We study lightest neutral Higgs decay to a pair of charm quarks in the MSSM at full one-loop level with non-minimal quark flavour violation (QFV). The process is renormalised in the \bar{DR} scheme. In the numerical analysis we consider mixing between the second and the third squark generations and the relevantconstraints from B meson data are taken into account. It is shown that the full one-loop corrected decay width can be quite sensitive to the MSSM QFV parameters and can differ up to ~ 60% from its SM value, due to large scharm-stop mixing and large QFV/QFC trilinear couplings. After summarising the theoretical and experimental errors we conclude that an observation of these SUSY QFV effects is possible with a good chance at the ILC.

Precision SUSY / 48

MadGolem and MC@NLO: further on the road of automation

Dr. LOPEZ-VAL, David [1]; Dr. MAWATARI, Kentarou [2]; Dr. GONCALVES NETTO, Dorival [3]; Dr. ZARO, Marco [4]

[1] *CP3 - Universite Catholique de Louvain*

[2] *Vrije Universiteit Brussels*

[3] *IPPP University of Durham*

[4] *LPTHE Jussieu, Paris*

Corresponding Author: david.lopezval@uclouvain.be

After the successful completion of Run I at the LHC, experimental searches are intensively confronting Supersymmetry to data. In this context, a major call for phenomenologists
is to improve, extend and combine the different tools automating
beyond-the-standard Model (BSM) NLO calculations, which have
been developped over the past years.

In this talk we will present one example of the work in this direction.
We will show the recent progress in linking the MadGolem
and MC@NLO frameworks, setting sights
at an automated NLO event generator for generic new physics processes.

In the first part of the talk we will discuss
the strategies by which we automate the
calculation of renormalized one-loop amplitudes,
the subtraction of infrared and on-shell divergences,
and the interface to the parton shower.

In the second part of the talk we will illustrate how the combined MadGolem-MC@NLO
toolkit performs in practice, applying it to exemplary processes
relevant for SUSY searches at the LHC.

51

Welcome

Corresponding Author: apostolos.pilaftsis@manchester.ac.uk

52

Phenomenology of Dirac Gaugino Models

Corresponding Author: kribs@uoregon.edu

53

PLANCK Results for the CMB

Corresponding Author: epss@damtp.cam.ac.uk

54

Experimental Overview on Dark Matter

Corresponding Author: h.araujo@imperial.ac.uk

55

Conformal and Scale Invariance in Four Dimensions

Corresponding Author: zkomargo@weizmann.ac.il

56

Higgs Results from ATLAS

Corresponding Author: sekula@physics.smu.edu

57

Higgs Results from CMS

Corresponding Author: alexandre.nikitenko@ecrn.ch

58

Implications of the Higgs Discovery for SUSY and Beyond

Corresponding Author: carena@fnal.gov

59

Theoretical Advances in Dark Matter

60

String and SUGRA Models with Strong Moduli Stabilization

Corresponding Author: emilian.dudas@cpht.polytechnique.fr

61

CMS Searches for Supersymmetric Particles at the LHC

Corresponding Author: henning.flaecher@bristol.ac.uk

62

ATLAS Searches for Supersymmetric Particles at the LHC

Corresponding Author: onofrio@liverpool.ac.uk

63

Phenomenology of Supersymmetric Particles at High-Energy Colliders

Corresponding Author: sabine.kraml@lpsc.in2p3.fr

64

Higgs Physics in the SM and the MSSM

Corresponding Author: sven.heinemeyer@cern.ch

65

Scattering Amplitudes

66

ATLAS Searches for no-SUSY Exotics at the LHC

Corresponding Author: vasiliki.mitsou@ific.uv.es

67

CMS Searches for no-SUSY Exotics at the LHC

Corresponding Author: skhalil@phys.ksu.edu

68

Scale-Invariant Extensions of the Standard Model

Corresponding Author: raymondv@unimelb.edu.au

69

Models of Leptogenesis

Corresponding Author: thambye@ulb.ac.be

70

Scattering Amplitudes and the Positive Grassmannian

71

LHCb Results and their Impact on SUSY and New Physics

Corresponding Author: johannes.albrecht@tu-dortmund.de

72

Quark Flavour Violation: SM and Beyond

Corresponding Author: aburas@ph.tum.de

73

Neutrinos

Corresponding Author: smirnov@mpi-hd.mpg.de

74

Testing Models of Neutrinos at the LHC

Corresponding Author: rmohapat@umd.edu

75

Electric Dipole Moments and Supersymmetry

Corresponding Author: jslee@jnu.ac.kr

76

GUTs and SUSY GUTs

Corresponding Author: nath@neu.edu

77

Electroweak Baryogenesis and Supersymmetry

Corresponding Author: dmorri@triumf.ca

78

Models of Inflation in Light of PLANCK and BICEP2

79

SUSY 2014: an Overview

80

SUSY 2015

Corresponding Author: jfgunion@ucdavis.edu

81

Closing Remarks

Corresponding Author: apostolos.pilaftsis@manchester.ac.uk

Higgs Phenomenology / 82

Higgs characterisation via the FeynRules and MadGraph5_aMC@NLO frameworks

Dr. MAWATARI, Kentarou [1]

[1] *Vrije Universiteit Brussel*

Corresponding Author: kentarou.mawatari@vub.ac.be

We introduce a framework, based on an effective field theory approach, that allows one to perform characterisation studies of the boson recently discovered at the LHC, for all the relevant channels and in a consistent, systematic and accurate way.

Alternative Theories / 83

Search for extra dimensions via forward detectors at the LHC

Ms. YAMASHITA, Kimiko [1]; Prof. CHO, Gi-Chol [1]; Dr. KONO, Takanori [2]; Dr. MAWATARI, Kentarou [3]

[1] *Ochanomizu University*

[2] *Ochaonmizu University*

[3] *Vrije Universiteit Brussel*

Corresponding Author: yamashita@hep.phys.ocha.ac.jp

We study a possibility to search for extra dimensions via forward detectors at the LHC.
We investigate photon-induced ADD/RS graviton exchange reactions,
where the photons emitted from protons and quasi-real.

Models of SUSY / 84

A supersymmetric model for gravity without gravitini

Dr. ALVAREZ, Pedro [1]

[1] *Oxford Physics*

Corresponding Author: pd.alvarez.n@gmail.com

We consider a supersymmetric theory in an arbitrary 2+1 dimensional curved background containing a U(1) and a Dirac spin-1/2 fields. The action is a Chern-Simons form for a connection of the OSp(2|2) group. All the fields (gauge and matter) enter as parts of the connection, that transforms in the adjoint representation of the gauge group. The system is off-shell invariant under supersymmetry. Although the supersymmetry is realized, there is no spin-3/2 gravitino, it is not therefore standard supergravity. The fields do not necessarily form supersymmetric doublets of equal mass, and moreover, fermions may acquire mass through the coupling with geometry, while the bosons -the U(1) field and the spin connection-remain massless. Finally, we present the generalization to four dimensions.

Formal SUSY and Strings / 86

Supersymmetry Breaking and Superspace Higher Derivatives

Dr. FARAKOS, Fotis [1]

[1] *Masaryk University of Brno*

Corresponding Author: fotisf@mail.muni.cz

We present new methods for supersymmetry breaking which rely on superspace higher derivatives. The theories under consideration have a deformed auxiliary field potential, thus admit more than one vacua. In the new vacua supersymmetry is broken. We also investigate the possible origin of these superspace higher derivatives.

Models of SUSY / 87

Large-Field Inflation and Supersymmetry Breaking

Mr. HEURTIER, Lucien [1]; Dr. GOODSELL, Mark [2]; Mr. TZIVELOGLOU, Pantelis [3]; Prof. DUDAS, Emilian [4]

[1] *CPHT, école Polytechnique, Palaiseau, FRANCE*

[2] *LPTHE, UPMC*

[3] *IIHE - VUB*

[4] *CPHT*

Corresponding Author: lucien.heurtier@cpht.polytechnique.fr

Large-field inflation is an interesting and predictive scenario. Its non-trivial embedding in supergravity was intensively studied in the recent literature, whereas its interplay with supersymmetry breaking has been less thoroughly investigated. We consider the minimal viable model of chaotic inflation in supergravity containing a stabilizer field, and add a Polonyi field. Furthermore, we study two possible extensions of the minimal setup. We show that there are various constraints: first of all, it is very hard to couple an O'Raifeartaigh sector with the inflaton sector, the simplest viable option being to couple them only through gravity. Second, even in the simplest model the gravitino mass is bounded from above parametrically by the inflaton mass. Therefore, high-scale supersymmetry breaking is hard to implement in a chaotic inflation setup. As a separate comment we analyze the simplest chaotic inflation construction without a stabilizer field, together with a supersymmetrically stabilized K?hler modulus. Without a modulus, the potential of such a model is unbounded from below. We show that a heavy modulus cannot solve this problem.

SUSY Phenomenology / 88

SUSY naturalness and implications for LHC, ILC, axion and wimp detection

Prof. BAER, Howard [1]

[1] *University of Oklahoma*

Corresponding Author: baer@nhn.ou.edu

We show that the essential feature of SUSY naturalness is the presence of light Higgsinos with mass the closer to m(h) the better. The expected spectra gives rise to a unique same-sign diboson signature for LHC but a definitive test will require ILC with sqrt(s)~500-600 GeV. The perfectly natural Little Hierarchy might be a reflection of mismatch between PQ breaking scale and hidden sector mass scale fa<<m. In this model, ultimate detection of both an axion and a higgsino-like wimp is expected. A ton-scale noble liquid detector should probe the entire model since the lightest Higgsino always contains a non-negligible gaugino component.

Lepton Flavour Violation and Neutrinos / 91

Lepton flavor violation and lepton dipole moments in SUSY low scale seesaw models

Prof. ILAKOVAC, Amon [1]; Prof. PILAFTSIS, Apostolos [2]; Dr. POPOV, Luka [1]

[1] *University of Zagreb*

[2] *University of Manchester*

Corresponding Author: ailakov@phy.hr

The analysis of the leptonic lepton flavour violation (LFV) processes and lepton dipole moments in low
scale seesaw models of minimally extended minimal supergravity (SUGRA) is presented. Minimal extension of the
minimal SUGRA framework for MSSM is achieved adding a CP violating phase only in the soft SUSY breking trilinear
couplings for right sneutrinos, A_ν. For the LFV processes two new box helicity amplitudes,
not considered before, were found. Numerical results show dominance of the soft SUSY breaking Z-boson and heavy neutrino box amplitudes, opposed to the photon-penguin dominance in the high scale seesaw models.
The muon anomalous magnetic moment ($a_\mu) anomaly Δa_μ cannot be explained by the presence of
the heavy neutrinos and sneutrinos, since their contribution to a_μ is too small to explain Δa_μ.
At the one loop level the electric dipole moment (EDM) of the electron (d_e) depends strongly on A_ν phase. It is equal zero for zero phase and achieves values comparable to the experimental d_e upper bounds for the maximal CP phase.

Formal SUSY and Strings / 92

On the smallness of the cosmological constant in SUGRA models with Planck scale SUSY breaking and degenerate vacua

Dr. NEVZOROV, Roman [1]; Prof. FROGGATT, Colin [2]; Prof. NIELSEN, Holger [3]; Prof. THOMAS, Anthony [1]

[1] *University of Adelaide*

[2] *University of Glasgow*

[3] *Niels Bohr Institute*

Corresponding Author: roman.nevzorov@adelaide.edu.au

In $N=1$ supergravity (SUGRA) supersymmetric (SUSY) and non-supersymmetric Minkowski vacua originating in the hidden
sector can be degenerate. This allows for consistent
implementation of the multiple point principle (MPP)
assumption. We present no--scale inspired SUGRA model
where the MPP assumption is realised at the tree--level
without extra fine-tuning. In the supersymmetric phase in
flat Minkowski space SUSY may be broken dynamically inducing
tiny vacuum energy density which can be assigned, by virtue
of MPP, to all other phases including the one in which we
live. We argue that the measured value of the cosmological constant, as well as the small values of quartic Higgs
self--coupling and the corresponding beta function
at the Planck scale, which can be obtained by extrapolating
the Standard Model (SM) couplings to high energies, can
originate from supergravity (SUGRA) models with degenerate
vacua. This scenario is realised if there are at least
three exactly degenerate vacua. In the first vacuum,
associated with the physical one, local supersymmetry (SUSY)
is broken near the Planck scale while the breakdown of the $SU(2)_W\times U(1)_Y$ symmetry takes place at the
electroweak (EW) scale. In the second vacuum local
SUSY breaking is induced by gaugino condensation at a
scale which is just slightly lower than Λ_{QCD}
in the physical vacuum. Finally, in the third vacuum
local SUSY and EW symmetry are broken near the Planck
scale.

Models of SUSY / 93

Nonstandard Higgs decays in the E6 inspired SUSY models

Dr. NEVZOROV, Roman [1]; Prof. PAKVASA, Sandip [2]

[1] *University of Adelaide*

[2] *University of Hawaii*

Corresponding Author: roman.nevzorov@adelaide.edu.au

We study the decays of the SM-like Higgs state within the E_6 inspired supersymmetric (SUSY) model based on the SM gauge group together with an extra $U(1)_{N}$ gauge symmetry under which right--handed neutrinos have zero charge. To ensure anomaly cancellation and gauge coupling unification the low energy matter content of this SUSY model involves three 27 representations of E_6 and a pair of $SU(2)$ doublets from additional 27 and $\overline{27}$. In addition, we impose a $\tilde{Z}^{H}_2$ symmetry to forbid tree--level flavor--changing transitions and the most dangerous baryon and lepton number violating operators. This model contain at least two states which are absolutely stable and can contribute to the dark matter density. One of them is the lightest SUSY particle (LSP) which is expected to be lighter than $1\,\mbox{eV}$ forming hot dark matter in the Universe. The presence of another stable neutral state which is the lightest ordinary neutralino can account for all or some of the observed cold dark matter density. In this SUSY model the next--to--lightest SUSY particle (NLSP) also tend to be light. We argue that the NLSP with GeV scale mass can result in the substantial branching ratio of the nonstandard decays of the SM--like Higgs boson into NLSPs.

Models of SUSY / 94

Non-standard Higgs Decays in U(1)' extensions of the MSSM

Dr. ATHRON, Peter [1]; Prof. WILLIAMS, Anthony [1]; Dr. NEVZOROV, Roman [1]

[1] *University of Adelaide*

Corresponding Author: roman.nevzorov@adelaide.edu.au

We consider the implications of the E_6 inspired supersymmetric (SUSY) models with an additional $U(1)_N$ gauge symmetry under which right--handed neutrinos. We introduce a mechanism to relax the rigid structure, allowing non-standard Higgs decays into pseudoscalrs.

Higgs Phenomenology / 95

Electroweak Higgs Boson Production in Association with Three Jets (A.K.A. VBF + 1 Jet) at NLO QCD

Dr. FIGY, Terrance [1]

[1] *University of Manchester*

Corresponding Author: terrance.figy@hep.manchester.ac.uk

I will present the computation of the next-to-leading order (NLO) QCD corrections to electroweak Higgs plus three jet production (EW H+3jets) within the Matchbox NLO framework of the Herwig++ event generator. Both vector boson fusion (VBF) and Higgs-strahlung type contributions are included along with all interferences. I will discuss features of our Matchbox implementation and show the impact of QCD corrections on kinematic distributions relevant Higgs boson studies at the CERN Large Hadron Collider (LHC).

Higgs Phenomenology / 97

Confronting Higgs couplings from D-terms and Natural SUSY at the LHC & ILC

Dr. MCGARRIE, Moritz [1]; Mr. PORTO, Stefano [2]; Dr. MOORTGAT-PICK, Gudrid [3]

[1] *Wits*

[2] *Institut für Theoretische Physik Universität Hamburg*

[3] *DESY*

Corresponding Author: moritz.mcgarrie@desy.de

We present the full anatomy of various D-term extensions of the MSSM's Higgs sector, which lift the Higgs mass at tree level and for a range of tan beta. We then explore the LHC & ILC's capability to determine their effect through their enhancement of Higgs branching ratios with respect to the Standard Model.

A given D-term enhancement of the Higgs sector allows one to further set a lower bound on the required stop masses versus trilinear soft term values to obtain the observed Higgs mass. In particular these extensions may bring stops within reach of the LHC, but with excesses in Higgs decays only just observable at the LHC or definitely observable at the ILC. We also comment on the D-term enhancement of MSSM squarks and sleptons.

Higgs Phenomenology / 98

Higgs pair production at the LHC

Dr. VRYONIDOU, Eleni [1]; MALTONI, Fabio [2]

[1] *Universite Catholique de Louvain*

[2] *Universite de Louvain, Center for Particle Physics and Phenomenology*

Corresponding Author: evryonidou@gmail.com

I will present predictions for the SM-Higgs-pair production channels at the LHC. Results, shown in arXiv:1401.7340, are at the NLO accuracy in QCD, and matched to parton showers by means of the MC@NLO method; hence, they are fully differential. I will show that for all channels in general, and for gluon-gluon fusion which is the dominant production channel, in particular, NLO corrections reduce the theoretical uncertainties, and are needed to provide reliable predictions for total rates as well as for distributions. I will also briefly present results for Higgs pair production in the 2HDM, for specific benchmark points.

Particle Cosmology / 99

New results on Sommerfeld enhancements and relic abundance of neutralino dark matter in the general MSSM

BENEKE, Martin [1]; HELLMANN, Charlotte [1]; RUIZ FEMENIA, Pedro [2]

[1] *TU Munich*

[2] *IFIC Valencia*

Corresponding Author: charlotte.hellmann@tum.de

We discuss the impact of Sommerfeld enhancements on the neutralino LSP relic abundance calculation for heavy neutralino dark matter including co-annihilations of nearly mass-degenerate neutralino and chargino states. Interesting regions in the MSSM parameter space are identified, focusing on heavy wino- and higgsino-like dark matter scenarios and models interpolating between the two cases. We investigate several benchmark scenarios in this part of the parameter space.

Sommerfeld enhancements in all (co-)annihilation processes of (nearly)
mass-degenerate neutralino and chargino states are considered, including P- and next-to-next-to-leading order S-wave annihilations. A newly developed method enables us in addition to treat effects from heavy states perturbatively in the Sommerfeld enhanced rates. Our generic analytic calculation of all (off)-diagonal potential and annihilation matrices allows for the first time a rigorous study of Sommerfeld enhancements in neutralino and chargino pair-annihilations in the general MSSM.

Precision SUSY / 100

Next-to-leading order accuracy for production and decay of squarks and gluinos

PELLEN, Mathieu [1]; GAVIN, Ryan [2]; HANGST, Christian [3]; KRÄMER, Michael [4]; MÜHLLEITNER, Margarete [3]; POPENDA, Eva [2]; SPIRA, Michael [2]

[1] *Institute for theoretical particle physics and cosmology - RWTH Aachen*

[2] *PSI*

[3] *KIT*

[4] *RWTH Aachen*

Corresponding Author: pellen@physik.rwth-aachen.de

The search for supersymmetric version of the standard model is a central task of the Large Hadron Collider. The interpretation of the experimental data requires accurate and flexible theoretical predictions. We present a new calculation of the next-to-leading order supersymmetric-QCD corrections to the production and the decay of supersymmetric particles. In particular, we provide fully differential cross sections in a partonic Monte Carlo program including parton shower effect. We will focus our discussion on the production of squarks which then directly decay into the lightest
supersymmetric particle and jets. We will also evoke processes involving gluinos. The methods used and some exemplary results will be presented.

Precision SUSY / 101

High Precision Prediction for the lightest CP-even MSSM Higgs-Boson Mass

HEINEMEYER, Sven [1]; HAHN, Thomas [2]; HEINEMEYER, Sven [1]; HOLLIK, Wolfgang [2]; RZEHAK, Heidi [3]; WEIGLEIN, Georg [4]

[1] *IFCA (CSIC)*

[2] *MPI Munich*

[3] *Freiburg university*

[4] *DESY*

Corresponding Author: sven.heinemeyer@cern.ch

We review recent progress in the calculation of the lightest CP-even MSSM Higgs boson mass. For the first time we consistently combine a high-precision diagrammatic calculation with the resummation of large logarithms from the top/stop sector.

Precision SUSY / 102

Precise Prediction of the W boson mass in the MSSM

HEINEMEYER, Sven [1]; HOLLIK, Wolfgang [2]; WEIGLEIN, Georg [3]; ZEUNE, Lisa [4]

[1] *IFCA (CSIC)*

[2] *MPI Munich*

[3] *IPPP Durham*

[4] *DESY*

Corresponding Author: sven.heinemeyer@cern.ch

We present the most precise calculation of the W boson mass in the MSSM. We review the restrictions imposed by the experimental measurement of M_W can be placed on the MSSM parameter space with current and future experimental accuracies.

SUSY Phenomenology / 103

SUSY Decays to Higgs bosons and their implications

HEINEMEYER, Sven [1]; Dr. VON DER PAHLEN, Federico [2]

[1] *IFCA (CSIC)*

[2] *Universidad de Antioquia*

Corresponding Author: sven.heinemeyer@cern.ch

We review recent calculations of SUSY particles decaying to Higgs bosons (and another SUSY particle). We discuss the phenomenological implications for the LHC seaches and the Linear Collider phenomenology.

Precision SUSY / 104

Renormalization of the Complex MSSM in FeynArts/FormCalc

HEINEMEYER, Sven [1]; HAHN, Thomas [2]; RZEHAK, Heidi [3]; VON DER PAHLEN, Federico [4]

[1] *IFCA (CSIC)*

[2] *MPI Munich*

[3] *University of Freiburg*

[4] *Universidad de Antioquia*

Corresponding Author: sven.heinemeyer@cern.ch

We review the implementation of the renormalized MSSM with complex parameters (cMSSM). We show how the renormalization can be used via its implementation into the FeynArts/FormCalc package.

SUSY Phenomenology / 105

The CMSSM and NUHM1 after Run I of the LHC

HEINEMEYER, Sven [1]; Dr. FLAECHER, Henning [2]; ELLIS, John [3]

[1] *IFCA (CSIC)*

[2] *University of Bristol*

[3] *CERN/King's college*

Corresponding Author: sven.heinemeyer@cern.ch

We review the recent results of the MasterCode collaboration on fits of the CMSSM and the NUHM1. We take into account the constraints from Run I at the LHC, as well as all relevant available constraints from Higgs searches, Dark Matter, flavor physics and electroweak precision data.

Higgs Phenomenology / 106

Fitting the pMSSM to all available Higgs data

HEINEMEYER, Sven [1]; WEIGLEIN, Georg [2]; BECHTLE, Philip [3]; STAL, Oscar [4]; STEFANIAK, Tim [3]; ZEUNE, Lisa [5]

[1] *IFCA (CSIC)*

[2] *IPPP Durham*

[3] *University of Bonn*

[4] *University of Stockholm*

[5] *DESY*

Corresponding Author: sven.heinemeyer@cern.ch

We present new results for a fit of the pMSSM to all available Higgs data (mass measurement, production and decay rates etc.)

Precision SUSY / 107

Higgs and the electroweak precision observables in the MRSSM

Mr. KOTLARSKI, Wojciech [1]; Prof. STOECKINGER, Dominik [2]; Prof. KALINOWSKI, Jan [1]; Mr. DIESSNER, Philip [2]

[1] *University of Warsaw*

[2] *TU Dresden*

Corresponding Author: wojciech.kotlarski@fuw.edu.pl

We present a full one-loop analysis of a Higgs sector of
the Minimal R-symmetric SUSY model in light of the recent reduction of
uncertainty on the W boson mass. Although EWPO put strong constrains on
this model, particularly due to the presence of a Higgs triplet, we argue that it is
possible to accommodate in it the measured mass of the Higgs boson as well as the
constraints imposed both by precision and direct detection experiments.

Particle Cosmology / 108

Higgs potential and inflation

Mr. HAMADA, Yuta [1]

[1] *Kyoto University*

Corresponding Author: hamada@gauge.scphys.kyoto-u.ac.jp

The observed value of the Higgs mass indicates that the Higgs potential becomes small and flat at the scale around 1017GeV. Having this fact in mind, we reconsider the Higgs inflation scenario proposed by Bezrukov and Shaposhnikov. It turns out that the non-minimal coupling ξ of the Higgs-squared to the Ricci scalar can be smaller than ten. For example, ξ=7 corresponds to the tensor-to-scalar ratio r≅0.2, which is consistent with the recent observation by BICEP2.

Lepton Flavour Violation and Neutrinos / 109

Dark θ_{13}, Leptogenesis and Inflation

HUANG, Wei-Chih [1]

[1] *UCL*

Corresponding Author: wei-chih.huang@ucl.ac.uk

In the context of the type-I seesaw mechanism, when there is an underlying discrete flavor symmetry, such as $\mu-\tau$ symmetry, at work, θ_{13} in the active neutrino mixing matrix is zero and leptogenesis can not be realized since there are no complex phases in the heavy-light neutrino mixing. In this work, we demonstrate that the existence of dark matter, which violates the flavor symmetry, renders θ_{13} non-zero via radiative corrections and provides the complex phase(s) needed for leptogenesis. We also briefly comment on possibilities of explaining BICEP2 results based on inflation.

Formal SUSY and Strings / 110

Classification of Flipped SU(5) Heterotic-String Vacua

Mr. SONMEZ, Hasan [1]; Prof. FARAGGI, Alon [1]; Prof. RIZOS, John [2]

[1] *University of Liverpool*

[2] *Ioannina University*

Corresponding Author: hasan.sonmez@liverpool.ac.uk

We extend the classification of the free fermionic heterotic–string vacua to models in which the SO(10) GUT symmetry at the string scale is broken to the flipped SU(5) subgroup. In our classification method, the set of basis vectors defined by the boundary conditions which are assigned to the free fermions is fixed and the enumeration of the string vacua is obtained in terms of the Generalized GSO (GGSO) projection coefficients entering the one–loop partition function. We derive algebraic expressions for the GGSO projections for all the physical states appearing in the sectors generated by the set of basis vectors. This enables the analysis of the entire string spectrum to be programmed in to a computer code therefore, we performed a statistical sampling in the space of $2^{44} \approx 10^{13}$ flipped SU(5) vacua and scanned up to 10^{12} GGSO configurations. For that purpose, two independent codes were developed based on JAVA and FORTRAN95. All the results presented are confirmed by the two independent routines. Contrary to the corresponding Pati–Salam classification, we do not find exophobic flipped SU(5) vacua with an odd number of generations.

Quark Flavour Violation / 111

Searches for BSM Physics in Rare B-Decays in ATLAS

IBRAGIMOV, Iskander [1]

[1] *University of Siegen*

Corresponding Author: iskander.ibragimov@cern.ch

Beyond Standard Model (BSM) Physics can be searched for indirectly in processes strongly suppressed in the Standard Model, e.g. in flavor-changing neutral-current processes. Results of the study with ATLAS data of the renowned rare decay, Bs -> mu+mu-, will be presented. The measurement of the angular distribution parameters in the weak decay Bd -> K*mumu is also sensitive to BSM physics. Results with ATLAS data will be discussed in the presentation.

Precision SUSY / 112

Momentum Dependent Two-Loop Corrections to the Neutral Higgs Boson Masses in the MSSM

HOLLIK, Wolfgang [1]; HEINRICH, Gudrun [1]; BOROWKA, Sophia [1]; HEINEMEYER, Sven [2]

[1] *Max Planck Institute for Physics*

[2] *IFCA (CSIC)*

Corresponding Author: sborowka@mpp.mpg.de

Results are presented for the momentum dependent two-loop contributions of order $\mathcal{O}(\alpha_s\alpha_t)$ to the masses and mixing effects in the Higgs sector of the real MSSM. They are obtained in the
Feynman-diagrammatic approach using a mixed on-shell/$\bar{DR}$ renormalization that can directly be matched onto the higher-order corrections included in the code FeynHiggs.
Several two-loop diagrams entering the calculation are not known analytically. They are evaluated numerically with the program SecDec.
The combination of the new momentum dependent two-loop contribution with
the existing one- and two-loop corrections in the on-shell/$\bar{DR}$ scheme leads to an improved prediction of the light MSSM Higgs boson mass and a correspondingly reduced theoretical uncertainty.

Alternative Theories / 113

Characterizing New physics with Polarized Beams at High-Energy Hadron Colliders

PROUDOM, Josselin [1]; FUKS, Benjamin [2]; SCHIENBEIN, Ingo [1]; ROJO, Juan [3]

[1] *LPSC Grenoble*

[2] *CERN / IPHC Strasbourg*

[3] *Rudolf Peierls Centre for Theoretical Physics Oxford*

Corresponding Author: josselin.proudom@lpsc.in2p3.fr

If new physics has to be discovered in the forthcoming years, the ultimate goal of the high-energy physics program will consist of fully characterizing the newly-discovered degrees of freedom in terms of properties such as their masses, spins and couplings. I will show how the availability of polarized beams at high-energy proton-proton colliders could yield a unique discriminating power between different beyond the Standard Model scenarios giving the same final-state signature, and how polarized beams could be help us to obtain information on the parameters of the hypothetical new physics sector of the theory. I will discuss as an illustrative example the case of a particular class of models leading to monotop production, and explain how these models could be distinguished by means of single- and double-spin asymmetries in polarized collisions at a Large Hadron Collider operating at a center of-mass energy of 14 TeV and at the recently proposed Future Circular Collider.

SUSY Phenomenology / 114

Simplified Model Limits for Supersymmetry and Models with Opposite Spin

SONNEVELD, Jory [1]; OYMANNS, Lennart [1]; KRÄMER, Michael [1]; HEISIG, Jan [1]; EDELHÄUSER, Lisa [1]

[1] *RWTH Aachen*

Corresponding Author: sonneveld@physik.rwth-aachen.de

With new results and limits on constrained models of supersymmetry (SUSY) from the ATLAS and CMS collaborations at the LHC, questions arise about what these limits imply for more general models of SUSY or other models for physics beyond the Standard Model. Since SUSY has a vast array of parameters, both collaborations also quantify their search results in terms of simplified models, augmenting the particle spectrum of the standard model with only a very limited set of new, hypothetical particles.
In our work presented here, we focus on all-hadronic (multijet plus missing transverse energy) searches at the LHC and test the usability of simplified models parametrized by the squark, gluino and lightest SUSY particle (LSP) masses. By comparing results of different variants of these simplified models, we show that despite some underlying differences it is possible to use simplified models to estimate limits on SUSY and other BSM models. We also study if we would obtain the same result when the given model has spin quantum numbers unequal to those used in the simplified model.

Models of SUSY / 115

Gauge mediation and the light Higgs mass

Mr. MUMMIDI, Venkata Suryanarayana [1]

[1] *Indian Institute of Science*

Corresponding Author: soori9@cts.iisc.ernet.in

The discovery of Higgs at 125 GeV has put strong constraints on gauge mediation in supersymmetric models. We consider minimal models of gauge mediated supersymmetry breaking with an extra U(1) factor in addition to the Standard Model gauge group. A U(1) charged, Standard Model singlet is assumed to be present which allows for an additional NMSSM like coupling, λHuHdS. The U(1) is assumed to be flavour universal. Anomaly cancellation in the MSSM sector requires additional coloured degrees of freedom. The S field can get a large vacuum expectation value along with consistent electroweak symmetry breaking. It is shown that the lightest CP even Higgs boson can attain mass of the order of 125 GeV.

Higgs Phenomenology / 116

Updated Constraints on the Higgs Singlet Extension of the SM

ROBENS, Tania [1]

[1] *IKTP, TU Dresden*

Corresponding Author: tania.robens@tu-dresden.de

We discuss the current status of theoretical and experimental constraints on a Higgs singlet extension of the Standard Model. We focus on the case of a real Higgs singlet extension with the second neutral Higgs boson being in the mass range accessible to the LHC (0 GeV - 1TeV). We consider constraints from perturbative unitarity, electroweak oblique parameters, perturbativity of the couplings, and vacuum stability, where the latter are tested up to a scale of ⊠ 10^11 GeV using renormalization group equations. Furthermore, direct collider constraints from signal strength measurements and 95% C:L: exclusion limits from Higgs searches are included via the public codes HiggsSignals and HiggsBounds, respectively.We present predictions for the 14 TeV LHC run which are in accordance with all above constraints.

SUSY Phenomenology / 117

Distinction between MSSM and NMSSM from the neutralino/chargino sector

Mr. PORTO, Stefano [1]; Dr. ROLBIECKI, Krzysztof [2]; Prof. MOORTGAT-PICK, Gudrid [3]

[1] *Universität Hamburg*

[2] *Instituto de Fisica Teorica IFT-UAM/CSIC, Universidad Autonoma de Madrid, Spain*

[3] *Universität Hamburg/DESY*

Corresponding Author: stefano.porto@desy.de

The identification of the underlying new physics model is one of the main issues of present and future colliders.
We are interested in the distinction between different supersymmetric
models, the MSSM and the NMSSM. We study tricky cases where the Higgs sector alone is not
sufficient to distinguish the models. Exploring the chargino/neutralino sector can be a useful alternative to the Higgs sector. Under the assumption that only the light chargino and neutralino masses and the polarized
cross sections $e^+e^-\rightarrow\tilde{chi}^0_i\tilde{chi}^0_j,\tilde{chi}^+_i\tilde{chi}^-_j$ have been measured at a linear collider, we reconstruct through a fit the fundamental MSSM
parameters M_1 , M_2 , μ and $\tan \beta$. We study whether a model distinction is possible and how additional information can be exploited.
We concentrate in more challenging cases in which NMSSM scenarios have a relatively heavy singlino, while we address two classes of
neutralino mixing, where neutralino-LSP is either higgsino- or gaugino-like.

Higgs Phenomenology / 118

Higher-order scalar interactions and SM vacuum stability

Mr. LEWICKI, Marek [1]; Mr. OLSZEWSKI, Paweł [2]

[1] *University of Warsaw*

[2] *Physics Department, Warsaw University*

Corresponding Author: marek.lewicki@fuw.edu.pl

Investigation of the structure of the Standard Model effective potential at very large field strengths opens a window towards new phenomena and can reveal properties of the UV completion of the SM. The map of the lifetimes of the vacua of the SM enhanced by nonrenormalizable scalar couplings has been compiled to show how new interactions modify stability of the electroweak vacuum. Whereas it is possible to stabilize the SM by adding Planck scale suppressed interactions and taking into account running of the new couplings, the generic effect is shortening the lifetime and hence further destabilisation of the SM electroweak vacuum. These findings have been illustrated with phase diagrams of modified SM-like models. It has been demonstrated that stabilisation can be achieved by lowering the suppression scale of higher order operators while picking up such combinations of new couplings, which do not deepen the new minima of the potential. Our results show the dependence of the lifetime of the electroweak minimum on the magnitude of the new couplings, including cases with very small couplings (which means very large effective suppression scale) and couplings
vastly different in magnitude (which corresponds to two different suppression scales).

SUSY Phenomenology / 119

Low fine tuning in the MSSM with higgsino dark matter and unification constraints

SESSOLO, Enrico Maria [1]; Dr. KOWALSKA, Kamila [2]

[1] *NCBJ, Warsaw*

[2] *National Center for Nuclear Research*

Corresponding Author: sessolo@fuw.edu.pl

We examine the issue of fine tuning in the MSSM with GUT-scale boundary conditions. We focus on a phenomenologically interesting region that is favored by the Higgs mass measurement and the relic density, where the dark matter is a nearly pure higgsino with mass ~1 TeV, while the scalars and gauginos have masses in the multi-TeV regime.
We identify specific unification patterns that can lead to a significant reduction of the fine tuning due to the gaugino, scalar, and higgsino masses, relative to the simplest unification conditions. More properly, the fine tuning is shifted from the masses to the parameters of the underlying theory, whose relation can emerge quite strikingly from phenomenological requirements (relic density, Higgs+LHC, LUX). We give an example of this mechanism in the context of supergravity and SU(5) unification.

Quark Flavour Violation / 120

NATURAL SUSY AFTER THE LHC 8 TeV RUN

Dr. KOWALSKA, Kamila [1]; SESSOLO, Enrico Maria [2]

[1] *National Center for Nuclear Research*

[2] *NCBJ, Warsaw*

Corresponding Author: kamila.kowalska@fuw.edu.pl

We investigate the impact of direct LHC SUSY searches on the parameter
space of three natural scenarios in the MSSM.

In the first case the spectrum consists of light stops, sbottoms, and
Higgsino-like neutralinos, while the other particles are assumed to be out of the experimental reach. In the second case we consider an additional light gluino. Finally we study a more complex spectrum comprising also light sleptons, wino-like chargino, and a bino-like neutralino.

We simulate in detail three orthogonal LHC SUSY searches and we calculate the exclusion likelihood due to the individual searches as well as their statistical combination. We calculate the fine-tuning measure of the points allowed by the LHC and the implications for the Higgs mass and other phenomenological observables: Higgs signal rates, the relic density, $B_s\to \mu^+\mu^-$, $b\to s \gamma$, and the spin-independent neutralino-proton scattering cross section.

SUSY Phenomenology / 121

Searching evidences of new physics in the light of extended supersymmetric models

Dr. GHOSH, Pradipta [1]

[1] *Instituto de Fisica Teorica, Universidad Autonoma de Madrid*

Corresponding Author: pradipta.ghosh@uam.es

Supersymmetric theories with non-minimal field content can accommodate light scalar(s), pseudoscalar(s) and neutralino(s) in certain regions of the parameter space. These states, through their presence in the decay cascades of the heavier particles can lead to novel signatures at the LHC. This conclusion is not only limited to the supersymmetric particles but also extended for the heavy standard model particles. We emphasise how the presence of these states produces distinct final states at the LHC. Analyses of these kinds with heavy standard model particles (e.g., W±, Z, Higgs) are viable alternatives to verify evidence of new physics beyond the standard model when the rest of the mass spectrum remains beyond the reach of the LHC, following the trend of missing excess over the standard model prediction as of now. We exemplify our analysis with the standard scale invariant NMSSM and
the μνSSM, where three families of the right-handed neutrino superfields have been used to offer a solution to the μ-problem and at the same time to house the observed three flavour neutrino data.

Precision SUSY / 122

Top-quark Polarization and Charge Asymmetries at the LHC in the Effective Description of Squarks Interactions

Dr. ARGANDA, Ernesto [1]; Dr. PENARANDA, Siannah [1]; Mr. ABRAHANTES, Arian [1]

[1] *Departamento de Física Teórica, Universidad de Zaragoza*

Corresponding Author: ernesto.arganda@unizar.es

A detailed study of top-quark polarizations and $t \bar t$ charge asymmetries, induced by stop-pair production at the LHC
and the subsequent decays $\tilde t_1 \to t \tilde \chi_1^0$, is performed within the effective description of squarks interactions,
which includes the effective Yukawa couplings and another logarithmic term encoding the supersymmetry breaking.
This effective approach is more suitable for their introduction in Monte-Carlo simulations and we make use of its implementation
in {\tt MadGraph} in order to investigate the possibilities of the charge asymmetry A_C, measured at the LHC and consistent with the SM expectations,
to discriminate among different SUSY scenarios and analyze the implications of these scenarios on the top polarizations and related observables.

Precision SUSY / 123

Searches for Direct Electroweak Production of Charginos, Neutralinos and Sleptons with Leptons and MET in ATLAS

Dr. XU, Da [1]

[1] *Institue of High Energy Physics, Chinese Academy of Sciences*

Corresponding Author: da.xu@cern.ch

The production of charginos, neutralinos, or sleptons could be the dominant production mode(s) of supersymmetric particles at the LHC if strongly interacting squarks and gluinos are at very high mass scale. The talk presents the latest ATLAS results for searches for these particles using the full 2012 LHC dataset at sqrt(s)=8 TeV.

SUSY Phenomenology / 124

The LHC Confronts the pMSSM

Prof. HEWETT, JoAnne [1]; Dr. ISMAIL, Ahmed [2]; Dr. RIZZO, Thomas [1]; CAHILL-ROWLEY, Matthew [1]

[1] *SLAC*

[2] *Argonne National Laboratory*

Corresponding Author: mrowley@slac.stanford.edu

We explore the impact of current (7+8 TeV) and future (14 TeV) LHC searches on the range of viable sparticle spectra within the 19/20 – dimensional pMSSM. Considering both neutralino and gravitino LSPs, we compare our results with simplified model exclusion limits and describe important cases where the pMSSM results differ significantly from the simplified model descriptions. We also consider models that are poorly constrained by LHC data because of unusual decay topologies and/or displaced decays, and discuss ways to improve the LHC sensitivity in these scenarios. Finally, motivated by naturalness, we examine the sensitivity of current searches to models with light stops and to a specialized set of models with fine-tuning better than 1%. We show that a surprising variety of searches are sensitive to light stops, and that the 14 TeV LHC will be a very powerful probe of natural pMSSM models.

Higgs Phenomenology / 125

Higgs Bosons in the pMSSM

CAHILL-ROWLEY, Matthew [1]; Prof. HEWETT, JoAnne [1]; Dr. ISMAIL, Ahmed [2]; Dr. RIZZO, Thomas [1]

[1] *SLAC*

[2] *Argonne National Laboratory*

Corresponding Author: mrowley@slac.stanford.edu

We discuss the properties of the Standard Model-like Higgs boson in the pMSSM, a 19/20 – dimensional parameter space that captures most of the relevant phenomenology of the general MSSM. Within this framework, we characterize the range of possible deviations in the Higgs couplings to standard model particles and examine the possibility of invisible Higgs decays. We show that precision Higgs coupling measurements at the 14 TeV LHC and at the proposed 500 GeV ILC will be sensitive to many pMSSM models which are allowed by current data, including models which are expected to remain allowed after the 14 TeV LHC SUSY searches. In particular, we see that most of our models predict SUSY corrections to the h-g-g and h-b-b couplings that will be observable with future experimental precision. We also show that the null results of current LHC SUSY searches have a very mild effect on the distributions of possible Higgs couplings within our model set.

Models of SUSY / 126

Naturalness and fine tuning in scale-invariant NMSSMs with and without extra matter

Mr. BINJONAID, Maien [1]; KING, Steve [1]

[1] *University of Southampton*

Corresponding Author: mymb1a09@soton.ac.uk

We present a comparative and systematic study of the fine tuning in the Higgs sector of three scale-invariant NMSSM models: the first being the standard Z_3-invariant NMSSM; the second is the NMSSM with additional matter filling 3(5+5*) representations of SU(5) and is called the NMSSM+; while the third model comprises 4(5+5*)and is called the NMSSM++. Naively, one would expect the fine tuning in the plus-type models to be smaller than that in the NMSSM, but we find that LHC limits on sparticles, especially the gluino mass, m_Gluino, can play an indirect, but vital, role in controlling the fine tuning. In particular, working in a semi-constrained framework at the GUT scale, we find that the masses of third generation stops are always larger in the plus-type models than in the NMSSM without extra matter. This is an RGE effect which cannot be avoided, and as a consequence the fine tuning in the NMSSM+ is significantly larger than in the NMSSM, with fine tuning in the NMSSM++ being significantly larger than in the NMSSM+.

Quark Flavour Violation / 127

Soft supersymmetry breaking terms and unification of Yukawa matrices.

Mr. ISKRZYNSKI, Mateusz [1]

[1] *University of Warsaw*

Corresponding Author: mateusz.iskrzynski@fuw.edu.pl

The minimal supersymmetric SU(5) grand unified theory (GUT) requires equality of down-quark and lepton Yukawa matrices at the GUT scale. Fulfilling this condition for the first two generations in the MSSM can be achieved by an appropriate choice of soft supersymmetry-breaking parameters. Either non-universal A-terms or flavour-off-diagonal squark mass matrices can generate sizeable threshold corrections to the small Yukawa couplings at the SUSY decoupling scale. We investigate whether such corrections can be large enough without violating constraints from flavour observables and electroweak symmetry breaking.

SUSY Phenomenology / 128

Searches for Gluino, Stop and Sbottom Production in Channels with b-Jets and MET in ATLAS

Dr. FIASCARIS, Maria [1]

[1] *University of Chicago*

Corresponding Author: maria.fiascaris@cern.ch

Naturalness arguments for weak-scale supersymmetry favour supersymmetric partners of the third generation quarks with masses not too far from those of their Standard Model counterparts. Top or bottom squarks with masses less than a few hundred GeV can give rise to direct pair production rates at the LHC that can be observed in the data sample recorded by the ATLAS detector. Real and virtual production of third generation squarks via decay of a gluino can also be significant if the mass of the gluino does not exceed the TeV scale. The talk presents recent ATLAS results from searches for gluino mediated and direct stop and sbottom pair production.

SUSY Phenomenology / 129

Inclusive SUSY Particle Searches with Jets and MET in ATLAS

RURIKOVA, zuzana [1]

[1] *University of Freiburg*

Corresponding Author: rurikova@cern.ch

Despite the absence of experimental evidence, weak scale supersymmetry remains one of the best motivated and studied Standard Model extensions. This talk summarises recent ATLAS results on inclusive searches for supersymmetric squarks and gluinos, Results are presented for searches in final state events containing jets, missing transverse momentum, light leptons or taus.

Particle Cosmology / 130

Effect of interaction terms on particle production due to time-varying mass

Dr. ENOMOTO, Seishi [1]; Ms. FUKSIŃSKA, Olga [1]; Prof. LALAK, Zygmunt [1]

[1] *Faculty of Physics, University of Warsaw*

Corresponding Author: eno-book@live.jp

It is known that time-varying masses cause particle production. We shall discuss particle production of interacting bosons and fermions in the context of supersymmetric models. In such models both bosonic and fermionic particles are produced, since their masses are controlled by the same background scalar fields. We shall focus on the resulting abundance of fermions, taking into account supersymmetry breaking effects.

Higgs Phenomenology / 131

SUSY Higgs cross sections

Prof. HARLANDER, Robert [1]

[1] *Bergische Universitaet Wuppertal*

Corresponding Author: robert.harlander@uni-wuppertal.de

I will review recent developments in the theoretical description of Higgs cross sections in supersymmetric models.

Particle Cosmology / 132

Chaotic inflation and baryogenesis in Supergravity in the light of BICEP2 results

GARCIA GARCIA, Marcos A [1]; Prof. OLIVE, Keith A [1]; Prof. ELLIS, John [2]; Prof. NANOPOULOS, Dimitri [3]

[1] *University of Minnesota*

[2] *King's College London, CERN*

[3] *Texas A University, HARC*

Corresponding Author: garciagarcia@physics.umn.edu

The detection of tensor modes by the BICEP2 experiment has been interpreted as the first direct evidence of cosmological inflation. The magnitude of the tensor perturbations is consistent with simple models of chaotic inflation with a quadratic potential; however, the realization of chaotic inflation and baryogenesis in supergravity is a non-trivial task. The SUSY breaking energy density generally gives a would-be inflaton an additional mass (typically of the order of the Hubble parameter), which spoils the flatness of the potential. The same effect induces masses to the low energy flat directions of the scalar potential, preventing Affleck-Dine baryogenesis from occurring.
We show that the introduction of a chiral multiplet coupled to the inflaton (with a shift symmetry) and to the flat direction in N=1 supergravity allows the realization of quadratic inflation and Affleck-Dine baryogenesis. In addition, we present new schemes in which a quadratic potential for the inflaton can be obtained in no-scale supergravity. In this scenario the inflaton may be identified with the supersymmetric partner of a right-handed neutrino, generating the baryon asymmetry through its decay.

Particle Cosmology / 133

The LUX dark-matter search

Dr. MANALAYSAY, Aaron [1]

[1] *University of California Davis*

Corresponding Author: aaronm@ucdavis.edu

The LUX experiment searches for direct evidence of galactic dark matter. Located roughly 1.5 km underground at the Sanford Underground Research Facility in Lead, South Dakota (USA), the heart of the experiment is a 370 kg liquid-xenon target, instrumented as a dual-phase (liquid/gas) time projection chamber capable of 3-D position reconstruction and nuclear recoil discrimination. The initial science results reached a record-setting sensitivity to Weakly Interacting Massive Particles (WIMPs), excluding WIMP-nucleon couplings greater than 7.6e-46 cm^2 for WIMPs of mass 33 GeV. This null result strongly rules out dark-matter interpretations of anomalous features seen in the data of several less-sensitive experiments. A versatile detector, many other dark-matter models besides WIMPs can also be probed with the same data, as is often the case with direct-detection experiments. I discuss further implications of these results, and present the current status of this on-going experiment.

Alternative Theories / 134

Grand unified dark matter

Mr. LONSDALE, Stephen [1]; Prof. VOLKAS, Raymond [1]

[1] *The University of Melbourne*

Corresponding Author: lsj@student.unimelb.edu.au

Asymmetric dark matter models are useful in providing an explanation for the number density of dark matter in the universe but typically do not provide an explanation for the mass of dark matter particles.
In this talk I discuss the capacity for unified models to solve this problem by linking the confinement scales of baryons in visible and dark sectors to each other through the condition of unified coupling constants.

By examining the dependence of the QCD scale on fermion masses and
symmetry breaking scales in both SUSY and non-SUSY GUT models,
we can examine a wide range of unified models of two sectors paired under a discrete symmetry and which break asymmetrically, generating a final SU(3) confining gauge theory in each sector that yields similar but different masses for visible and dark baryons. It can then be demonstrated that this asymmetric breaking works in an SU(5)XSU(5) case and that we can acquire a dark QCD scale just above that of the standard model. I will finally discuss how we can adopt this approach in supersymmetric theories and explore the possibility of larger GUT candidates.

Higgs Phenomenology / 135

Future Prospects for Stau in Higgs Coupling to Di-photon

Mr. KITAHARA, Teppei [1]; Dr. ENDO, Motoi [1]; Mr. YOSHINAGA, Takahiro [1]

[1] *University of Tokyo*

Corresponding Author: kitahara@hep-th.phys.s.u-tokyo.ac.jp

We study future prospects of the stau which contributes to the Higgs coupling to di-photon. The coupling is sensitive to new physics and planned to be measured at percent levels in future colliders. We show that, if the excess of the coupling is measured to be larger than 4 %, the lightest stau is predicted to be lighter than about 200 GeV by taking vacuum meta-stability conditions into account. Such a stau can be discovered at ILC. Moreover, we show how accurately the stau contribution to the coupling can be reconstructed from the information that is available at ILC. We also argue that, if the stau mixing angle is measured, the mass of the heaviest stau can be predicted by measuring the Higgs coupling, even when the heaviest stau is not yet discovered at the early stage of ILC. This talk is based on arXiv:1401.3748, JHEP 1305, 035(2013) and JHEP 1211, 021(2012).

SUSY Phenomenology / 136

Searches for Long-Lived Massive Particles in ATLAS

GUIDO, Elisa [1]

[1] *Universita di Genova*

Corresponding Author: elisa.guido@cern.ch

Several supersymmetric scenarios predict massive long-lived particles. Such particles may be detected through abnormal specific energy loss, appearing or disappearing tracks,
displaced vertices, long time-of-flight, late calorimetric energy deposits or non-pointing photons.
The talk presents recent results from searches for long-lived supersymmetric particles with the ATLAS detector.

Particle Cosmology / 137

BICEP2 implications for small-field models of slow-roll inflation

NOLDE, David [1]; ANTUSCH, Stefan [1]

[1] *University of Basel*

Corresponding Author: david.nolde@unibas.ch

With the indications for r > 0.1 by BICEP2, there have been discussions on whether all small-field models of inflation can be ruled out due to the Lyth bound, or if the Lyth bound can be evaded by specific choices of the inflaton potential. We show that in single-field slow-roll inflation, it is impossible to reconcile r > 0.1 with field excursions \Delta \phi << M_pl, independently of the form of the potential. We also briefly discuss how this bound can be generalized to multi-field slow-roll models, and mention two ways in which multi-field models can dodge this bound.

Particle Cosmology / 138

Supersymmetric dark matter with low reheating temperature

Mr. TROJANOWSKI, Sebastian [1]; Prof. ROSZKOWSKI, Leszek [1]; Dr. TURZYNSKI, Krzysztof [2]

[1] *National Center for Nuclear Research (Warsaw, Poland)*

[2] *University of Warsaw (Poland)*

Corresponding Author: strojan@fuw.edu.pl

I will examine the relic abundance of supersymmetric dark matter in a scenario where the reheating temperature T_R of the Universe after inflation is low, in the range of tens or of hundreds of GeV. To this end I will solve the Boltzmann equation during and after the period of reheating, taking into account cosmological as well as collider constraints, in particular the recent Higgs boson discovery. I will consider several candidates for the lightest supersymmetric particle (LSP) as a dark matter candidate. In the case of the neutralino LSP, large new regions of parameter space open up, depending on the value of reheating temperature. Heavy wino LSP, which has been ruled out in a standard high T_R scenario by indirect detection limits, becomes again viable. Gravitino and axino as dark matter will be also presented.

====
The talk will be based on ongoing work done in collaboration with L. Roszkowski and K. Turzynski.

Particle Cosmology / 139

Observation is confirming the WIMP paradigm

Prof. BALAZS, Csaba [1]; Dr. LI, Tong [1]; Dr. NEWSTEAD, Jayden [2]

[1] *Monash University*

[2] *Arizona State University*

Corresponding Author: csaba.balazs@monash.edu

I present a model independent analysis of thermal dark matter constraining its mass and interaction strengths with data from astro- and particle physics experiments. Using effective field theory to describe interactions of dark matter particles I cover real and complex scalar, Dirac and Majorana fermion, and vector boson dark matter candidates. I show posterior probability distributions for the mass and interaction strengths for the various spin cases. The observationally favored dark matter particle mass region is 10-100 GeV with effective interactions that have a cut-off at 0.1-1 TeV. This is mainly the result of the requirement that the thermal abundance of dark matter does not exceed the observed value. Thus thermal dark matter coupled with present data implies new physics most likely under 10 TeV.

Models of SUSY / 140

Grand Unification with partial fine tuning

Dr. MILLER, David [1]; Dr. MORAIS, António [2]

[1] *University of Glasgow*

[2] *Universidade de Aveiro*

Corresponding Author: d.miller@physics.gla.ac.uk

We discuss supersymmetric Grand Unification under the groups SU(5) and SO(10) within the context of fine tuning. We show that models with non-universal gaugino masses, as one would expect from nontrivial breaking mechanisms, can avoid fine-tuning in the soft susy mass parameters (though not with respect to the mu parameter). We discuss scenarios that avoid all experimental constraints and give the correct Dark Matter relic abundance, and show that these will be challenging for the upgraded LHC.

Alternative Theories / 141

The Weyl Consistency Conditions and Standard Model Vacuum Stability

Dr. GILLIOZ, Marc [1]

[1] *CP3-Origins*

Corresponding Author: gillioz@cp3.dias.sdu.dk

The conformal symmetry plays an important role in quantum field theories, even when it is explicitly broken by a renormalization group flow. The Weyl consistency conditions reflect its presence in the renormalized theory. They provide relations among the beta functions of the theory at different loop orders. As an example, we show how the Weyl consistency conditions affect the computation of the vacuum stability in the Standard Model.

Alternative Theories / 142

A Naturally Light Higgs without Light Top Partners

Dr. CARMONA, Adrian [1]; Dr. GOERTZ, Florian [1]

[1] *ETH Zurich*

Corresponding Author: carmona@itp.phys.ethz.ch

I will show that lepton compositeness can have a non-negligible impact on the Higgs potential in Minimal Composite Higgs Models. This offers a possibility to raise the scale of the top partners above a TeV, thus reducing the tension with the current negative search results at the LHC for minimal setups of the quark sector.

SUSY Phenomenology / 143

The Higgs Spectrum from a Maximally SO(5) Symmetric Two Higgs Doublet Model Potential

Dr. DEV, Bhupal [1]; Prof. PILAFTSIS, Apostolos [1]

[1] *University of Manchester*

Corresponding Author: bhupal.dev@hep.manchester.ac.uk

We present a maximally symmetric Two Higgs Doublet Model (2HDM), where the scalar potential possesses an Sp(4)/Z_2 symmetry in the \Phi-space
which is isomorphic to SO(5) in the bilinear field space. The usual custodial symmetries of the 2HDM potential are identified as certain subsets of this maximal symmetry group. We analyze the mass spectrum for the charged (H^+, H^-), CP-even scalar (h, H) and CP-odd pseudoscalar (A) Higgs bosons in this minimal model. Starting from the SO(5)-symmetric limit of the theory with four Goldstone bosons
(h, A, H^+, H^-) at some high scale, we find that the renormalization group effects still leave the pseudoscalar Higgs boson massless at the weak scale, which can be identified as a U(1)_PQ axion. Introducing a soft symmetry-breaking mass term, we obtain a viable low-energy Higgs spectrum for a range of model parameter space, which is consistent with the current experimental limits, and may be testable in future Higgs precision measurements.

Higgs Phenomenology / 144

Testing Higgs sectors beyond the Standard Model with HiggsSignals

STÅL, Oscar [1]; HEINEMEYER, Sven [2]; BECHTLE, Philip [3]; STEFANIAK, Tim [3]; WEIGLEIN, Georg [4]

[1] *Stockholm University*

[2] *IFCA (CSIC)*

[3] *University of Bonn*

[4] *IPPP Durham*

Corresponding Author: oscar.stal@fysik.su.se

We introduce the public computer program HiggsSignals, which can be used to constrain arbitrary Higgs sectors from measurements of Higgs masses and rates at colliders. Using this code, we derive constraints on the parameters of Higgs sectors beyond the Standard Model from all currently available channels for the observed LHC signal. The results are presented both in a model-independent framework with coupling scale factors, and in model-dependent examples where e.g. specific scenarios in the MSSM are analyzed.

SUSY Phenomenology / 145

Triplet extended MSSM: naturality vs LHC data & perturbativity constraints

Dr. DI CHIARA, Stefano [1]; Dr. BANDYOPADHYAY, Priyotosh [1]; Prof. HUITU, Katri [1]; Ms. SABANCI, Asli [1]

[1] *University of Helsinki*

Corresponding Author: stefano.dichiara@helsinki.fi

In this talk, I will briefly review the triplet extended MSSM, and then show that for a sizable portion of viable parameter space, associated with a large but still perturbative triplet coupling, the model features conspicuously smaller fine-tuning than in the case of MSSM-like couplings. I will then present the results of a fit to Higgs physics data as well as to low energy observables like the B to X_{s\gamma} decay, which demonstrate that the couplings allowed by direct search constraints generally lie well within the experimentally viable regions. Finally, I will show that the goodness of fit of the given experimental data by the triplet extended MSSM is comparable with that of the SM.

Particle Cosmology / 146

Affleck-Dine baryogenesis with R-parity violation

Dr. SAIKAWA, Ken'ichi [1]; Dr. HIGAKI, Tetsutaro [2]; Dr. NAKAYAMA, Kazunori [3]; Dr. TAKAHASHI, Tomo [4]; Dr. YAMAGUCHI, Masahide [1]

[1] *Department of Physics, Tokyo Institute of Technology*

[2] *Theory Center, High Energy Accelerator Research Organization (KEK)*

[3] *Department of Physics, Graduate School of Science, University of Tokyo*

[4] *Department of Physics, Saga University*

Corresponding Author: saikawa@th.phys.titech.ac.jp

R-parity violation is getting more attention as a possible alternative to natural supersymmetry in the current LHC searches. We investigate whether the baryon asymmetry of the universe is explained in the framework of the supersymmetric extension of the Standard Model with R-parity violating interactions. It is shown that the Affleck-Dine mechanism naturally works via a trilinear interaction LLE^c, LQD^c, or $U^cD^cD^c$, if the magnitude of the coupling corresponding to the operator $¥lambda$, $¥lambda'$, or $¥lambda''$ is sufficiently small. The formation of Q-balls and their subsequent evolution are also discussed. The parameter region is constrained by considering the wash out effect due to the sphaleron transitions and baryon/lepton number violating interactions induced by R-parity violating operators, and the requirement that the hadronic decay of unstable LSPs must not affect the observed light element abundance. It is found that the present baryon asymmetry can be explained in the parameter region where R-parity is mildly violated and the mass of the gravitino is relatively heavy. On the other hand, it is difficult to explain the present baryon asymmetry for larger values of R-parity violating couplings, since Q-balls are likely to be destructed in the thermal environment and the primordial baryon number is washed away.

Models of SUSY / 147

Doublet-Triplet Mass Splitting and Proton Decay in SU(5) SUSY GUT with Horizontal Symmetry SU(1,1)

Dr. YAMATSU, Naoki [1]

[1] *Osaka University*

Corresponding Author: yamatsu@het.phys.sci.osaka-u.ac.jp

I will talk about an SU(5) SUSY GUT model with a noncompact horizontal symmetry SU(1,1). When doublet-triplet mass splitting is naturally realized via the spontaneous horizontal symmetry breaking, the contribution to proton decays via the colored Higgses is highly suppressed. This talk is based on a paper PTEP 2013, 123B01 (arXiv:1304.5215 [hep-ph]).

Particle Cosmology / 148

Partially Composite Higgsino

ASANO, Masaki [1]

[1] *University of Bonn*

Corresponding Author: masano@th.physik.uni-bonn.de

Several SUSY models with partially composite Higgs bosons coupled to a strong sector have been proposed. Such strong dynamics would help to cause the electroweak symmetry breaking naturally. We focus on the compositeness of the Higgsinos in such models. We show that such a Higgsino compositeness can induce the characteristic decay branching fraction of the neutralinos: The decay branching fraction of the second lightest neutral Higgsino into the lightest neutral Higgsino with photon can be large due to a dipole interaction. We also discuss the Higgsino dark matter feature: The annihilation cross section into γZ can be large. This talk is based on arXiv:1311.6823.

SUSY Phenomenology / 149

Implications of spontaneous R-parity or CP breaking in NMSSM with right handed neutrinos

Prof. HUITU, Katri [1]

[1] *University of Helsinki*

Corresponding Author: katri.huitu@helsinki.fi

I will discuss the possibilities of spontaneous breaking of R-parity and of CP in the NMSSM model, which contains additionally right handed neutrinos. In the case of R-parity breaking, I'll concentrate on the effects on Higgs production and decay, with special emphasis on diphoton mode. In the case of spontaneous CP violation, I will discuss the effects on neutralino and sneutrino dark matter. I will also comment on the effects of both R-parity and CP being spontaneously broken.

Particle Cosmology / 150

Astrophysical signatures of axino dark matter

Mr. LIEW, Seng Pei [1]; ENDO, Motoi [1]; HAMAGUCHI, Koichi [1]; MUKAIDA, Kyohei [1]; NAKAYAMA, Kazunori [1]

[1] *University of Tokyo*

Corresponding Author: liew@hep-th.phys.s.u-tokyo.ac.jp

Axino interacts weakly with ordinary matter and can be a good candidate of dark matter. In the case where R-parity is violated, axino dark matter decays slowly and can have interesting signatures in the form of cosmic rays. Here, we show two concrete examples of decaying axino dark matter that can explain the recently observed astrophysical anomalies: 130 GeV gamma-ray line from the Galactic Center, and 7 keV X-ray line from galaxy clusters. This talk is based on [1301.7536] and [1403.6621].

SUSY Phenomenology / 151

Hunting light SUSY: combined impact of LHC searches

Dr. ROLBIECKI, Krzysztof [1]; Dr. SAKURAI, Kazuki [2]; Dr. KIM, Jong Soo [1]; Dr. TATTERSALL, Jamie [3]

[1] *IFT Madrid*

[2] *King's College London*

[3] *Uni Heidelberg*

Corresponding Author: krzysztof.rolbiecki@desy.de

We discuss a possible explanation of a slight excess in the WW cross section measurement performed by ATLAS and CMS. While still consistent with the Standard Model within 1-2 sigma, the excess could be also a first hint of physics beyond the Standard Model. We argue that this effect could be attributed to the production supersymmetric particles, eg. stops or charginos. The stops of mass ~200 GeV has the right cross section and under some assumptions can significantly contribute to the final state of two leptons and missing energy. Using CheckMATE and ATOM, the automated packages for comparing BSM models with experimental data, we scan this region of parameter space to find particle masses preferred by Standard Model measurements (WW and WZ production) and SUSY searches. We propose kinematic observables that could distinguish supersymmetric signal from the Standard Model contribution, as well as differentiate between various supersymmetric processes.

Precision SUSY / 153

Searches for Signatures of R-Parity Violating Models in ATLAS

Prof. ERNST, Jesse [1]

[1] *SUNY Albany*

Corresponding Author: jae@albany.edu

In R-parity violating supersymmetric scenarios sparticles can be produced individually or in pairs with signatures that may be detectable at the LHC. This talk presents recent results from searches for resonant production and R-parity violating prompt signatures in multi-lepton and multi-jet final states in the data sample recorded by the ATLAS detector in 2012.

Formal SUSY and Strings / 154

M-brane dynamics and free energy of D=3 superconformal field theories

Prof. KIM, Nakwoo [1]; Dr. GANG, Dongmin [2]; Prof. LEE, Sangmin [3]

[1] *Kyung Hee University*

[2] *Korea Institute for Advanced Study*

[3] *Seoul National University*

Corresponding Author: nkim@khu.ac.kr

A peculiarity of M-theory when combined with gauge/gravity duality is that the free energy of the gauge theory on M2 and M5-branes follow a power law: N^{3/2} for M2, and N^3 for M5 when the number of branes N becomes large. This property has been considered mysterious for many years, but thanks to recent progress we now have a sound understanding and also semi-microscopic derivations of the scaling behaviors quoted above. Here we present field theory computations at large N in particular, and illustrate how the results come out in agreement with the prediction of AdS/CFT including coefficients.

Models of SUSY / 155

Non-standard Higgs decays in the U(1)′ extensions of the MSSM

Dr. ATHRON, Peter [1]; Dr. NEVZOROV, Roman [1]; Prof. WILLIAMS, Anthony [1]

[1] *University of Adelaide*

Corresponding Author: peter.athron@adelaide.edu.au

$U(1)$ extensions of the minimal supersymmetric (SUSY) standard model (MSSM) there can solve the μ-problem of the MSSM and give extra F and D term contributions to the Higgs mass. For such models there is a simple mechanism that splits the $Z^\prime$ mass from the SUSY scale allowing for sfermions which are significantly lighter that the Z' mass. This mechanism can also result in light pseudoscalar state, allowing the $125\,\mbox{GeV}$ SM-like Higgs boson to decay into a pair of such pseudoscalars. We study these decays within E_6 inspired SUSY models with exact custodial symmetry that forbids tree-level flavor-changing transitions and the most dangerous baryon and lepton number violating operators. We find that the branching ratio of the lightest Higgs boson decaying into a pair of light pseudoscalar states can be large.

Precision SUSY / 156

Next-to-Minimal SOFTSUSY

Prof. ALLANACH, Ben [1]; Mr. VOIGT, Alex [2]; Dr. TUNSTALL, Lewis [3]; Prof. WILLIAMS, Anthony [4]; Dr. ATHRON, Peter [4]

[1] *University of Cambridge*

[2] *TU Dresden*

[3] *University of Bern*

[4] *University of Adelaide*

Corresponding Author: peter.athron@adelaide.edu.au

We introduce the Next-to-Minimal extension of the SOFTSUSY~program which calculates the sparticle spectrum in the Next-to-Minimal Supersymmetric Standard Model (NMSSM). The NMSSM is an extension of the Minimal Supersymmetric Standard Model (MSSM) with one additional singlet superfield, which can solve the mu-problem of the MSSM and help ameliorate the little hierarchy problem. SOFTSUSY can calculate the spectrum for both the Z3 conserving and Z3 violating cases.

SUSY Phenomenology / 157

The general NMSSM with a mixed Higgs sector and an implication of light higgsinos

Dr. JEONG, Kwang Sik [1]; Mr. SHOJI, Yutaro [2]; Prof. YAMAGUCHI, Masahiro [3]

[1] *DESY*

[2] *Tohoku Univ.*

[3] *Tohoku University*

Corresponding Author: yshoji@tuhep.phys.tohoku.ac.jp

One of the most important outcomes of the experiments at the LHC is the Higgs mass, which turned out to be slightly heavier than naive expectation in the Minimal Supersymmetric Standard Model (MSSM). It might imply that the stop masses are heavy and the Higgs sector is fine-tuned. However, an alternative possibility is that there is an additional singlet supermultiplet and the Higgs mass is raised with a new F-term potential and/or a mixing with the singlet. In this case, it is still possible to consider the case that all the particles that are related to the Higgs sector are lighter than 1TeV. Thus we concentrate on this possibility.
We examine a general extension of the MSSM with one singlet (General NMSSM.) Especially we consider the case that the Higgs mass is raised mainly by the mixing effects. This is one of the most interesting regions of the general NMSSM because another boson is discoverable and the Higgs signal strengths are deviated from the standard model expectations. Furthermore the mixing effect is \tan\beta insensitive, whereas the F-term contribution is large only in the low \tan\beta region.
With the above setup, we find that the higgsinos tend to be light especially at large \tan\beta. Thus the parameter region is further constrained by the LEP search for charginos. Combining this and the LHC constraints on the Higgs signal strengths, we observe that the mixing angles are much constrained and the future measurements of the Higgs signal strengths can cover much of the parameter region. Our result is applicable to a more specific case such as the Z_3 invariant NMSSM and the nearly-MSSM. The only difference is that there are additional constraints on the parameter space.

Precision SUSY / 158

FlexibleSUSY - A spectrum generator generator for supersymmetric models

Mr. VOIGT, Alexander [1]; Dr. ATHRON, Peter [2]; Dr. PARK, Jae-hyeon [3]; Prof. STÖCKINGER, Dominik [1]

[1] *TU Dresden*

[2] *University of Adelaide*

[3] *University of Valencia*

Corresponding Author: alexander.voigt@physik.tu-dresden.de

After the discovery of a 125 GeV Higgs boson at the LHC and the increasing lower mass limits on supersymmetric particles, non-minimal alternatives to the MSSM, such as the NMSSM, USSM, E6SSM etc., are highly relevant. So it is very important to facilitate easier exploration of such models.

In this talk the spectrum generator framework FlexibleSUSY is presented, which creates a very fast, modular C++ spectrum generator for any SUSY model specified by the user. Previously the only available option for many models was the SPheno-like Fortran code generated by SARAH. FlexibleSUSY provides Mathematica meta code, which takes SARAH-generated RGEs, self-energies and tadpoles and creates a fast and modular C++ spectrum generator. It allows for great flexibility and easy adaptability at both the meta-code and the C++ level.

Quark Flavour Violation / 159

Flavour constraints on extended GMSB models

Dr. JELINSKI, Tomasz [1]

[1] *University of Silesia*

Corresponding Author: tomasz.jelinski@us.edu.pl

It is known that superpotential couplings between messenger sector and MSSM matter fields can significantly change phenomenology of the standard GMSB models. Those interactions not only give rise to A-terms and soft masses but also can lead to large FCNC effects. In this talk, we shall discuss examples of SU(5) unification models in which messengers couple to all generations of MSSM matter and confront predictions of such scenarios with low-energy flavour observables. Emerging constraints on messengers couplings will be presented.

Quark Flavour Violation / 160

The Flavour of Natural SUSY

BRUEMMER, Felix [1]

[1] *SISSA Trieste*

Corresponding Author: fbruemmer@sissa.it

An inverted mass hierarchy in the squark sector, as in so-called "natural supersymmetry", requires non-universal boundary conditions at the mediation scale of SUSY breaking. In this talk I will present a formalism to define such boundary conditions in a basis-independent manner, and apply it to natural SUSY scenarios with a high mediation scale. I will show that many generic scenarios with inverted squark mass hierarchies are in fact minimally flavour violating, or run towards a minimally flavour violating structure at low energies, and thus automatically evade flavour physics constraints.

Higgs Phenomenology / 161

SM Higgs Combination and Higgs Properties Measurements in ATLAS

Mr. YOSHIHARA, Keisuke [1]

[1] *The University of Tokyo*

Corresponding Author: keisuke.yoshihara@cern.ch

The discovery of a Higgs boson with a mass of approximately 126 GeV in 2012 at the LHC has opened up a new era in understanding the nature of electroweak symmetry breaking and possibly completing the standard model of particle physics.
The major focus of physics analysis at the LHC now is the measurement of the properties of the Higgs boson. The latest combined results are presented using the γγ, ZZ, WW, ττ, and bb channels, with the full run1 collision data recorded by the ATLAS detector at the LHC.

Higgs Phenomenology / 162

Complementarity between precision Higgs physics and direct searches for non-standard Higgs Bosons

Prof. WAGNER, Carlos [1]; Prof. HABER, Howard [2]; Prof. CARENA, Marcela [3]; Dr. SHAH, Nausheen [4]; Dr. LOW, Ian [5]

[1] *University of Chicago and Argonne National Lab*

[2] *UC, Santa Cruz*

[3] *Fermilab and University of Chicago*

[4] *University of Michigan*

[5] *Northwestern Univ and Argonne National Laboratory*

Corresponding Author: elcwagner@gmail.com

We analyze the bounds on the CP-odd Higgs boson coming from precision measurements of the properties of the recently discovered Higgs boson. We discussed the dependence on these bounds on the soft supersymmetry breaking parameters and compared these bounds with the ones obtained from direct searches for non-standard Higgs bosons. We show that there is an interesting complementarity between the bounds that may be obtained from the two methods and comment on recent experimental results.

Precision SUSY / 163

Precise Estimates of the Higgs Mass in Heavy SUSY scenarios

Prof. WAGNER, Carlos [1]; Dr. DRAPER, Patrick [2]; Dr. LEE, Gabriel [3]

[1] *University of Chicago and Argonne National Laboratory*

[2] *UC, Santa Cruz*

[3] *University of Chicago*

Corresponding Author: elcwagner@gmail.com

In supersymmetric models, very heavy stop squarks introduce large logarithms into the computation of the Higgs boson mass. We calculate three- and four-loop next-to-next-to-leading-log corrections to the Higgs mass and compare the fixed order formulas numerically to the resummation results in order to estimate the range of supersymmetry scales where the fixed-order results are reliable. We find that the four-loop result may be accurate up to a few tens of TeV. We confirm an accidental cancellation between different three-loop terms and show that it persists to higher scales and becomes more effective with the inclusion of higher radiative corrections. Existing partial three-loop calculations that include only one of the two cancelling terms may overestimate the Higgs mass. We give analytic expressions for the three- and four-loop corrections in terms of Standard Model and the soft SUSY breaking parameters, and discuss what happens for low values of the CP-odd Higgs mass.

Models of SUSY / 164

Impact of precision measurements for dark matter constraints

Dr. MOORTGAT-PICK, Gudrid [1]

[1] *IPPP, Durham University*

Corresponding Author: g.a.moortgat-pick@durham.ac.uk

We study SUSY models in the context of LHC searches and LHC exclusion bounds and explore models in the parameter range that are accessible at the future runs of the LHC and at a future Linear Collider. We study the impact of precision measurements of masses, cross sections and further observables, for instance as forward-backward asymmetries, to determine the fundamental SUSY parameters for dark matter predictions. We perform our dark matter predictions from the model-independent parameter determination at full one-loop order corrections and study which experimental observables are most powerful with regard to the dark matter constraints. Different SUSY models, MSSM, NMSSM etc. have been investigated and we also include challenging scenarios, as for instance light higgsino-like scenarios, in our study. The expected prospects at a high luminosity LHC as well as at a future ILC are discussed.

Quark Flavour Violation / 165

Light Up-Type Squarks in the MSSM

Mr. WLOTZKA, Alexander [1]; Prof. MUHLLEITNER, Margarete [1]; Dr. POPENDA, Eva [2]; Ms. GROBER, Ramona [1]

[1] *Institute for Theoretical Physics, Karlsruhe Institute of Technology, D-76128 Karlsruhe*

[2] *Paul Scherrer Institut, CH-5232 Villingen PSI, Switzerland*

Corresponding Author: alexander.wlotzka@student.kit.edu

Due to large mixing in the stop sector, one up-type squark can become rather light. If the mass difference of the lightest up-type squark and the lightest neutralino is sufficiently small, both the decay of the lightest up-type squark into a top quark and the neutralino and the decay into a W boson, a bottom quark and the neutralino are kinematically suppressed.
We present the calculation of the decay width of the lightest up-type squark in the MSSM with a general flavor structure in two different decay modes which are important in this regime: the flavor changing neutral current two-body decay into a charm- or an up-quark and the neutralino with SUSY-QCD NLO corrections and the four-body decay into three Standard Model fermions and the neutralino with masses of third generation fermions taken into account in the final states.

Higgs Phenomenology / 166

NMSSM Higgs Boson Search at the High-Energy Large Hadron Collider

Prof. MUEHLLEITNER, Milada Margarete [1]; Prof. KING, Steve F. [2]; Dr. NEVZOROV, Roman [3]; Mrs. WALZ, Anne-Kathrin [1]

[1] *Karlsruhe Institute for Technology*

[2] *University of Southampton*

[3] *University of Adelaide*

Corresponding Author: milada.muehlleitner@kit.edu

After the discovery of the Higgs boson with mass around 126 GeV it has to be investigated if it is the Standard Model (SM) Higgs boson or the Higgs boson of extensions beyond the SM (BSM). Among these, supersymmetry (SUSY) belongs to the most popular and most intensely studied BSM theories. The Higgs sector of the Next-to-Minimal Supersymmetric Extension (NMSSM) consists of seven Higgs bosons, two charged Higgs bosons, three neutral CP-even and two CP-odd Higgs bosons. We investigate the discovery prospects of the NMSSM Higgs bosons at the high-energy option of the Large Hadron Collider (LHC). While one of the neutral Higgs bosons is demanded to have a mass around 126 GeV and SM-like properties, there can be substantially lighter Higgs bosons which have not been excluded yet by LEP or the 8 TeV run of the LHC. The decays of the heavier Higgs bosons or the SM-like resonance into a pair of light Higgs states which subsequently decay into other SM particles can lead to interesting signatures that can be investigated at the high-energy and high-luminosity run of the LHC. Furthermore, the discovery signatures of the very light and the heavy Higgs bosons directly decaying into SM final state particles will be analysed.

Particle Cosmology / 167

Flavour Covariance in Semi-Classical and Field-Theoretic Transport Phenomena

Dr. MILLINGTON, Peter [1]; Prof. PILAFTSIS, Apostolos [1]; Dr. DEV, Bhupal [1]; Mr. TERESI, Daniele [1]

[1] *University of Manchester*

Corresponding Author: pwm@hep.manchester.ac.uk

In arXiv: 1404.1003, we develop a fully flavour-covariant formalism for transport phenomena. A significant and novel element of this formulation is the inclusion of rates that carry higher-rank tensorial structure in flavour space. In this talk, we illustrate the necessary appearance of such rates by means of a generalization of the optical theorem, making connection with the unitarity cuts of partial non-equilibrium self-energies. In addition, we describe the flavour-covariant canonical quantization of spinor fields in the presence of spatially-inhomogeneous and time-dependent statistical backgrounds. Finally, we highlight the need for thermally-corrected real intermediate state (RIS) subtraction and comment on potential implications of our approach for quasi-particle approximations in the field-theoretic transport equations of the Schwinger-Keldysh Kadanoff-Baym formalism.

Higgs Phenomenology / 168

Precision Measurements of Higgs Couplings and their Implications for New Physics Scales

Prof. MUEHLLEITNER, Milada Margarete [1]; Prof. ENGLERT, Christoph [2]; Prof. FREITAS, Ayres [3]; Prof. PLEHN, Tilman [4]; Dr. RAUCH, Michael [1]; Dr. SPIRA, Michael [5]; Mrs. WALZ, Anne-Kathrin [1]

[1] *Karlsruhe Institute for Technology*

[2] *University of Glasgow*

[3] *University of Pittsburgh*

[4] *University of Heidelberg*

[5] *Paul Scherrer Institute*

Corresponding Author: milada.muehlleitner@kit.edu

The measurements of the properties of the recently discovered Higgs boson show good agreement with the predictions from the Standard Model. The currently large uncertainties on the Higgs couplings will be improved in the high-energy and high-luminosity phase of the LHC as well as at a future Higgs factory, so that small deviations in the Higgs couplings may manifest themselves. In this talk typical new physics scenarios shall be reviewed that lead to observable modifications of the Higgs interactions. The coupling deviations in the various models will be related to their effective new physics scale, revealing that with percent level precision the Higgs coupings will be sensitive to the multi-TeV regime.

Lepton Flavour Violation and Neutrinos / 171

The Fermilab Muon g-2 Experiment

Prof. HENRY, Samuel [1]

[1] *Oxford University*

Corresponding Author: lkg5@cornell.edu

The anomalous magnetic dipole moment of the muon can be both measured and computed to very high precision, making it a powerful probe to test the standard model and search for new physics such as SUSY. The previous measurement by the Brookhaven E821 experiment found a 3.6 standard deviation discrepancy from the predicted value. The new g-2 experiment at Fermilab will improve the precision by a factor of four through a factor of twenty increase in statistics and a reduced systematic uncertainty with an upgraded apparatus. The experiment will also carry out an improved measurement of the muon electric dipole moment. Construction at Fermilab is well underway.

Precision SUSY / 172

Searches for SUSY in Final States with Photons in ATLAS

KUHL, Andrew [1]

[1] *University of California Santa Cruz*

Corresponding Author: andrew.kuhl@cern.ch

Several Gauge mediated supersymmetry breaking scenarios predict final states characterized by the presence of photons. This talk presents recent ATLAS results for inclusive searches for supersymmetry in final states containing photons with missing transverse momentum, jets and/or light leptons. Both weak and strong production processes are searched for.

Higgs Phenomenology / 173

Can the Hbb coupling be equal in magnitude to its SM value but opposite in sign?

HABER, Howard [1]; GUNION, John [2]; FERREIRA, Pedro [3]; SANTOS, Rui [3]

[1] *University of California, Santa Cruz*

[2] *U.C. Davis*

[3] *Universidade de Lisboa*

Corresponding Author: haber@scipp.ucsc.edu

We consider the two-Higgs-doublet model as a framework in which to evaluate the viability of scenarios in which the sign of the Hbb coupling is opposite to that of the Standard Model (SM), while at the same time all other tree-level couplings are close to their SM values. Whereas such a scenario is consistent with current LHC observations, both future running at the LHC and the ILC could determine the sign of the Hbb coupling. Discrimination is possible due to the interference between the b-quark and t-quark loop contributions to the ggh coupling. In addition, the charged-Higgs loop contribution to the amplitude for Higgs decay to two photons is large and fairly constant up to the largest charged-Higgs mass allowed by tree-level unitarity bounds when the Hbb coupling has the opposite sign from that of the SM.

Lepton Flavour Violation and Neutrinos / 174

New Production Mechanism for Heavy Neutrinos at the LHC

Dr. DEV, Bhupal [1]; Prof. PILAFTSIS, Apostolos [1]; Dr. YANG, Un-ki [1]

[1] *University of Manchester*

Corresponding Author: bhupal.dev@hep.manchester.ac.uk

We discuss a new production mechanism for heavy neutrinos at the LHC, which is infrared-enhanced by t-channel W-photon fusion processes, and dominates over the usually considered s-channel W-exchange diagram for heavy-neutrino masses larger than 100-200 GeV. This has important implications for the ongoing heavy neutrino searches at the LHC, complementary to their low-energy Lepton Flavor Violation searches. The scope of this new mechanism can as well be extended to other exotic searches at the LHC.

Higgs Phenomenology / 175

SM Higgs in Boson Decay Modes in ATLAS

Ms. TIOUCHICHINE, Elodie [1]

[1] *CPPM - CNRS/IN2P3 et Aix-Marseille Université (FR)*

Corresponding Author: elodie.tiouchichine@cern.ch

Standard model Higgs
ATLAS
boson decay mode

Quark Flavour Violation / 176

Searching for the Beyond Standard Model effects in $b\to c \ell \nu$ transitions

NISANDZIC, Ivan [1]

[1] *Institute Jozef Stefan Ljubljana*

Corresponding Author: ivan.nisandzic@ijs.si

There is the two years old BaBar's hint of the disagreement with the Standard Model predictions for the branching ratios in the decays $B \to D^{(*)} \tau \nu$. We study, in the model independent way, the angular distributions that could reveal the effects which are not seen in the total decay rates. We also note some of the possible implications of the the BaBar's puzzle for the particular New Physics models.

Alternative Theories / 177

Conformal Extensions of the Standard Model with Veltman Conditions

Mr. MOJAZA, Matin [1]; Prof. SANNINO, Francesco [2]; Dr. ANTIPIN, Oleg [3]

[1] *CP3-Origins*

[2] *CP3-Origins, University of Southern Denmark*

[3] *INFN, Firenze, Italy*

Corresponding Author: mojaza@cp3-origins.net

A new relevant class of perturbative models involving elementary scalars is proposed in which the theory simultaneously satisfies the Veltman conditions and is conformal at the classical level. These are so-called perturbative natural conformal (PNC) theories. I will show that PNC models are very constrained and thus highly predictive. Among several PNC examples, we have discovered a remarkably simple PNC extension of the standard model in which the Higgs is predicted to have the experimental value of the mass equal to 126 GeV. This model also predicts the existence of one more standard model singlet scalar boson with a mass of 541 GeV and the Higgs self-coupling to emerge radiatively. Other PNC examples generally predict a somewhat smaller mass of the Higgs.
These results can be a useful guide when building extensions of the standard model featuring fundamental scalars.

Particle Cosmology / 178

Long-Lived stop at the LHC with or without R-parity

Mr. DRADI, Federico [1]; Prof. COVI, Laura [2]

[1] *Goettingen university*

[2] *Goettingen University*

Corresponding Author: federico.dradi@theorie.physik.uni-goettingen.de

We consider scenarios of gravitino LSP and DM with stop NLSP both within R-parity conserving and R-parity violating supersymmetry (RPC and RPV SUSY, respectively).
We discuss cosmological bounds from Big Bang Nucleosynthesis (BBN) and the gravitino abundance and then concentrate on the signals of long-lived stops at the LHC as displaced vertices or metastable particles.
Finally we discuss how to distinguish R-parity conserving and R-parity breaking stop decays if they happen within the detector and suppress SM backgrounds.

Particle Cosmology / 179

The Gravitational Wave Background and Higgs False Vacuum Inflation

Dr. MASINA, Isabella [1]

[1] *University of Ferrara*

Corresponding Author: masina@fe.infn.it

For a narrow band of values of the top quark and Higgs boson masses, the Standard Model Higgs potential develops a shallow local minimum at energies of about 10^16 GeV, where primordial inflation could have started in a cold metastable state. For each point of that band, the highness of the Higgs potential at the false minimum is calculable, and there is an associated prediction for the inflationary gravitational wave background, namely for the tensor to scalar ratio r. We show that the recent measurement of r by the BICEP2 collaboration, r=0.16+0.06−0.05 at 1σ, combined with the most up-to-date measurements of the top quark and Higgs boson masses, reveals that the hypothesis that a Standard Model shallow false minimum was the source of inflation in the early Universe is viable.

Alternative Theories / 180

LHC signals and dark matter in the SO(5)xU(1) gauge-Higgs unification

Prof. HOSOTANI, Yutaka [1]

[1] *Osaka University*

Corresponding Author: hosotani@phys.sci.osaka-u.ac.jp

Signatures of the SO(5) x U(1) gauge-Higgs unification at 14 TeV LHC are presented.
The Kaluza-Klein (KK) mass spectra of $¥gamma, Z, Z_R$ and the Higgs self-couplings
obey universality relations with the Aharonov-Bohm (AB) phase $¥theta_H$ in the fifth dimension. The current data at low energies and at LHC indicate $¥theta_H <0.2$.
Three neutral gauge bosons, the first KK modes $Z_R^{(1)}$, $Z^{(1)}$, and
$¥gamma^{(1)}$, appear as Z' bosons in dilepton events at LHC.
For $¥theta_H = 0.114$, the mass and decay width of $Z_R^{(1)}$, $Z^{(1)}$, and
$¥gamma^{(1)}$ are (5.73¥,TeV, 482¥,GeV), (6.07¥,TeV, 342¥,GeV),
and (6.08¥,TeV, 886¥,GeV), respectively. For $¥theta_H = 0.073$ their masses are 8.00¥,TeV$¥sim$8.61¥,TeV.
An excess of events in the dilepton invariant mass
should be observed in the Z' search at the upgraded LHC at 14$¥,$TeV.

Furthermore the neutral components of n_F
$SO(5)$-spinor fermions (dark fermions), relevant for having
the observed unstable Higgs boson, become the dark matter of the universe.
We show that the relic abundance of the dark matter determined by WMAP and Planck data
is reproduced, below the bound placed by the direct detection observation.

Refs: arXiv:1404.2748 [hep-ph] and one paper in preparation.

Formal SUSY and Strings / 181

Spectral flow as a map between N=(2,0)-models

Mr. ATHANASOPOULOS, Panagiotis [1]

[1] *University of Liverpool*

Corresponding Author: panos@liv.ac.uk

We explain how the spectral flow operator normally acting within a general (2,2) theory can be used as a map between (2,0) models. The space of (2,0) models is of particular interest among all heterotic-string models for two important reasons: i)N=1 spacetime SUSY requires (2,0) superconformal invariance and ii)models with the minimal SO(10) unification structure, which is well motivated by the Standard Model of particle physics data, are of this type. This idea was inspired by a new symmetry in the space of fermionic Z2×Z2 heterotic-string models that exchanges the spinors and vectors of the SO(10) GUT group, dubbed spinor-vector duality. Such symmetries are important for the understanding of the landscape of string vacua and ultimately for the possible operation of a dynamical vacuum selection mechanism in string theory. We will describe how to generalize these ideas to arbitrary internal Conformal Field Theories (CFTs).

Higgs Phenomenology / 182

Higgs physics with effective dimension-six operators: the safest route to BSM islands

RIVA, Francesco [1]; Dr. GUPTA, Rick Sandeepan [2]

[1] *EPFL*

[2] *IFAE Barcelona*

Corresponding Author: francesco.riva@epfl.ch

In the absence of direct discoveries, physics Beyond the Standard Model (BSM) can be parametrized by an effective field theory as an expansion in inverse powers of the New Physics scale.
This expansion serves as a guide for precision searches. In fact, the leading term in this expansion coincides with the SM: its symmetries and relations are well known and are being tested at colliders. In this talk I discuss the next order in the expansion, that parametrize the largest effects that can be expected from physics BSM. I will show that many relations persist, implying that not all the observables that we experimentally test are independent. For example, deviations in the differential distribution of h->Vff decays, are correlated with deformations of the couplings of vectors to fermions, that are already well measured at LEP.

Lepton Flavour Violation and Neutrinos / 183

Lepton Number Violation with Dirac Neutrinos

Mr. HEECK, Julian [1]

[1] *Max Planck Institute for Nuclear Physics, Heidelberg*

Corresponding Author: julian.heeck@mpi-hd.mpg.de

We point out that lepton number violation is possible even if neutrinos are of Dirac type, and construct a simple renormalizable model that leads to $\Delta L = 4$. We identify the signature low-energy decay of this new framework as neutrinoless quadruple beta decay and present potential candidate isotopes. In addition, an accompanying leptogenesis mechanism will be discussed that differs qualitatively from standard Dirac leptogenesis.

Models of SUSY / 184

Triplet extension of the MSSM: Higgs physics and Dark Matter

NARDINI, Germano [1]; ARINA, Chiara [2]; DELGADO, Antonio [3]; MARTIN LOZANO, Victor [4]; QUIROS, Mariano [5]

[1] *DESY*

[2] *Institut d'Astrophysique de Paris*

[3] *Univ. of Notre Dame*

[4] *Univ. Autonoma Madrir*

[5] *IFAE*

Corresponding Author: germano.nardini@desy.de

The Triplet extension of the MSSM (TMSSM) alleviates the little hierarchy problem and can provide SM-like Higgs signatures even in the presence of a rather light CP-odd Higgs. It is also compatible with enhancements in the gamma+gamma and gamma+Z decays of the CP-even Higgs. In this talk we review these issues. In particular we quantify the above loop-induced enhancements, and we determine how they are reduced once the lightest neutralino is assumed to be the dark matter particle.

Formal SUSY and Strings / 185

Monopole-vortex complex at large distances: new steps for elucidating the mysteries of nonAbelian duality

Prof. KONISHI, Kenichi [1]

[1] *University of Pisa and INFN, Pisa*

Corresponding Author: konishi@df.unipi.it

We discuss the large-distance approximation of the monopole-vortex complex soliton in a hierarchically broken gauge system, SU(N+1) \to SU(N) \to 1, in a color-flavor locked SU(N) symmetric vacuum. The ('t Hooft-Polyakov) monopole of the higher-mass-scale breaking appears as a point and acts as a source of the thin vortex generated by the lower-energy gauge symmetry breaking. The exact color-flavor diagonal symmetry of the bulk system is broken by each individual soliton, leading to nonAbelian orientational CP^{N-1} zeromodes propagating in the vortex worldsheet, well studied in the literature. As the vortex ends at the monopoles these fluctuating modes endow the monopoles with a local SU(N) charge. This phenomenon is studied by performing the duality transformation in the presence of the CP^{N-1} moduli space. The result is an effective action is a CP^{N-1} model defined on a finite-width worldstrip, in which the pointlike monopoles at the boundaries appear as the source and sink of the massless CP^{N-1} fluctuations. Our construction seems to explain the appearance of nonAbelian monopoles in various degenerate singularities of N=2 supersymmetric gauge theories.

Particle Cosmology / 186

Inert Dark Matter in Type-II Seesaw

Dr. NOMURA, Takaaki [1]; Prof. CHEN, Chuan-Hung [1]

[1] *National Cheng-Kung University*

Corresponding Author: nomura@mail.ncku.edu.tw

Weakly interacting massive particle (WIMP) as a dark matter (DM) candidate is further inspired by recent AMS-02 data, which confirm the excess of positron fraction observed earlier by PAMELA and Fermi-LAT experiments. Additionally, the excess of positron+electron flux is still significant in the measurement of Fermi-LAT. For solving the problem of massive neutrinos and observed excess of cosmic-ray by DM annihilation, we study the model with an inert Higgs doublet (IHD) in the framework of type-II seesaw mechanism by imposing a Z_2 symmetry on the IHD, where the lightest particle of IHD is the DM candidate while the neutrino masses origin from the Higgs triplet in type-II seesaw model. We calculate the cosmic-ray production in our model by using three kinds of neutrino mass spectra, classified as normal ordering, inverted ordering and quasi-degeneracy. We find that if leptonic triplet decays are dominant, the observed excess of positron/electron flux could be explained well in normal ordered neutrino mass spectrum, when the constraints of DM relic density and comic-ray antiproton spectrum are taken into account. Moreover, excess of comic-ray neutrinos is implied in our model. We find that our results on $\langle \sigma v \rangle$ are satisfied with and close to the upper limit of IceCube analysis. More data from comic-ray neutrinos could test our model.

Quark Flavour Violation / 187

Rare Top-quark decays to Higgs boson in the MSSM

Prof. DEDES, Athanasios [1]; Prof. ROSIEK, Janusz [2]; Prof. TAMVAKIS, Kyriakos [3]; Dr. SUXHO, Kristaq [3]; Dr. PARASKEVAS, Michalis [3]

[1] *University of Ioannina, Greece*

[2] *University of Warsaw, Poland*

[3] *University of Ioannina*

Corresponding Author: adedes@cc.uoi.gr

In full one-loop generality, and under the light of the recent LHC constraints on
Higgs boson mass and B-physics observables,
we study, $t\to q\, h$, $q=u,c$ top-quark
FCNC decay processes in the MSSM with R-parity conservation. Our results are
presented assuming either degenerate or hierarchical squark flavour structure.

Alternative Theories / 189

Constraining new coloured matter from the ratio of 3- to 2-jets cross sections at the LHC

Dr. GILLIOZ, Marc [1]; Dr. NARDECCHIA, Marco [2]; Prof. SANNINO, Francesco [1]; Dr. SPANNOWSKY, Michael [3]; Dr. BECCIOLINI, Diego [1]

[1] *CP3-Origins, University of Southern Denmark*

[2] *DAMTP Cavendish Laboratory, University of Cambridge*

[3] *IPPP, Durham University*

Corresponding Author: becciolini@cp3.dias.sdu.dk

The Large Hadron Collider experiments are testing the evolution of the strong coupling αs up to the TeV scale. We show that the ratio of 3- to 2-jets cross sections provides a good determination of αs, even in the presence of new physics. The experimental measurements can then be used to place a model-independent bound on new particles carrying QCD colour charge and can constrain such states to be heavier than a few hundred GeVs.

Alternative Theories / 190

Searches for BSM Physics in Events with Top Quarks in ATLAS

Dr. ZHONG, Jiahang [1]

[1] *University of Oxford*

Corresponding Author: jiahang.zhong@cern.ch

Due to its heavy mass, top quarks are often expected among the decay products of heavy BSM particles. The unique decay pattern of the top quarks also make them great probe for new physics. In this talk, I present the latest results from the ATLAS collaboration, on a wide range of searches in the final states with top quarks. These include searches for top pair resonance, top-bottom resonance, as well as heavy quarks.

Lepton Flavour Violation and Neutrinos / 191

Search for Sterile Neutrinos by the MINOS Long-baseline Neutrino Experiment

Dr. BLAKE, ANDREW [1]

[1] *CAMBRIDGE UNIVERSITY*

Corresponding Author: blake@hep.phy.cam.ac.uk

MINOS is a long-baseline neutrino oscillation experiment operated at the Fermi Laboratory, USA. The experiment is situated along the central axis of the NuMI accelerator neutrino beam, and comprises two kiloton-scale steel-scintillator detectors, located 1km and 735km downstream of the beam target. Since its start-up in 2005, the NuMI beam facility has delivered in excess of 15e20 protons-on-target, enabling MINOS to perform precision measurements of neutrino oscillations. MINOS is the only long-baseline experiment exposed to a wide-band accelerator beam and therefore able to measure neutrino oscillations over a broad range of energies. This enables MINOS to perform searches for new physics beyond the standard model of neutrino oscillations. In particular, MINOS is sensitive to sterile neutrinos in the regions of parameter space favoured by the LSND and MiniBooNE experiments. In this talk, I will present the latest sterile neutrino results from MINOS, based on a 3+1 model. I will also preview the sensitivity of the next phase of the experiment, MINOS+, which has recently begun operating in the higher-intensity and higher-energy NuMI beam.

Precision SUSY / 192

The ${\cal O}(\alpha_s\alpha_t)$ Corrections to the Higgs Masses in the Complex NMSSM

DAO, Thi Nhung [1]; MUEHLLEITNER, Margarete [1]; RZEHAK, Heidi [2]; WALZ, Kathrin [1]

[1] *ITP, KIT*

[2] *University of Freiburg*

Corresponding Author: thi.dao@kit.edu

The calculation and results of the ${\cal O}(\alpha_s\alpha_t)$ Corrections to the Higgs Masses in the NMSSM will be presented.
Our results are computed the complex NMSSM, in which all possible complex phases can appeares. This QCD contribution is important to reduce theoretical uncertainty and improve prediction of the NMSSM Higgs Masses.

Quark Flavour Violation / 193

Searches for BSM Physics in Rare B-Decays (CMS)

MARGONI, Martino [1]

[1] *Universita` di Padova and INFN*

Corresponding Author: martino.margoni@pd.infn.it

Rare B decays are an excellent laboratory for the search for physics beyond the Standard Model. In the last few years several new measurements from LHC and B-Factories experiments have been released with impressive experimental precision. In this talk, the most recent measurements of Rare B-Decays from the CMS collaboration will be reviewed. After a brief theoretical introduction, some details on the experimental strategy and on the analyses technique will be reported. Particular emphasis will be dedicated to the comparison of the experimental results with the predictions of the Standard Model as well of new physics models.

Formal SUSY and Strings / 195

Localization on four-manifolds, Casimir energy and gravity duals

Dr. CASSANI, Davide [1]

[1] *King's College London*

Corresponding Author: davide.cassani@kcl.ac.uk

I will consider supersymmetric gauge theories on a manifold with topology S^1 x S^3, allowing for a general class of metrics. I will present the exact computation of the partition function for these theories using localization of the path integral. The result reproduces the supersymmetric index, and includes a normalization factor that can be interpreted as a Casimir energy. The latter gives the leading order contribution in a large N expansion, and therefore provides a prediction for the on-shell action of dual gravity solutions.

SUSY Phenomenology / 196

Constraining Supersymmetry using the relic density and the Higgs boson

RAUCH, Michael [1]; HENROT-VERSILLÉ, Sophie [2]; LAFAYE, Rémi [3]; PLEHN, Tilman [4]; ZERWAS, Dirk [5]

[1] *ITP, Karlsruhe Institute of Technology*

[2] *LAL*

[3] *CNRS Annecy*

[4] *ITP Heidelberg*

[5] *Universite de Paris-Sud 11*

Corresponding Author: michael.rauch@kit.edu

Recent measurements by Planck, the LHC experiments and dark matter direct detection experiments yield significant constraints on supersymmetric models and their parameters. Illustrating first the impact on the mSUGRA/CMSSM parameter space, we then go beyond and perform a detailed analysis of the general MSSM with 13 free parameters. Using the SFitter tool, Bayesian and Frequentist approaches are applied and their results compared. We will show how the remaining allowed regions emerge from different mechanisms of dark matter annihilation in combination with the light Higgs mass prediction.

Lepton Flavour Violation and Neutrinos / 197

keV sterile neutrinos model building

Dr. NIRO, Viviana [1]

[1] *University of Barcelona*

Corresponding Author: viviana.niro@gmail.com

Sterile neutrinos of keV scale are a well motivated candidate for Warm Dark Matter. I'll review the cosmological and astrophysical implications of keV sterile neutrinos. Then, I'll discuss the current models present in the literature, that are able to explain a sterile mass pattern with one neutrino at the keV scale and the other two considerably heavier. Finally, I'll present a new production mechanism for keV sterile neutrino Dark Matter from the decay of a frozen-in scalar.

Lepton Flavour Violation and Neutrinos / 198

Latest result and future prospect of MEG

Dr. SAWADA, Ryu [1]

[1] *ICEPP, the University of Tokyo*

Corresponding Author: sawada@icepp.s.u-tokyo.ac.jp

Lepton flavor violating processes of charged particles (CLFV) are forbidden in the standard model of elementary particle physics. The muon rare decay $\mu \rightarrow e\gamma$ is a CLFV process and has never been observed significantly.
On the other hand, in many new theories beyond the standard model, for example supersymmetric grand unification models, the branching ratio of $\mu \rightarrow e\gamma$ is predicted to be around 10^{-14}--10^{-12}, which is experimentally reachable.
In year 2013, the MEG experiment has finished its physics-data taking of five years to search for $\mu^{+} \rightarrow e^{+}\gamma$ events with a branching-ratio sensitivity of $~5\times10^{-13}$. Compared to the result published in 2013 by MEG, the full data statistics was doubled by adding data taken in 2012 and 2013 with higher beam intensity.
The MEG collaboration plans to upgrade the detector to achieve a ten times better sensitivity. In the conference, a physics result of the MEG experiment and the studies for the upgrade will be presented.

Lepton Flavour Violation and Neutrinos / 199

Altered dispersion relations for sterile neutrino phenomenology

Prof. PÄS, Heinrich [1]

[1] *TU Dortmund*

Corresponding Author: heinrich.paes@uni-dortmund.de

The search for sterile neutrinos is motivated by the LSND and MiniBooNE, reactor and Gallium anomalies. The fact that this evidence is partly conflicting can be a consequence of either experimental systematics or of non-standard neutrino properties. A particular interesting case for such non-standard properties are scenarios where the simple dispersion relation between energy and momentum is changed due to the presence of additional terms which can result from Lorentz violation, shortcuts in extra dimension, the variation of mass, or non-standard matter effects. The consequences for neutrino oscillation phenomenology and cosmology are discussed.

SUSY Phenomenology / 200

The “Recursive Jigsaw” Reconstruction Technique

Dr. JACKSON, Paul [1]

[1] *University of Adelaide*

Corresponding Author: p.jackson@adelaide.edu.au

Signal events where multiple missing neutral particles are present in a final state represent challenging topologies to search for new physics at the LHC. The key to any search is the ability to separate background-like events from signal-like events. Identifying such signal-like events, and extracting their properties, is exacerbated by a lack of knowledge of the particle masses and some missing kinematic handles. We present a new method to search for open final states where the decays of the two parent particles may proceed via the same, or different, channels. For final states with weakly interacting particles, a new basis of variables can be derived using the "Recursive Jigsaw" technique. We discuss the application of this procedure by considering final states containing 2 b-jets and 2 charged leptons and missing transverse momentum. We apply the “Recursive Jigsaw” reconstruction to extract quantities sensitive to scales and angles on an event-by-event basis. The utility of this variable basis is demonstrated by studying dileptonic ttbar decays in comparison to various parameter choices for direct stop production, where each stop decays to bottom chargino, which subsequently decay to a neutralino LSP via either on- or off-shell W decay. The applicability of the variable basis is further demonstrated using resonant ttbar production through a heavy graviton.

Models of SUSY / 201

Fine Tuning in a Low Energy Exceptional Supersymmetric Standard Model

Mr. HARRIES, Dylan [1]; Dr. ATHRON, Peter [2]; Prof. WILLIAMS, Anthony [1]

[1] *The University of Adelaide*

[2] *University of Adelaide*

Corresponding Author: dylan.harries@adelaide.edu.au

With the discovery of a 125 GeV Standard Model (SM) like Higgs boson
and rising lower bounds on the masses of superpartners, minimal models of low energy supersymmetry (SUSY) appear to be increasingly fine tuned. In the Minimal Supersymmetric Standard Model (MSSM) large stop masses, needed to obtain the observed Higgs mass, give a significant contribution to fine tuning. U(1) extensions of the MSSM that solve the mu-problem have new F- and D-term contributions to the Higgs mass, allowing a 125 GeV Higgs with lighter stops and so alleviating the associated fine tuning. However, it was recently demonstrated, within a constrained version of the Exceptional Supersymmetric Standard Model (E(6)SSM) defined at the Grand Unification (GUT) scale, that the presence of a massive Z' boson introduces a substantial new source of tuning in these theories at tree level. Here we consider the impact of this tuning when we remove the fine tuning that depends on assumptions about the SUSY breaking scale, by setting the SUSY breaking parameters at low energies. We find that the existing experimental bounds on the Z' mass impose an effective lower bound on the fine tuning, which does not depend on assumptions about SUSY breaking. We compare our results against the tuning in the phenomenological MSSM (pMSSM), where the SUSY breaking terms are also defined at low energies.

Precision SUSY / 202

Searches for Direct Electroweak Production of Charginos, Neutralinos and Sleptons with Leptons and MET (CMS)

FOLGUERAS, Santiago [1]

[1] *Universidad de Oviedo*

Corresponding Author: santiago.folgueras@gmail.com

In this talk, the latest results from CMS on searches for supersymmetry produced through electroweak production channels are presented using 20/fb of data from the 8 TeV LHC run. A variety of complementary final state signatures and methods are used to probe chargino, neutralino, and slepton production.

Higgs Phenomenology / 203

The 126 GeV Higgs boson mass and naturalness in (deflected) mirage mediation

Mr. KAWAMURA, Junichiro [1]; Prof. ABE, Hiroyuki [1]

[1] *Waseda University*

Corresponding Author: junichiro-k@ruri.waseda.jp

We study the mass of the lightest CP-even Higgs boson in the deflected mirage mediation that is a quite general framework of the mediation of supersymmetry breaking, incorporating the case where all of the modulus-, the anomaly- and the gauge-mediated contributions to the soft supersymmetry breaking parameters become sizable. We evaluate the degree of tuning the so-called mu parameter required for realizing a correct electroweak symmetry breaking and study how to accomplish both the observed Higgs boson mass and the relaxed fine-tuning. We identify the parameter space favored from such a perspective and show the superparticle mass spectrum with some input parameters inside the indicated region. The results here would be useful when we aim to prove the communication between the visible and the hidden sectors in supergravity and superstring models based on the recent observations.
This result is based on arXiv:1405.0779

SUSY Phenomenology / 204

How alive is constrained SUSY really?

Dr. BECHTLE, Philip [1]; Prof. DESCH, Klaus [1]; Mr. UHLENBROCK, Mathias [1]; Dr. WIENEMANN, Peter [1]; Prof. DREINER, Herbert K. [2]; Dr. HAMER, Matthias [3]; Prof. KRÄMER, Michael [4]; Dr. O'LEARY, Ben [5]; Prof. POROD, Werner [5]; Mr. SARRAZIN, Björn [1]; Mr. STEFANIAK, Tim [2]

[1] *Physikalisches Institut, University of Bonn, Germany*

[2] *Physikalisches Institut and Bethe Center for Theoretical Physics, University of Bonn, Germany*

[3] *Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil*

[4] *Institute for Theoretical Particle Physics and Cosmology, RWTH Aachen, Germany*

[5] *Institut für Theoretische Physik und Astrophysik, University of Würzburg, Germany*

Corresponding Author: sarrazin@physik.uni-bonn.de

Constrained SUSY models like the CMSSM might look less attractive nowadays because of fine tuning arguments. They also might look less probable in terms of Bayesian statistics. The question how well the model under study describes the data, however, is answered by frequentist p-values. Thus, for the first time, we calculate p-values for the CMSSM by performing dedicated toy experiments. We combine constraints from low-energy and astrophysical observables, Higgs mass and rate measurements as well as the non-observation of new physics in searches for supersymmetry at the LHC. Using the framework Fittino, we perform global fits of the CMSSM to the toy data. In this way we also derive estimates of the allowed ranges of parameters and observables in this model. Results using the well-established profile likelihood technique are shown in comparison.

Formal SUSY and Strings / 205

Covariant techniques in projective and harmonic superspace

Dr. BUTTER, Daniel [1]

[1] *Nikhef*

Corresponding Author: dbutter@nikhef.nl

The most general supersymmetric theories involving eight supercharges can only be off-shell if one introduces an auxiliary manifold associated with the R-symmetry group. The resulting structure, which can be formulated either as projective or harmonic superspace, naturally provides a framework for constructing hypermultiplet actions both in flat space and in supergravity. I will discuss recent progress in unifying these two approaches and describe how the covariant approach to supergravity in projective superspace naturally yields a corresponding covariant harmonic formulation.

Formal SUSY and Strings / 206

Moduli inflation in 5D SUGRA

Mr. OTSUKA, Hajime [1]; Prof. ABE, Hiroyuki [2]

[1] *Waseda University*

[2] *Waseda university*

Corresponding Author: hajime.13.gologo@akane.waseda.jp

We propose a simple but effective mechanism to realize an
inflationary early universe consistent with the observed
WMAP, Planck and/or BICEP2 data which would be incorporated
in numerous particle physics models constructed in a
(effective) five-dimensional spacetime.
In our scenario, the inflaton field is identified with one of
the moduli appearing when the fifth direction is compactified,
and a successful cosmological inflation without
a so-called η problem can be achieved by a very simple
moduli stabilization potential without breaking the
supersymmetry at the vacuum.
We also discuss the related particle cosmology during
and (just) after the inflation,
such as a (no) cosmological moduli problem.

Formal SUSY and Strings / 207

The role of field redefinitions on renormalisability of a $N=\frac{1}{2}$ supersymmetric gauge theories

Dr. FARZANEH KORD, Ahmad [1]; Mr. HADDADI MOGHADDAM, Mohsen [1]

[1] *Hakim Sabzevari University*

Corresponding Author: afarzaneh@hsu.ac.ir

We study one loop corrections to $N=\frac{1}{2}$ supersymmetric gauge theory. In order to show theory is renormalisable in the standard way, we redefine the gaugino and the auxiliary fields($\lambda, \bar F$) which results to extra terms of the lagrangian. We show these extra terms generated by field redefinitions are necessary for renormalisability of the
non-anti-commutative field theories. Finally we prove $N = \frac{1}{2}$ supersymmetric gauge theory is renormalisable up to one loop corrections using standard method of the renormalisation. We prove the disagreement between component formalism and superspace formalism is solved and both result to the gauge invariant effective action.

Models of SUSY / 208

Natural Supersymmetry in Warped Space

Dr. NAKAI, Yuichiro [1]; Dr. HEIDENREICH, Ben [1]; Prof. RANDALL, Lisa [1]

[1] *Harvard University*

Corresponding Author: ynakai@physics.harvard.edu

We propose a framework of R-parity violating supersymmetry in a 5D
warped space where the Higgs fields live on the IR brane. Quark and lepton multiplets are located in the bulk so that the Yukawa hierarchies arise from their wavefunction profiles. For suppressing dangerous proton decay, we impose a discrete lepton number symmetry on the theory while baryon number conservation is not assumed, which naturally leads to a viable R-parity violation. We assume a supersymmetry breaking sector on the UV brane. Gaugino masses are generated by interactions with the supersymmetry breaking sector
or anomaly/radion mediation. Light quark and lepton multiplets couple to the supersymmetry breaking sector and the scalar superpartners are heavy. Light stop masses are generated by gaugino mediation or anomaly/radion mediation. They also receive two-loop corrections from light quarks and leptons when their scalar superpartners are absent in the low-energy theory. We introduce a bulk singlet field localized toward the IR brane to explain the Higgs boson mass and generate the Higgsino mass term at the electroweak scale. The unification
of the standard model gauge groups is also discussed. Interestingly, the unified theory emerges just above the IR scale near the TeV scale.

SUSY Phenomenology / 209

Inclusive SUSY Particle Searches with Jets and MET (CMS)

GOEBEL, Kristin [1]

[1] *University of Hamburg*

Corresponding Author: kristin.goebel@desy.de

In this talk, the latest results from CMS on inclusive searches for squark and gluino pair production in events containing jets and missing energy are reviewed. A variety of complementary methods and discriminants based on event kinematics are deployed to suppress standard-model backgrounds. Results are interpreted in the context of several different SUSY model scenarios using up to 20/fb of data from the 8 TeV LHC run.

Quark Flavour Violation / 210

Flavour symmetries after the first LHC phase

Dr. BUTTAZZO, Dario [1]

[1] *Institute for Advanced Study, TU Munich*

Corresponding Author: dario.buttazzo@tum.de

Based on flavour symmetries only, there are two ways to give rise to an effective description of flavour physics in the quark sector close to the CKM picture: one is based on U(3)_q x U(3)_u x U(3)_d, and the other on U(2)_q x U(2)_u x U(2)_d (or equivalent symmetries). In this context we analyze the current status of flavour physics measurements and we compare their impact, in the specific case of supersymmetry, with the direct searches of new particles at the LHC, present or foreseen.

SUSY Phenomenology / 211

Kinematic Variables for Weakly Interacting Particle Final State Reconstruction at the LHC

Dr. ROGAN, Christopher [1]

[1] *Harvard University*

Corresponding Author: crogan@cern.ch

At the Large Hadron Collider (LHC), many new physics signatures feature pair-production of massive particles with subsequent direct or cascading decays to weakly interacting particles, such as SUSY scenarios with conserved R-parity or $H \to W(\ell\nu)W(\ell\nu)$, often motivated by models of new physics which attempt to mitigate the hierarchy problem in the Standard Model. While final states containing multiple weakly interacting particles represent an opportunity for discovery of new physics phenomena, they also present a unique experimental challenge; the kinematic information lost through particles escaping detection makes fully reconstructing these collision events impossible. In order to address this shortcoming special kinematic variables are used to partially reconstruct these events, providing sensitivity to properties of the particles appearing in them, including masses and even their spin correlations.

We discuss a collection kinematic variables developed to study final states with weakly interacting particles at the LHC, focusing on the {\it super-razor} variables. Using the examples of searches for slepton and charging pair-production at the LHC, the motivation and derivation of these observables are described along with comparisons to previously existing approaches. Generalizations of the super-razor variables to more complicated decay topologies are also discussed, using fully leptonic top quark pair production as an example, along with its supersymmetric analogue of stop pair-production with subsequent decays to b-quarks and charginos.

SUSY Phenomenology / 212

What do simplified models actually tell us about the stop mass?

Dr. BARNARD, James [1]; Mr. FARMER, Ben [2]

[1] *University of Melbourne*

[2] *Monash University*

Corresponding Author: james.barnard@unimelb.edu.au

The stop mass is often constrained using simplified models, where it is assumed that all stops decay via a single decay mode. This is not usually the case in realistic models so limits derived from any single simplified model tend to be too strong. To derive more accurate limits one should instead combine information from several different simplified models. I will present a fast and easy technique for doing this, which yields limits that are conservative but independent of the branching ratios for each stop decay mode. Along the way I will demonstrate the importance of a simplified model analysis for mixed decay modes, which is yet to be implemented by ATLAS or CMS.

Lepton Flavour Violation and Neutrinos / 213

The Effect of Cancellation in Neutrinoless Double Beta Decay

Dr. MITRA, Manimala [1]; Dr. PASCOLI, Silvia [2]

[1] *Postdoctoral fellow, IPPP, Durham University*

[2] *IPPP - Durham*

Corresponding Author: manimala.mitra@durham.ac.uk

In light of recent experimental results, we carefully analyze the effects of interference in neutrinoless double beta decay, when more than one mechanism is operative. If a complete cancellation is at work, the half-life of the corresponding isotope is infinite and any constraint on it will automatically be satisfied. We analyze this possibility in detail assuming a cancellation in 136-Xe, and find its implications on the half-life of other isotopes, such as 76-Ge.
For definiteness, we consider the role of light and heavy sterile neutrinos. In this case, the value of the redefined effective Majorana mass parameter gets suppressed, and a larger values of neutrino masses are required for the same half-life. As a result, where all the sterile neutrinos are heavy, the tension between the results from neutrinoless double beta decay and cosmology becomes even more severe, than the canonical light neutrino case. We show that the inclusion of light sterile neutrinos in this set up can resolve this issue. Using the recent results from GERDA, we derive upper limits on the active-sterile mixing angles and compare it with the case of no cancellation. The required values of the mixing angles become larger, if a cancellation is at work. We show that the sterile neutrinos of few hundred MeV or GeV mass range, coming from an Extended seesaw framework or a further extension, can satisfy the required cancellation.

Alternative Theories / 214

ATOM/Fastlim: Recasting LHC constraints on new physics models

Dr. SAKURAI, Kazuki [1]; Dr. WEILER, Andreas [2]; Dr. PAPUCCI, Michele [3]; Dr. ZEUNE, Lisa [4]; Dr. KIM, Ian-Woo [2]

[1] *King's College London*

[2] *CERN*

[3] *Michigan University*

[4] *DESY*

Corresponding Author: kazuki.sakurai@kcl.ac.uk

The results of ATLAS and CMS beyond the Standard Model searches are very useful to constrain various new physics modes, yet they are originally designed to search for a particular model. Recasting existing analyses on to an arbitrary model involves various subtleties and one has to simulate detector responses and selection cuts as realistic as possible. For this task, we developed two programs: ATOM (Automated Testing Of Models) and Fastlim. ATOM takes event files as inputs and calculates the efficiencies of various analyses automatically, which can be used to calculate an exclusion p-value for an given model. Fastlim, on the other hand, takes spectrum files as inputs and immediately calculates an exclusion p-value using pre-calculated efficiencies of various simplified topologies. In this talk, we discuss the methodology used and present performances of these tools.

Particle Cosmology / 215

A solution to the baryon-DM coincidence problem in the mSUGRA/CMSSM model with a 126 GeV Higgs boson

Mr. YAMADA, Masaki [1]; Dr. KAMADA, Ayuki [2]; Prof. KAWASAKI, Masahiro [1]

[1] *Institute for Cosmic Ray Research, University of Tokyo*

[2] *University of California*

Corresponding Author: yamadam@icrr.u-tokyo.ac.jp

We have investigated the Affleck-Dine baryogenesis in detail and have shown that the baryon-dark matter coincidence problem can be solved in the mSUGRA/CMSSM model with a 126 GeV Higgs boson. The baryons and dark matter are generated simultaneously through the late-time decay of non-topological solitons, Q-balls, which are formed after the Affleck-Dine baryogenesis. A relation between the universal scalar mass and the unified gaugino mass is required to solve the coincidence problem, marginally depending on the other mSUGRA parameters.

Alternative Theories / 216

Searches for non-SUSY Exotics in ATLAS

Dr. MARINO, Christopher [1]

[1] *University of Victoria*

Corresponding Author: christopher.marino@cern.ch

A summary is given of non-SUSY searches for physics beyond the Standard Model with the ATLAS detector. Searches using leptons, photons, missing transverse energy, and jets are presented, as well as searches for resonances and for objects requiring custom reconstruction. No significant evidence of new physics is found in the data collected at center-of-mass energies of 7 TeV and 8 TeV. Limits on a wide set of predictions for Exotics extensions to Standard Model are set including many which represent more stringent limits than previous measurements.

Alternative Theories / 217

Renormalization group flows and the Weyl consistency conditions

Mr. MØLGAARD, Esben [1]; Prof. SANNINO, Francesco [1]; Prof. SHROCK, Robert [2]; Dr. GILLIOZ, Marc [3]; Dr. ANTIPIN, Oleg [4]

[1] *CP3-Origins*

[2] *C.N. Yang Institute for Theoretical Physics, Stony Brook University*

[3] *CP3-Origins, University of Southern Denmark*

[4] *INFN, Florence*

Corresponding Author: molgaard@cp3-origins.net

In this talk, I will introduce the concept of renormalization group flow and describe the general features that can be found in such flows in (gauge-)Yukawa theories. In perturbation theory, the renormalization group flow is given by the beta functions of the various couplings, and these can be calculated to different loop orders. It will become apparent that it is necessary to have a criterion that can determine the correct way to go to higher order in the multi-coupling loop expansion. I propose that the Weyl consistency conditions are exactly that criterion and present both their derivation and their implication. If there is sufficient time, I will also touch upon how this affects the stability of the standard model vacuum.

Precision SUSY / 218

NNLL soft and Coulomb resummation for squark and gluino production at the LHC

SCHWINN, Christian [1]

[1] *Freiburg University*

Corresponding Author: christian.schwinn@physik.uni-freiburg.de

The talk will present state of the art predictions for total production cross sections of squarks and gluinos that include for the first time a combined resummation of soft-gluon and Coulomb gluon effects at next-to-next-to leading logarithmic accuracy. The corrections can be very large, above 100 percent relative to the NLO predictions, and up to 25 percent relative to earlier NLL results. The theoretical scale uncertainties are reduced to the 10 percent level.

Precision SUSY / 219

NLO SQCD corrections to the decay of top-squarks to charm and neutralino

Mr. AEBISCHER, Jason [1]

[1] *University of Bern*

Corresponding Author: aebischer@itp.unibe.ch

In order to solve the hierarchy problem, the stop quark should be rather light and its mass can be close to the one of the LSP. If the mass difference of the stop to the neutralino LSP is smaller than the top mass it can only decay flavour violating (mainly to charm and neutralino). The decay is not allowed in naive MFV at tree-level and is suppressed by small CKM angels in symmetry based MFV giving a sizable lifetime to the stop.

We calculate the SQCD corrections to this deacy in the MSSM with
generic sources of flavour-violation. Assuming that the SUSY breaking
mechanism is flavour-blind the stop-neutralino-charm vertex is RGE-induced. Our new corrections allow us to use the 2-loop running and we study the numerical impact of our QCD correction.

Formal SUSY and Strings / 220

Dark Radiation in Fibred LARGE Volume Compactifications

Mr. ANGUS, Stephen [1]

[1] *University of Oxford*

Corresponding Author: stephen.angus@physics.ox.ac.uk

Dark radiation is a compelling extension to ΛCDM: current experimental results hint at $\Delta N_{\rm eff} \gtrsim 0.5$, which is increased to $\Delta N_{\rm eff} \simeq 1$ if the recent BICEP2 results are included. In recent years dark radiation has been considered in the context of string theory models such as the LARGE Volume Scenario of type IIB string theory, forging a link between present-day cosmological observations and models of physics at the Planck scale. In this talk I will consider a fibred extension of the LARGE Volume Scenario, in which the bulk volume is stabilised by two moduli instead of one. Consequently, the lightest modulus no longer corresponds to the compactification volume but instead to a transverse direction in the bulk geometry. I will focus on scenarios in which sequestering of soft masses is achieved by localising the Standard Model on D3 branes at a singularity. The fraction of dark radiation produced in such models vastly exceeds experimental bounds, ruling out the fibred sequestered LARGE Volume Scenario as a model of the early Universe.

Higgs Phenomenology / 221

Off-shell effects in Higgs decays to gauge bosons

LIEBLER, Stefan [1]; MOORTGAT-PICK, gudrid [2]; WEIGLEIN, Georg [3]

[1] *Uni Hamburg*

[2] *University of Hamburg*

[3] *IPPP Durham*

Corresponding Author: stefan.liebler@desy.de

We discuss off-shell contributions in H->ZZ/WW and the signal-background interference in H->AA for the two main production mechanisms, Higgsstrahlung and vector boson fusion, at a linear collider.
In case of extended Higgs sectors the correct description of the former effect is of importance for the observance of heavy Higgses in ZZ/WW final states.

SUSY Phenomenology / 222

Cosmological predictions and their precision requirements for colliders

MOORTGAT-PICK, Gudrid [1]; BHARUCHA, Aoife [2]; ROLBIECKI, Krzyszyof [3]; WEIGLEIN, Georg [4]

[1] *University of Hamburg / DESY*

[2] *Technical University Munich*

[3] *Universidad Autonoma de Madrid*

[4] *DESY Hamburg*

Corresponding Author: gudrid.moortgat-pick@desy.de

Calculations of the relic density within the MSSM rely on information
about the mass both of the LSP and of other particles which play a key
role in the dominant mechanisms of annihilation.
Direct searches at the LHC have not yet detected any SUSY particles,
however in the upcoming 14 TeV run ATLAS and CMS will close in on sub-TeV
electroweakinos and third generation fermions. The extremely high
precision measurements (< 1%) expected to be achievable at the linear
collider would further provide us with much improved
sensitivity to many of the relevant MSSM particles, including those appearing only via loop effects. In the talk we analyze several phenomenologically
motivated scenarios, derive projected errors on the relic density
prediction from combined measurements at LHC and different LC options and discuss the implications for dark matter models.

Precision SUSY / 223

Latest results for squark and gluino production cross sections at the LHC: threshold resummation at NNLL

Mr. BORSCHENSKY, Christoph [1]; BEENAKKER, Wim [2]; KRÄMER, Michael [3]; KULESZA, Anna [4]; LAENEN, Eric [5]; THEEUWES, Vincent [4]; THEWES, Silja [6]

[1] *Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster*

[2] *Radboud University Nijmegen (NL)*

[3] *RWTH Aachen (DE)*

[4] *WWU Münster (DE)*

[5] *University of Amsterdam (NL)*

[6] *DESY Hamburg (DE)*

Corresponding Author: borschensky@uni-muenster.de

In this talk, latest results on the inclusive squark and gluino production cross sections are reported. The results include threshold resummation corrections up to next-to-next-to-leading logarithmic (NNLL) precision as well as Coulomb corrections up to second order, using Mellin-space methods. The corrections lead to significant enhancing effects and a reduction of scale dependence for most processes of squark and gluino production. An outlook for higher energies at the LHC is given.

Lepton Flavour Violation and Neutrinos / 224

Lepton Flavour Violation in the MSSM and non-decoupling

Dr. ARANA-CATANIA, Miguel [1]; Prof. HERRERO, Maria Jose [1]; Dr. ARGANDA, Ernesto [2]; HEINEMEYER, Sven [3]

[1] *IFT-UAM/CSIC*

[2] *Departamento de Física Teórica, Universidad de Zaragoza*

[3] *IFCA (CSIC)*

Corresponding Author: miguel.arana@uam.es

We present a phenomenological study of the implications on charged lepton flavor violating (LFV) processes from slepton flavor mixing within the Minimal Supersymmetric Standard Model. We work under the model-independent hypothesis of general flavor mixing in the slepton sector, being parametrized by a complete set of dimensionless δABij (A,B = L,R; i,j = 1, 2, 3) parameters. The present upper bounds on the most relevant LFV processes, together with the requirement of compatibility in the choice of the MSSM parameters with the recent LHC and (g-2) data, lead to updated constraints on all slepton flavor mixing parameters, and a comparative discussion of the most effective LFV processes to constrain the various generation mixings. We study also the non-decoupling behavior with mSUSY of some indirect SUSY observables, in particular we focus on the LFV decays of the three neutral MSSM Higgs bosons h, H, A→τμ, considering the four types of slepton mixing (δLL23, δLR23, δRL23, δRR23). We show the expected measurable events for some of these channels at the present and future LHC stage.

Models of SUSY / 225

The decoupling limit in the Georgi-Machacek model

KUMAR, Kunal [1]; E. LOGAN, Heather [1]; HARTLING, Katy [1]

[1] *Carleton University*

Corresponding Author: kkumar@physics.carleton.ca

We study the most general scalar potential of the Georgi-Machacek model, which adds isospin-triplet scalars to the Standard Model (SM) in a way that preserves custodial SU(2) symmetry. We show that this model possesses a decoupling limit, in which the predominantly-triplet states become heavy and degenerate while the couplings of the remaining light neutral scalar approach those of the SM Higgs boson. We find that the SM-like Higgs boson couplings to fermion pairs and gauge boson pairs can deviate from their SM values by corrections as large as $\mathcal{O}(v^2/M_{\rm new}^2)$, where v is the SM Higgs vacuum expectation value and $M_{\rm new}$ is the mass scale of the predominantly-triplet states. In particular, the SM-like Higgs boson couplings to W and Z boson pairs can decouple much more slowly than in two Higgs doublet models, in which they deviate from their SM values like $\mathcal{O}(v^4/M_{\rm new}^4)$. Furthermore, near the decoupling limit the SM-like Higgs boson couplings to W and Z pairs are always larger than their SM values, which cannot occur in two Higgs doublet models. As such, a precision measurement of Higgs couplings to W and Z pairs may provide an effective method of distinguishing the Georgi-Machacek model from two Higgs doublet models. Using numerical scans, we show that the coupling deviations can reach 10\% for $M_{\rm new}$ as large as 800~GeV.

Formal SUSY and Strings / 226

Axion Conversion and the Soft X-ray Excess in the Outskirts of the Coma Cluster

Mr. RUMMEL, Markus [1]

[1] *University of Oxford*

Corresponding Author: markus.rummel@physics.ox.ac.uk

Recently, it was found that the soft X-ray excess in the center of Coma can be explained by axion to photon conversion of a cosmic axion background (CAB). We extend this analysis to the outskirts of Coma, including regions up to 5 Mpc from the center of the cluster. We extract the soft X-ray flux from ROSAT All-Sky Survey data and compare it to the expected flux from axion to photon conversion of a CAB. The soft X-ray excess both in the center and the outskirts of Coma can be simultaneously explained by axion to photon conversion of a CAB. Given the uncertainties of the cluster magnetic field in the outskirts we constrain the parameter space of the CAB. In particular, an upper limit on the CAB mean energy and a range of allowed axion photon couplings are derived.

Alternative Theories / 227

6D Gauge-Higgs unification with custorial symmetry

Dr. SAKAMURA, Yutaka [1]

[1] *KEK*

Corresponding Author: sakamura@post.kek.jp

We investigate a possibility of constructing 6-dimensional gauge-Higgs unification models compactified on T^2/Z_N that have a custodial symmetry. We consider all simple groups whose ranks are two and three as a 6D gauge group, and find appropriate orbifold boundary conditions that realize a realistic field content in 4D effective theory for each gauge group. We also calculate the Higgs potential at tree level and discuss the Higgs mass. Our results are useful to construct realistic models.

Higgs Phenomenology / 228

BSM Higgs Searches at ATLAS

Dr. ZUR NEDDEN, Martin [1]

[1] *Humboldt-University Berlin*

Corresponding Author: martin.zur.nedden@cern.ch

The ATLAS experiment at the LHC has achieved the precision level for the
measurement of the Standard Model processes and has observed the Higgs boson in different production and decay channels. This is an excellent basis to probe the data for possible extensions of the Higgs sector of the Standard Model. In this talk, an overview of the recent searches for Higgs bosons beyond the Standard Model based on data taken in Run I is given. Prospect for the expected sensitivities for physics scenarios beyond the Standard Model in the Higgs sector will be discussed for the enhanced luminosity phase at an energy of 14 TeV at Run II starting in 2015.

Higgs Phenomenology / 229

SM Higgs in Boson Decay Modes (CMS)

STOYNEV, Stoyan [1]

[1] *Northwestern University*

Corresponding Author: stoyan.stoynev@cern.ch

Within the SM, the masses of the electroweak vector bosons arise by the spontaneous breaking of electroweak symmetry by the Higgs field. The ATLAS and CMS experiments at the Large Hadron Collider (LHC), have reported the discovery of a new boson with a mass of approximately 125 GeV with a significance of five or more standard deviations each. In this talk we present the latest measurements by the CMS of Higgs production in boson decay modes at CMS.

Models of SUSY / 230

Hierarchies in the hidden sector and gravitational rescue of minimal gauge mediation.

Mr. MUMMIDI, Venkata Suryanarayana [1]

[1] *Indian Institute of Science*

Corresponding Author: soori9@cts.iisc.ernet.in

We consider a situation where the hidden sector is parametrised by two hierarchical F-terms: while both of them participates in gravity mediation only one participates in the the minimal gauge mediation. The gravitational sector can contribute a large A_t such that a 125 GeV Higgs is possible with light stops. We present an explicit model where this scenario can be realised. We provide semi-analytical solutions to the renormalisation group equations for the two scale supersymmetry breaking.

Particle Cosmology / 231

Neutrino as dark matter under $U(1)_X$

Dr. HUANG, Wei-Chih [1]; Dr. DEPPISCH, Frank [1]

[1] *University College London*

Corresponding Author: wei-chih.huang@ucl.ac.uk

We augment the standard model gauge groups by an additional $U(1)_X$ group with the corresponding gauge boson, $Z^\prime$, in the context of the type-I seesaw. After breaking $U(1)_X$ with vacuum expectation values of even charge, the lightest of particles, one of the heavy neutrinos, with odd $U(1)_X $ charge is a dark matter candidate. We first find the minimum anomaly-free particle content and then discuss the light neutrino mass spectrum and mixing matrix, which in this model consists of radiative corrections and tree-level contributions from the right-handed neutrinos. Second, in terms of the relic density, we investigate the interplay between annihilation processes via the $Z^\prime$ exchange and co-annihilation processes, including experimental constraints, and reproducing the observed neutrino mixing angles and mass-squared differences.

Formal SUSY and Strings / 232

Heterotic Line Bundle Models

Prof. LUKAS, Andre [1]; Prof. ANDERSON, Lara [2]

[1] *University of Oxford*

[2] *Virginia Tech*

Corresponding Author: lukas@physics.ox.ac.uk

Heterotic string compactifications based on Calabi-Yau manifolds and line bundle sums have led to a large number of phenomenologically promising models with precise MSSM spectra. I will discuss the structure of these models, phenomenological implications and some recent developments.

Particle Cosmology / 233

Determination of the inflationary parameters by the direct detection of primordial gravitational waves

Mr. JINNO, Ryusuke [1]

[1] *University of Tokyo*

Corresponding Author: jinno@hep-th.phys.s.u-tokyo.ac.jp

The result of BICEP2 strongly suggests that there exists primordial gravitational wave background. We have investigated how precisely we can determine the inflationary parameters, i.e. the amplitude of the tensor power spectrum, the tensor spectral index and its running, by future interferometer experiments in high-TR(reheating temperature) case. We also investigated the sensitivity of future experiments on TR in low-TR case.

Models of SUSY / 234

Dirac gauginos, R symmetry and the 125 GeV Higgs

Mr. GREGOIRE, Thomas [1]

[1] *Carleton University*

Corresponding Author: gregoire@physics.carleton.ca

We study a supersymmetric scenario with a quasi exact R-symmetry in light of the discovery of a Higgs resonance with a mass of 125 GeV. In such a framework, the additional adjoint superfields, needed to give Dirac masses to the gauginos, contribute both to the Higgs mass and to electroweak precision observables. We analyze the interplay between the two aspects, finding regions in parameter space in which the contributions to the precision observables are under control and a 125 GeV Higgs boson can be accommodated. We estimate the fine-tuning of the model finding regions of the parameter space still unexplored by the LHC with a fine-tuning considerably improved with respect to the minimal supersymmetric scenario. In particular, sizable non-holomorphic (non-supersoft) adjoints masses are required to reduce the fine-tuning.

Formal SUSY and Strings / 236

Unified Theory of space-time and matter based on Nonlinear Representation of SUSY and General Relativity Principle

Prof. SHIMA, Kazunari [1]; Dr. TSUDA, Motomu [1]

[1] *Saitama Institute of Technology*

Corresponding Author: shima@sit.ac.jp

Nonlinear representation of SUSY describing the geometric spontaneous SUSY breakdown fuses simply with gravity, which produces the nonlinear-supersymmetric general relativity theory(NLSUSYGR) of the Einstein-Hilbert type for NG-fermion and graviton before the Big Bang. The familiar standard model (M)SSM is reproduced in the true vacuum of NLSUSYGR as the composite theory of NG-fermion and continues naturally to the SMs scenarios for cosmology and the particle physics. It gives new insights into unsolved problems of SMs(cosmology and particle physics) and their mysterious relations, e.g. generation structure, proton decay, dark energy, neutriono mass, etc.

Lepton Flavour Violation and Neutrinos / 237

LBNE in the Precision Era of Neutrino Oscillation: Status and Schedule

Dr. EVANS, Justin [1]

[1] *University of Manchester*

Corresponding Author: silvia.pascoli@durham.ac.uk

LBNE (Long-Baseline Neutrino Experiment) is an accelerator-based neutrino oscillation experiment. LBNE will produce a muon-neutrino beam using protons from Fermilab's Main Injector and will detect electron-neutrino appearance and muon-neutrino disappearance using a Liquid Argon TPC located at a distance of 1300 km at Sanford Underground Research Facility in South Dakota. The primary physics motivation of LBNE is to determine the neutrino mass hierarchy, to determine the octant of the neutrino mixing angle theta_23, to search for CP violation in neutrino oscillation, and ultimately, to precisely measure the size of any CP-violating effect that is discovered. The status of LBNE and the physics potential of the LBNE research program will be described including the underground physics, in particular atmospheric neutrinos, proton decay, and supernova neutrinos, which are also primary physics goals of LBNE.

Alternative Theories / 238

Searches for no-SUSY Exotics

Ms. DEMIRAGLI, Zeynep [1]

[1] *Brown University CMS Experiment*

Corresponding Author: zeynep.demiragli@cern.ch

Exotic searches for non-SUSY physics beyond Standard Model using the 8 TeV data collected at the LHC is presented. The CMS collaboration has investigated various scenarios, including the possibility of new heavy gauge bosons and resonances, extra-dimensions, and excited quarks. No evidence for these signatures has been found therefore limits on various model parameters are extended.

Formal SUSY and Strings / 239

F-theory on Spin(7) manifolds

Mr. BONETTI, Federico [1]

[1] *MPI Munich*

Corresponding Author: bonetti@mpp.mpg.de

The longstanding problem of accessing F-theory on eight-dimensional manifolds of Spin(7) holonomy is addressed from an M-theory perspective. A novel version of the duality from M-theory to F-theory is proposed, in which M-theory on certain Spin(7) manifolds is dual to F-theory on the same geometries times an interval. The F-theory effective action is discussed by uplifting the M-theory effective action from three to four dimensions. The Type IIB weak-coupling limit of these setups is analyzed and their supersymmetry properties are discussed.

Formal SUSY and Strings / 240

Algebroids, Heterotic Moduli Spaces and the Strominger System

Prof. GRAY, James [1]

[1] *Virginia Tech*

Corresponding Author: jamesgray@vt.edu

We study compactifications of heterotic string theory on manifolds satisfying the ddbar-lemma. We consider the Strominger system description of the low energy supergravity to first order in alpha' and show that the moduli of such compactifications are subspaces of familiar cohomology groups such as H^1(TX), H^1(TX*), H^1(End_0(V)) and H^1(End_0(TX)). These groups encode the complex structure, Kahler moduli, bundle moduli and perturbations of the spin connection respectively in the case of a Calabi-Yau compactification.The structure we present can be interpreted in terms of recent work in Atiyah and Courant algebroids, and we conjecture links with aspects of Hitchin's generalized geometry to heterotic moduli.

Models of SUSY / 241

RGEs and group theory calculations with the Susyno program

Mr. FONSECA, Renato [1]

[1] *IFIC - Valencia*

Corresponding Author: renato.fonseca@ific.uv.es

Susyno is a Mathematica package developed to calculate the renormalization group equations of a supersymmetric model, requiring as input only its defining elements (gauge group and superfield representations, essentially). To achieve this, various functions were implemented to calculate group theoretical quantities --- valid for any gauge group and field content --- such as the explicit representation matrices, Clebsch-Gordon coefficients, branching rules, among others. In light of this, I will make an overview of the potential uses of the program for model building.

Particle Cosmology / 242

Searches for Dark Matter Production with Mono-objects and MET (CMS)

Ms. GOMBER, bhawna [1]

[1] *Saha Institute of Nuclear Physics*

Corresponding Author: bhawna.gomber@cern.ch

Searches for Dark
Matter Production with Mono-objects and MET (CMS)

Higgs Phenomenology / 243

Higgs in fermion decays

Mr. MORANGE, Nicolas [1]

[1] *The University of Iowa*

Corresponding Author: nicolas.morange@cern.ch

While there is little doubt that the particle discovered in July 2012 by the ATLAS and CMS collaborations is a Higgs boson, the question of its SM nature is tackled through the measurement of its properties: spin, parity, and couplings.
The study of its fermion decay modes is an important part of this research programme, as evidenced by a number of analyses performed on the LHC Run 1 data by the ATLAS collaboration. This talk will present the latest updates of these analyses.
Evidence of the coupling of the Higgs to fermions has been obtained in the tau-tau decay mode. A search for the decay of the Higgs boson to bbar has been performed by looking for its associated production with a vector boson or a pair of top quarks. The results of a search for the decay of the Higgs to a pair of muons will also be presented.

Models of SUSY / 244

Supersymmetric Moduli Stabilization and Inflation

Mr. WIECK, Clemens [1]

[1] *DESY Hamburg*

Corresponding Author: clemens.wieck@desy.de

We analyze the corrections to various F-term inflation models induced by a supersymmetrically stabilized Kähler modulus. We present general expressions for both small-field and large-field (chaotic) inflation models. Furthermore, we investigate the implications and constraints of supersymmetry breaking after

Lepton Flavour Violation and Neutrinos / 245

Neutrinoless double beta decay experiments and the neutrino mass

Dr. MACOLINO, Carla [1]

[1] *Laboratori Nazionali del Gran Sasso INFN Italy*

Corresponding Author: carla.macolino@lngs.infn.it

Neutrinoless double beta decay is a lepton number violating process which allows to investigate the Dirac or Majorana nature of neutrinos and to indirectly estimate their absolute mass. At present, several experiments based on different experimental techniques are searching for this rare decay. In this talk a review of the most relevant current and upcoming experiments is given and the comparison of their sensitivity in terms of neutrino mass is discussed.

Higgs Phenomenology / 246

SM Higgs in Fermion Decay modes (CMS)

Dr. TAKAHASHI, Yuta [1]

[1] *CERN*

Corresponding Author: yuta.takahashi@cern.ch

The discovery of a new boson with a mass of approximately 125 GeV in 2012 at the LHC has opened a new era in understanding the nature of electroweak symmetry breaking. Since the first observation in decays to γγ, WW, and ZZ boson pairs, an extensive set of measurements of the mass, couplings to W and Z bosons and the spin-parity quantum numbers, have revealed that the properties of the new boson are consistent with the standard model (SM) Higgs particle responsible for electroweak symmetry breaking. An important open question is whether the new particle also couples to fermions as expected in the SM. In this talk we present the latest measurements by CMS of Higgs production in fermionic decay channels.

Higgs Phenomenology / 247

Vacuum stability and the Higgs boson

Dr. BEZRUKOV, Fedor [1]

[1] *EPFL*

Corresponding Author: fedor.bezrukov@epfl.ch

We discuss most recent results on the vacuum stability taking into account the LHC Higgs and top data

Higgs Phenomenology / 248

The Two Higgs Doublet Model and LHC Results

Dr. FERREIRA, Pedro [1]

[1] *ISEL and CFTC, UL*

Corresponding Author: ferreira@cii.fc.ul.pt

The Two Higgs Doublet Model (2HDM) is one of the simplest extensions of the Standard Model (SM). The discovery of the Higgs boson at the LHC, and the fact that its properties seem to follow what is expected within the SM, puts constrainst of the 2HDM. We will review those constraints and show that there is still a great deal of parameter space left where extra scalars may dwell.

Alternative Theories / 249

A 3.55 keV Photon Line and its Morphology from a 3.55 keV ALP Line

Mr. RUMMEL, Markus [1]

[1] *University of Oxford*

Corresponding Author: markus.rummel@physics.ox.ac.uk

Galaxy clusters can efficiently convert axion-like particles (ALPs) to photons. We propose that the recently claimed detection of a 3.55--3.57 keV line in the stacked spectra of a large number of galaxy clusters and the Andromeda galaxy may originate from the decay of either a scalar or fermionic 7.1 keV dark matter species into an axion-like particle (ALP) of mass ma≈6·10−11 eV, which subsequently converts to a photon in the cluster magnetic field. In contrast to models in which the photon line arises directly from dark matter decay or annihilation, this can explain the anomalous line strength in the Perseus cluster. As axion-photon conversion scales as B2 and cool core clusters have high central magnetic fields, this model can also explains the observed peaking of the line emission in the cool cores of the Perseus, Ophiuchus and Centaurus clusters, as opposed to the much larger dark matter halos. We describe distinctive predictions of this scenario for future observations.

Formal SUSY and Strings / 250

Duality in 3d N=2

Mr. AMARITI, Antonio [1]

[1] *ENS*

Corresponding Author: amariti@ltp.ens.fr

I review the status of Seiberg like dualities in 2+1 dimensional N=2 gauge theories with unitary and real gauge groups and fundamental and tensor representations. I discuss the role of localization on the three sphere to support the dualities. RG flows connecting diferrent dual pairs are analyzed.

Lepton Flavour Violation and Neutrinos / 251

Generalised CP transformations

Mr. NEDER, Thomas [1]

[1] *University of Southampton*

Corresponding Author: tn2e12@soton.ac.uk

Generalised CP transformations are the only known framework which allows to predict Majorana phases in a flavour model purely from symmetry. For the first time generalised CP transformations are investigated for an infinite series of finite groups, $\Delta(6n^2)=(Z_n\times Z_n)\rtimes S_3$. In direct models the mixing angles and Dirac CP phase are solely predicted from symmetry. $\Delta(6n^2)$ flavour symmetry provides many examples of viable predictions for mixing angles. For all groups the mixing matrix has a trimaximal middle column and the Dirac CP phase is 0 or π. The Majorana phases are predicted from residual flavour and CP symmetries where α_{21} can take several discrete values for each n and the Majorana phase α_{31} is a multiple of π. We discuss constraints on the groups and CP transformations from measurements of the neutrino mixing angles and from neutrinoless double-beta decay and find that predictions for mixing angles and all phases are accessible to experiments in the near future.

Alternative Theories / 252

Thick brane cosmology

AHMED, Aqeel [1]; Prof. GRZADKOWSKI, Bohdan [1]; Prof. WUDKA, Jose [2]

[1] *University of Warsaw*

[2] *University of California Riverside*

Corresponding Author: aqeel.ahmed@fuw.edu.pl

We searched for time-dependent solutions for the 5-dimensional system of a scalar field canonically coupled to gravity. For the case of time-independent scalar field, the time evolution of the scale factor is obtained for different values of the spatial curvature k=0,+1,-1. In the case of time-dependent scalar field, two classes of solutions are discussed and an extension of the superpotential formalism is proposed. This talk is based on JHEP 1404 (2014) 061.

Quark Flavour Violation / 253

Pati-Salam GUT-Flavour Models with Three Higgs Generations

Mr. HARTMANN, Florian [1]

[1] *University Siegen*

Corresponding Author: hartmann@physik.uni-siegen.de

Pati-Salam GUTs are a first step in the direction of a complete fermion unification. We show that by a multi-step breaking of the symmetry, the mass scale of the right-handed neutrinos can be chosen near its best-fit value of ~ 1014 GeV, while a full unification of all gauge couplings near the Planck scale is possible. In addition, Pati-Salam models provide a framework to study mechanisms generating flavour structures simultaneously in quark and lepton sector. We study a SU(3) flavour symmetry and its spontaneous breaking by flavons. Within this framework we present a supersymmetric model containing flavoured Higgs fields which may lead to a matter-Higgs-unification. We investigate which flavon representations are useful in constructing models leading to the desired CKM- and PMNS-mechanisms.

Lepton Flavour Violation and Neutrinos / 254

The COMET experiment

Prof. MIHARA, Satoshi [1]

[1] *KEK*

Corresponding Author: satoshi.mihara@kek.jp

The COMET (Coherent Muon-to-Electron Transition) experiment is seeking to measure the neutrinoless, coherent transition of a muon to an electron in the field of an aluminum nucleus with a single event sensitivity below 10-16. The experiment utilizes a 8GeV proton beam provided at J-PARC (Japan Proton Accelerator Research Complex); and takes a staged approach to reach the final goal. The 1st stage of the experiment (phase I) uses 3.2kW proton beam, anticipated to start in 2016-2017 with a partial construction of the muon beam facility and a dedicated detector setup. The targeted sensitivity of the phase I is set below 10-14, which is about two orders of magnitudes better than the current limit (7 × 10-13) obtained in the SINDRUM II experiment at Paul Scherrer Institute in Switzerland. The 2nd stage (phase II) will follow this to reach the goal of the experiment with a complete facility setup and maximum beam power of 56kW. In this presentation status of the phase-I COMET and future prospects of the experiment including a possible upgrade plan using PRISM (Phase-Rotated Intense Slow Muon) as a muon source are explained.

Lepton Flavour Violation and Neutrinos / 255

Lepton Flavour Violation and Flavour Symmetry

Dr. MORISI, Stefano [1]

[1] *DESY Zeuthen*

Corresponding Author: stefano.morisi@gmail.com

I give a short summary if the implications of non abelian discrete flavor symmetry for lepton flavor violation processes. In particular I focus on the possibility to distinguish flavor symmetries by means of LFV.

Formal SUSY and Strings / 256

The impact of hidden sector renormalisation on estimates of fine tuning

HARDY, Edward [1]

[1] *Oxford Univerisity*

Corresponding Author: e.hardy2@physics.ox.ac.uk

The simplest models of supersymmetry compatible with LHC searches typically require very significant tuning of the electroweak scale. However, the renormalisation flow of the visible sector soft masses can be significantly modified by the dynamics of the hidden sector. I will discuss ways in which this can modify conventional estimates of the fine tuning, and show that if the hidden sector runs through a region of strong coupling not too far from the weak scale, a dramatic reduction in tuning is possible.

Precision SUSY / 257

Complete two-loop QCD corrections to the neutral MSSM Higgs masses from the top/stop sector

Dr. DI VITA, Stefano [1]

[1] *Max Planck Institute for Physics, Munich (Germany)*

Corresponding Author: divita@mpp.mpg.de

We examine the two-loop QCD corrections to the neutral Higgs masses in the MSSM by performing the full diagrammatic computation of the top/stop contributions in a mixed OS/DRbar scheme. We include novel results for the corresponding O(alpha alpha_s) corrections. The explicit shifts of the Higgs self-energies with respect to their effective potential counterparts are given in terms of a set of master integrals. The master integrals which are not yet known in analytic form are evaluated numerically with the fast computer code TSIL. All our results are expressed in terms of low energy physical parameters and can be readily included in the existing packages for phenomenological studies.

Higgs Phenomenology / 259

Very boosted Higgs in gluon fusion

SALVIONI, Ennio [1]

[1] *University of California, Davis*

Corresponding Author: ennio.salvioni@cern.ch

In a natural theory of electroweak symmetry breaking, the degrees of freedom that cure the hierarchy problem are expected to affect also the loop-induced couplings of the Higgs to gluons and photons. However, in the inclusive Higgs production rate measured so far at the LHC, the long-distance contribution of the top quark and the short-distance contribution of new physics cannot be disentangled. In this talk I will argue that the pp -> h + jet process at large pT can resolve this degeneracy, and thus provide another handle besides pp -> t tbar h. As concrete examples, I will discuss the cases of stops in supersymmetry and of top partners in composite Higgs models.

Lepton Flavour Violation and Neutrinos / 260

Interpretations of IceCube High Energy Neutrinos

Dr. FONG, Chee Sheng [1]

[1] *University of Sao Paulo*

Corresponding Author: fong@if.usp.br

In this talk we discuss the possibility that IceCube high energy neutrino events can be understood by a power law spectrum produced by astrophysical sources as well as by the decay spectrum of long-lived particles. We study the possibility of distinguishing these scenarios with current IceCube data and in the future as more data is accumulated. In particular, we study the circumstances under which the data can be explained solely by decaying long-lived particles. We consider a particular model which realizes this scenario,

Particle Cosmology / 261

Formalism and applications of Heavy WIMP Effective Theory

Prof. HILL, Richard [1]

[1] *University of Chicago*

Corresponding Author: richardhill@uchicago.edu

The discovery of a Standard Model-like Higgs boson and the hitherto absence of evidence for other new states may indicate that if WIMPs comprise cosmological dark matter, they are heavy compared to electroweak scale particles, M >> m_{W^\pm}, m_{Z^0}. In this limit, the absolute cross section for a WIMP of given electroweak quantum numbers to scatter from a nucleon becomes computable in terms of Standard Model parameters. We develop effective field theory techniques to analyze the heavy WIMP limit of WIMP-nucleon scattering, and present the first complete calculation of the leading spin-independent cross section in Standard Model extensions consisting of one or two electroweak SU(2)_W x U(1)_Y multiplets. A new extension of the effective theory to describe heavy WIMP annihilations is discussed.

Particle Cosmology / 262

Gravitino Dark Matter in Split Supersymmetry with Bilinear R-Parity Violation

Mr. PANES, Boris [1]; Ms. COTTIN, Giovanna [2]; Ms. GUZMAN, Maria Jose [3]; Prof. DIAZ, Marco A. [4]

[1] *Instituto de Fisica, Universidade de Sao Paulo, Brasil*

[2] *Cavendish Laboratory, University of Cambridge, United Kingdom*

[3] *Instituto de Astronomia y Fisica del Espacio, Universidad de Buenos Aires, Argentina*

[4] *Instituto de Fisica, Universidad Catolica de Chile, Chile*

Corresponding Author: bapanes@gmail.com

In Split-SUSY with BRpV we show that the Gravitino DM solution is consistent with experimental evidence on its relic density and life-time. We arrive to this conclusion performing a complete numerical and algebraic study of the parameter space, including constraints from the recently determined Higgs mass, updated neutrino physics, and BBN constraints to NLSP decays. The Higgs mass requires a relatively low Split-SUSY mass scale, which is naturally smaller than usual values for reheating temperature, allowing the use of the standard expression for the relic density. We include restrictions from neutrino physics with three generations, and notice an impact on the gravitino decay via the atmospheric neutrino mass scale. We calculate the neutralino decay and find it consistent with BBN. We mention some implications on indirect DM searches, but this work should be complemented with an exhaustive study of the different channels.

Formal SUSY and Strings / 263

Geometric description of the Standard Model

Prof. KANG-SIN, Choi [1]

[1] *Ewha Womans University*

Corresponding Author: kangsin@ewha.ac.kr

The Standard Model is gauge theory based on a particular gauge group and matter fields transforming under it. One possible explanation of its origin is given by string theory. In particular, F-theory describes gauge theory in geometric way and gives us good explanation on Grand Unified structure. Although many Grand Unification based on simple groups are suggested for simplicity, without intermediate unification, we want to directly obtain the Standard Model at the unification scale.

Particle Cosmology / 264

The Case of Light Neutralino Dark Matter

LIU, Zhen [1]

[1] *University of Pittsburgh*

Corresponding Author: zhl61@pitt.edu

We study the neutralino to be the lightest Supersymmetric particle (LSP) as a Dark Matter (DM) candidate with a mass 2-40 GeV in the framework of the Next-to-Minimal-Supersymmetric-Standard-Model (NMSSM). We find that with the current collider constrains from the LEP, Tevatron and LHC, there are three types of light DM solutions consistent with the direct/indirect searches as well as the relic abundance considerations: (i) A1/H1-funnel, (ii) stau co-annihilation and (iii) sbottom co-annihilation. Type-(i) may take place in any theory with a light scalar (or pseudo-scalar) near the LSP pair threshold; while Type-(ii) and (iii) could occur in the framework of Miminal Supersymmetric-Standard-Model (MSSM) as well. We present a comprehensive study on the properties of these solutions and point out their immediate relevance in the direct search and indirect search experiments. We then focus on the observational aspects of them at colliders. The decays of the SM-like Higgs boson may be modified appreciably and the new decay channels to the light SUSY particles may be sizable. The new light CP-even and CP-odd Higgs bosons will decay to a pair of LSP as well as other observable states, leading to rich new Higgs phenomenology at colliders. For the light sfermion searches, the signal becomes hard to observe at the LHC when the LSP mass is nearly degenerate with the parent particle. However, a lepton collider would be able to uncover this scenario through pair production and pair production with additional photon.

Particle Cosmology / 265

XENON searches for dark matter

Dr. BROWN, Andrew [1]

[1] *Purdue University / XENON collaboration*

Corresponding Author: andygrahambrown@gmail.com

The XENON project utilises liquid xenon Time Projection Chambers (TPCs) to search for terrestrial evidence of dark matter, looking for spin-dependent and spin-independent interactions of WIMPs, as well as axio-electric couplings of axions and axion-like particles. The most recent XENON experiment, XENON100, completed 225 live-days of data taking in 2012. This run lead to one of the most stringent limits on the spin-independent elastic-scattering cross-section of WIMP-like dark matter to date, with a limit of 2.0×10^-45 cm^2 for WIMPs of mass 55 GeV/c^2. A further XENON00 run with 154 live-days has completed and is soon to be un-blinded. Presently, XENON100 is set to test new calibrations, with a view to improve the understanding of nuclear recoil behaviour in liquid xenon and advanced calibration sources.

The XENON project is quickly moving to its next step, XENON1T, which is currently under construction and will begin taking data next year. The sensitivity of XENON1T is expected to be 2 orders of magnitude greater than XENON100. Understanding how this new detector behaves is a key concern, and new calibration methods are under research to meet this concern. An upgrade for the XENON1T detector is also planned, with a designed sensitivity of a few times 10^-48 cm^2.

Particle Cosmology / 266

Mass Bounds on Wino Dark Matter from Thermal Leptogenesis

Dr. SCHMITZ, Kai [1]

[1] *Kavli IPMU, University of Tokyo*

Corresponding Author: kai.schmitz@ipmu.jp

A high inflationary energy scale not only entails a measurably large tensor-to-scalar ratio, which (could be / has been) seen in the polarization of the cosmic microwave background, but also suggests a high reheating temperature after the end of inflation. The prime candidate for a viable mechanism to generate the baryon asymmetry of the universe as well as the dark matter relic abundance is then thermal leptogenesis in combination with the decay of very heavy, thermally and nonthermally produced gravitinos into light winos. We revisit this cosmological scenario and connect it to upcoming searches for supersymmetry at the LHC. In particular, we derive explicit mass bounds on the dark matter particle that allow to scrutinize the compability between high-scale models of inflation and the vanilla scenario of thermal leptogenesis accompanied by WIMP dark matter.

Higgs Phenomenology / 267

Improved τ-weapons for Higgs hunting

Dr. VIVES, Oscar [1]

[1] *U. de Valencia and IFIC*

Corresponding Author: oscar.vives@uv.es

In this work, we use the results from Higgs searches in the $\gamma \gamma$ and $\tau \tau$ decay channels at LHC and indirect bounds as BR($B\toX_s\gamma$) to constrain the parameter space of a generic MSSM Higgs sector. In our analysis, we reduce to the minimum the model input and use only experimental information to restrict the scalar masses and mixings. In particular, we include the latest CMS results that look for additional Higgs states with masses up to 1 TeV. We show that the $\tau \tau$ channel is the best and most accurate weapon in the hunt for new Higgs states beyond the Standard Model. We obtain that present experimental results rule out additional neutral Higgs bosons in a generic MSSM below 300 GeV for any value of $\tan \beta$ and, for instance, values of $\tan \beta$ above 30 are only possible for Higgs masses above 600 GeV.

Particle Cosmology / 268

Large tensor-to-scalar ratio from supersymmetric hybrid inflation potential

SETO, Osamu [1]

[1] *Hokkai-Gakuen University*

Corresponding Author: seto@physics.umn.edu

We show in double inflation scenario where a second inflation follows hybrid inflation, the supersymmetric hybrid inflation with a coupling of the order of unity can generate a large tensor perturbatio. This scenario would relax the tension between BICEP2 and Planck concerning the tensor-to-scalar ratio, because a negative large running can also be obtained for a certain number of e-fold of the hybrid inflation. (This is based on arXiv:1404.3102.)

Lepton Flavour Violation and Neutrinos / 269

Naturalness reconsidered: the example of neutrino seesaw mechanism and dark matter

FABBRICHESI, Marco [1]

[1] *INFN*

Corresponding Author: marco@sissa.it

We discuss how two birds---the little hierarchy problem of low-scale type-I seesaw models and the search for a viable dark matter candidate---are killed by one stone: a new inert scalar state

Particle Cosmology / 270

The interplay of the LHC and Direct Dark Matter Detection in unravelling Natural Supersymmetry at the Focus Point

Mr. BARDUCCI, Daniele [1]; Dr. BELYAEV, Alexander [1]; Dr. BHARUCHA, Aoife [2]; Dr. POROD, Werner [3]; Dr. SANZ, Veronica [4]

[1] *University of Southampton*

[2] *Technische Universität München*

[3] *Universität Würzburg*

[4] *University of Sussex*

Corresponding Author: a.belyaev@soton.ac.uk

We present results on the interplay of the LHC and direct dark matter(DDM) experiments in probing the far focus point (FFP) region of natural supersymmetry, within the MSSM framework. This parameter space is characterised by low values of mu-parameter and a compressed spectrum for DM and the next-to-lightest neutralino and the lightest chargino -- which can only be probed via mono-jet signatures -- the subject of our analysis. The low signal-to-background ratio is a challenging but important characteristic of this search and the control of the systematic error is crucial. We take into account a) realistic systematic errors and b) fast detector simulation which are both essential in estimating the correct LHC sensitivity to the FFP. As a result we have have found a high degree of the complementary between the LHC and DDM search experiments in this special and well-motivated region.

Formal SUSY and Strings / 272

Some phenomenological aspects of String Sequestered Models

Dr. APARICIO, Luis [1]

[1] *Postdoc*

Corresponding Author: laparici@ictp.it

We present a general analysis of soft SUSY breaking in fluxed Type IIB de Sitter string vacua with all moduli stabilized, focusing on models in which the MSSM is sequestered from the SUSY breaking sources and the spectrum of soft terms is hierarchically smaller than the gravitino mass

Lepton Flavour Violation and Neutrinos / 273

Heavy neutral leptons

Mr. IVASHKO, Artem [1]

[1] *Leiden University*

Corresponding Author: ivashko@lorentz.leidenuniv.nl

Heavy neutral leptons are attractive candidates for the extension of the Standard Model, since they can explain the physical origin of the three major observable BSM phenomena (Neutrino oscillations, Baryon asymmetry of the Universe, and Dark matter) in framework of one model, where the number of new free parameters is quite small. I will review the role of the new particles in cosmology, their past searches at accelerator facilities, together with the prospects for future searches in the new SHIP experiment (Search for HIdden Particles), that is being actively discussed in CERN.

Alternative Theories / 274

Searches for No-SUSY Exotics

Dr. DE CAPUA, Stefano [1]

[1] *University Of Manchester*

Corresponding Author: decapua.stefano@gmail.com

Its forward acceptance and good resolution allow LHCb to perform competitive searches for heavy particles beyond the Standard Model. We report about searches for long lived particles with the LHCb detector and give our prospects for future measurements.

Lepton Flavour Violation and Neutrinos / 275

Overview of lepton flavour violation and lepton number violation measurements at LHCb

Dr. RANGEL, Murilo [1]

[1] *UFRJ*

Corresponding Author: rangel@cern.ch

The observation of neutrino oscillations has re-opened the case for searches of lepton-flavour violating decays. We report on recent results and prospects on lepton-flavour violating τ decays, as well as searches for short or long-lived Majorana heavy neutrinos in $B \longrightarrow \mu\mu\pi$ decays.

Quark Flavour Violation / 276

Radiative decays at LHCb

RIVES MOLINA, Vicente Jose [1]

[1] *Universitat de Barcelona*

Corresponding Author: vrives@ecm.ub.edu

The Standard Model predicts that the photons emitted in flavor---changing neutral current b to s gamma transitions are predominantly left---handed. However, the photon polarization has never been observed in a direct measurement and remains largely unexplored. Several extensions of the Standard Model predicting a significantly different

photon
polarization
have
not
been
yet
ruled
out
by
other

measurements,
such
as
the
inclusive
B
to
Xs
gamma
decay
rate.

Among
other
topics,
this
talk
will
focus
on
the
recent
study
of
the
radiative
B
to
K

pi
pi
gamma
decays
performed
using
data
collected
in
pp
collisions
with
the

LHCb
detector
at
7
and
8
TeV
center---of---mass
energies.
The
distribution
of
the

angle
of
the
photon
direction
with
respect
to
the
plane
defined
by
the
final---state

hadrons
in
their
rest
frame
is
studied
in
intervals
of
K
pi
pi
mass
and
the

asymmetry
between
the
number
of
signal
events
found
on
each
side

of
the
plane

is
presented.

The
first
direct
observation
of
the
photon
polarization
in
the
b
to
s
gamma

transition
is
reported
with
a
significance
of
5.2
standard
deviations.

Quark Flavour Violation / 277

Electroweak penguin decays to leptons at LHCb

Mr. LINN, Christian [1]

[1] *CERN*

Corresponding Author: christian.linn@cern.ch

Rare decays of beauty and charm hadrons test the flavour structure of the underlying theory at the level of quantum corrections. They provide information on the couplings and masses of heavy virtual particles appearing as intermediate states. A review of recent results obtained by LHCb on these topics will be presented

Quark Flavour Violation / 278

Searches for BSM Physics in Rare B-Decays (CMS)

MARGONI, Martino [1]

[1] *Universita` di Padova and INFN*

Corresponding Author: martino.margoni@pd.infn.it

Searches for BSM Physics in Rare B-Decays (CMS)

Alternative Theories / 279

Proton Stability in SU(5)XU(1) and SU(6)X SU(2) GUTs

Dr. PARASKEVAS, Michael [1]

[1] *University of Ioannina*

Corresponding Author: mparask@grads.uoi.gr

We consider explicit unified models based on the flipped SU(5)X U(1) and SU(6)X SU(2) gauge groups in which gauge mediated proton decay operators are suppressed at leading order due to the special placement of matter fields in unified multiplets. We discuss both the theoretical structure and phenomenological implications of these models. For the latter, we examine the viability of the physical spectrum in each scenario and focus on the possible presence of other operators that could also contribute significantly to the proton decay rate.

Alternative Theories / 281

Searches for BSM Physics in Events with Top Quarks (CMS)

HOEING, Rebekka [1]

[1] *University of Hamburg*

Corresponding Author: rebekka.hoeing@desy.de

In many models of physics beyond the Standard Model the coupling of new physics to third generation quarks is enhanced and signatures are expected that mimic top production. We present a review of non-MSSM based searches for new physics beyond the standard model in final states containing top quarks and/or bottom quarks. This includes includes searches for heavy gauge bosons, excited quarks, chirall and vector-like top quark partners. The searches span a range of final states, from multi-leptonic to entirely hadronic, and many results use novel analysis techniques to reconstruct the highly boosted final states that are created in these topologies. The searches are performed on data collected with the CMS experiment in proton-proton collisions at the LHC at a centre-of-mass energy of 7 and 8 TeV.

Formal SUSY and Strings / 282

Higher Curvature Corrections in M-Theory Reductions

Dr. PUGH, Tom [1]

[1] *Max Planck Institute Munich*

Corresponding Author: pught@mppmu.mpg.de

The reduction of the 11 dimensional supergravity action on an elliptically fibered Calabi-Yau fourfold gives rise to an N=2 supersymmetric theory in 3 dimensions which is dual to a 4 dimensional N=1 F-theory reduction. We will consider how higher derivative corrections to the 11 dimensional action modify these effective theories. Our discussion of this will include an analysis of the effective action for the Kahler moduli taking into account contributions which come from the expansion of both the 11 dimensional metric and 3 form.

Formal SUSY and Strings / 283

Heterotic Line Bundle Models on Smooth Calabi-Yau Manifolds

Dr. CONSTANTIN, Andrei [1]

[1] *University of Oxford*

Corresponding Author: a.constantin1@physics.ox.ac.uk

It has recently been realised that polystable, holomorphic sums of line bundles over smooth Calabi-Yau three-folds provide a fertile ground for heterotic model building. Large numbers of phenomenologically promising such models have been constructed for various classes of Calabi-Yau manifolds. I will briefly discuss the class of models based on complete intersections in products of projective spaces. I will also present a particular line bundle model constructed on the tetra-quadric manifold. Further, I will explore the embedding of the line bundle sum into the larger moduli space of non-Abelian bundles, both by means of constructing specific polystable non-Abelian bundles and by turning on VEVs in the associated low-energy theory. The non-Abelian compactifications thus constructed lead to SU(5) GUT models with an extra global U(1) symmetry, which combined with the hypercharge leads to a B-L symmetry. The non-Abelian compactifications inherit many of the appealing phenomenological features of the Abelian model, such as the absence of dimension four and dimension five operators triggering a fast proton decay.

Lepton Flavour Violation and Neutrinos / 284

Reactor Neutrino Experiments

Dr. DAWSON, Jaime [1]

[1] *laboratoire APC*

Corresponding Author: jdawson@in2p3.fr

The reactor anti-neutrino experiments; Daya Bay, Double Chooz and RENO, have been incredibly successful. Since the first hint of theta_13 in 2011, which was larger than expected, the value of sin^2(2theta_13) has been now measured by the three experiments to be 0.084 +/- 0.005, 0.09 +/-0.03 and 0.101 + 0.013 respectively.
I will describe the experiments, highlighting the main differences between them, and review the different and complementary methods of obtaining theta_13 (rate, spectrum, rate modulation, and hydrogen capture). I will show the latest results and the projections of the expected final sensitivities.
Other measurements can also be made with reactor experiments, such as delta_m^2ee, search for sterile neutrinos, and comparisons of the anti-neutrino spectrum to reactor models. I will briefly summarise these additional results.

Lepton Flavour Violation and Neutrinos / 285

Recent accelerator long baseline neutrino oscillation results

Prof. RATOFF, Peter [1]

[1] *Lancaster University*

Corresponding Author: p.ratoff@lancaster.ac.uk

Recent neutrino oscillation results from the MINOS and T2K collaborations will be reviewed, including their latest muon neutrino disappearance, electron neutrino appearance and combined disappearance/appearance measurements. The new constraints that these experiments impose on the neutrino mixing parameters will be discussed and the prospects for future improvements will be briefly outlined.

Precision SUSY / 286

Searches for Signatures of R-Parity Violating Models (CMS)

Mr. SAKA, Halil [1]

[1] *Princeton University*

Corresponding Author: skhalil@phys.ksu.edu

In this talk, the latest results from CMS on searches for RP violating supersymmetry or Leptoquarks are presented using 20/fb of data from the 8 TeV LHC run. Results across a wide range of final states are reviewed, and interpreted in the context of a variety of models of new physics including leptoquarks, gluinos, squarks, neutralinos, charginos and sleptons.

Precision SUSY / 287

Searches for Gluino, Stop and Sbottom Production in Channels with b-Jets and MET (CMS)

Ms. STROBBE, Nadja [1]

[1] *Ghent University*

Corresponding Author: nadja.strobbe@cern.ch

In this talk, the latest results from CMS on searches for gluino, stop and sbottom squarks are presented in final states with b-tagged jets and MET. A variety of complimentary techniques for a wide range of number of jets, HT, and MET in the final state are reviewed. The results based on up to 20/fb of data collected during the 8 TeV LHC run are presented, and interpreted in a variety of models.

Higgs Phenomenology / 288

BSM Higgs Searches at CMS

Mr. FRENSCH, Felix [1]

[1] *CMS*

Corresponding Author: felix.frensch2@kit.edu

In July 2012 the discovery of a new particle has been announced. While it is clear that the particle is a Higgs boson it is not clear if it is the Standard Model Higgs boson. Measurements of the new particle have been performed and are ongoing to extract the properties of the boson. Finding additional Higgs bosons would exclude the Standard Model in its current shape. Many theories beyond the Standard Model predict an extended Higgs sector.
In this talk, an overview for Higgs boson searches beyond the Standard Model is given. Results are presented in model independent ways as well as interpreted in selected SUSY models.
The data has been taken with the CMS detector at the LHC based on Run I

Higgs Phenomenology / 289

SM Higgs Combination and Higgs Properties Measurements (CMS)

Dr. PIN, Arnaud [1]

[1] *University of Manchester*

Corresponding Author: arnaud.pin@cern.ch

Within the SM, the masses of the electroweak vector bosons arise by the spontaneous breaking of electroweak symmetry by the Higgs field. The ATLAS and CMS experiments at the Large Hadron Collider (LHC), have reported the discovery of a new boson with a mass of approximately 125 GeV with a significance of five or more standard deviations each. Both observations show consistency with the expected properties of the SM Higgs boson at that mass. The determination of the properties of the observed boson, such as its couplings to other particles, mass, and quantum numbers, including spin and parity, is crucial for establishing the nature of this boson. In this talk we present the CMS experiment's combination of results from Higgs all decays channels and the measurements of its properties.

Lepton Flavour Violation and Neutrinos / 290

An unidentified line in X-ray spectra of the Andromeda galaxy and Perseus galaxy cluster

Mr. FRANSE, Jeroen [1]

[1] *Leiden University*

Corresponding Author: franse@lorentz.leidenuniv.nl

We identify a weak line at 3.5 keV in X-ray spectra of the Andromeda galaxy and Perseus galaxy cluster using deep exposures from the XMM-Newton Telescope Science Archive. The detection of this signal is presented, along with evidence that it can not concern a previously unknown systematic. The possibility is discussed that the signal originates from the decay of dark matter particles rather than an astrophysical source. Finally, outlines of ongoing and future work to test this scenario are given.

Lepton Flavour Violation and Neutrinos / 291

Relation between neutrino sector and proton decay in flipped SU(5) unification

Mrs. KOLESOVA, Helena [1]

[1] *Czech Technical University in Prague*

Corresponding Author: helena.kolesova@fjfi.cvut.cz

e implement the Witten's loop mechanism for the right-handed Majorana neutrino mass generation within the framework of the non-SUSY unification based on $SU(5)\times U(1)$ gauge group -- so called flipped SU(5). Since in this model the mass matrices of up-type quarks and Dirac neutrinos differ only by transposition, the mixing matrix relevant for proton decay computation is closely related to lepton mixing. With the recent data on PMNS mixing angles at hand, bounds on the proton lifetime are computed. Finally, our model is compared with SUSY flipped SU(5). This is joint work with Michal Malinsky and Carolina Arbelaez Rodriguez.

Quark Flavour Violation / 292

Bs(d) → mu+ mu+ in the SM and beyond

MISIAK, Mikolaj [1]

[1] *University of Warsaw*

Corresponding Author: misiak@fuw.edu.pl

Constraints from Bs(d) → mu+ mu+ on the parameter spaces of beyond-SM models become more powerful with growing accuracy of the measurements and the SM calculations. I will describe the current status of the SM predictions, including the recently determined NLO EW and NNLO QCD corrections. Consequences for the 2HDM-II and the MSSM will be briefly discussed.

Lepton Flavour Violation and Neutrinos / 293

Prospects for Lepton Number Violation searches with SuperNEMO and other future neutrinoless double beta decay experiments

GUZOWSKI, Pawel [1]

[1] *Manchester*

Corresponding Author: pawel.guzowski@hep.manchester.ac.uk

Neutrinoless double beta decay is a Lepton Number Violating decay, the observation of which would answer one of the remaining questions of the Standard Model: the Dirac or Majorana nature of the neutrino. The search can also constrain Beyond the Standard Model processes which could mediate this decay. The SuperNEMO experiment, currently under construction, will have a neutrino mass sensitivity down to 50 meV, and sensitivity to BSM processes such as Right Handed Weak Currents and Majoron emission.This talk will present the status of SuperNEMO and give an overview of other experiments in the field.

Precision SUSY / 294

Electroweak Effective Operators and Higgs Physics

Dr. CHEN, Chien-Yi [1]

[1] *Brookhaven National Laboratory*

Corresponding Author: cychen@bnl.gov

We derive bounds from oblique parameters on the dimension-6 operators of an effective field theory of electroweak gauge bosons and the Higgs doublet. The loop-induced contributions to the S, T, and U oblique parameters are sensitive to these contributions and we pay particular attention to the role of renormalization when computing loop corrections in the effective theory. Limits on the coefficients of the effective theory from loop contributions to oblique parameters yield complementary information to direct Higgs production measurements.

Precision SUSY / 295

GravitinoPack - a tool for calculating gravitino processes

EBERL, Helmut [1]

[1] *Institut for High Energy Physics*

Corresponding Author: helmut.eberl@oeaw.ac.at

We present the numerical package GravitinoPack that calculates processes involving the gravitino. GravitinoPack is written in Fortran77 and can be linked to Mathematica.

The framework is the R-parity conserving Minimal Supersymmetric Standard Model, assuming that the gravitino is unstable or the Next to Lightest Supersymmetric Particle decays to gravitino. For calculating the squared amplitudes we use the packages FeynArts and FormCalc, with appropriate extensions to accommodate the gravitino with spin 3/2. Our code treats automatically the intermediate exchanged particles that are on their mass shell, using the narrow width approximation. This method considerably simplifies the complexity of the evaluation and stabilizes it numerically.

Lepton Flavour Violation and Neutrinos / 296

Searches for Electroweak-Scale Heavy Neutrinos at the LHC

Prof. YANG, Un-ki [1]

[1] *Seoul National University*

Corresponding Author: ukyang@snu.ac.kr

The discovery of neutrino oscillations suggests the existence of right-handed neutrinos. LHC can probe right-handed heavy neutrino masses inaccessible to previous direct and indirect searches. In particular, models predicting Majorana neutrinos can result in striking experimental signatures of like-sign lepton pairs with two additional high transverse momentum jets. In this talk, we present the results of searches for heavy Majorana neutrinos using the ATLAS and CMS detectors.

Lepton Flavour Violation and Neutrinos / 297

Precision tests of the Standard Model with kaon decays at CERN

Dr. PICCINI, Mauro [1]

[1] *CERN & INFN - sezione di Perugia*

Corresponding Author: mauro.piccini@pf.infn.it

Recent results and prospects for precision tests of the Standard Model in kaon decay in flight experiments at CERN are presented. A measurement of the ratio of leptonic decay rates of the charged kaon at a 0.4% precision constrains the parameter space of new physics models with extended Higgs sector, a fourth generation of quarks and leptons or sterile neutrinos.
Searches for heavy neutrino mass states and the dark photon in the ~100 MeV/c^2 mass range based on samples collected in 2003-2007 are in progress and prospects will be discussed. The NA62 experiment starting in 2014 will search for a range of lepton number and lepton flavour violating decays of the charged kaon and the neutral pion at improved sensitivities down to ~10^{-12}, which will probe new physics scenarios involving heavy Majorana neutrinos or R-parity violating SUSY.

Models of SUSY / 298

What next for the CMSSM and the NUHM: Improved prospects for superpartner and dark matter detection

Dr. WILLIAMS, Andrew [1]

[1] *NCBJ*

Corresponding Author: andrew.williams@fuw.edu.pl

We present an updated analysis of the CMSSM and the NUHM using the latest experimental data and numerical tools. We map out favored regions of Bayesian posterior probability in light of data from the LHC, flavor observables, the relic density and dark matter searches. We present some updated features with respect to our previous analyses: we include the effects of corrections to the light Higgs mass beyond the 2-loop order using FeynHiggs v2.10.0; we include in the likelihood the latest limits from direct searches for squarks and gluinos at ATLAS with ~20/fb; the latest constraints on the spin-independent scattering cross section of the neutralino from LUX are applied taking into account uncertainties in the nuclear form factors. We also derive the excepted sensitivity of the future CTA experiment to 1TeV higgsino dark matter for both models. We comment on the complementarity of this search to planned direct detection experiments such as XENON 1T. We compare the prospects of future detection in both models.

Lepton Flavour Violation and Neutrinos / 299

Neutrino parameters and N2 -dominated leptogenesis

Mr. RE FIORENTIN, Michele [1]

[1] *University of Southampton*

Corresponding Author: mrf1g12@soton.ac.uk

I will concentrate on the link between leptogenesis and low-energy neutrino data, showing how the baryon asymmetry of the Universe can constrain a type- I seesaw model and yield interesting predictions on the neutrino parameters. To this aim, I will consider the conditions required by strong thermal leptogenesis, where the final asymmetry is fully independent of the initial conditions. In this framework, barring strong cancellations in the seesaw formula and in the
flavoured decay parameters, a lightest neutrino mass m1 10 meV for normal ordering and m1
3 meV for inverted ordering are favoured. Finally, I will
briefly comment on the even richer predictions of SO(10)-inspired leptogenesis models and on the present experimental evidences.
This talk is based on arXiv:1401.6185 [hep-ph].

Precision SUSY / 301

Searches for SUSY in Final States with Photons (CMS)

Prof. HANSON, Gail [1]

[1] *University of California, Riverside*

Corresponding Author: gail.hanson@cern.ch

In this talk, the latest results from CMS on searches for supersymmetry in final states with photons are presented using up to 20/fb of data from the 8 TeV LHC run. A variety of complementary final state signatures and methods are used to probe gluino, squark and Electroweak SUSY production.

Quark Flavour Violation / 302

Recent Babar results on CP violation

Prof. BARLOW, Roger [1]

[1] *University of Huddersfield*

Corresponding Author: roger.barlow@manchester.ac.uk

Recent Babar results on CP violation

Quark Flavour Violation / 303

Direct searches for New Physics particles at BABAR

GUIDO, Elisa [1]

[1] *Universita di Genova*

Corresponding Author: elisa.guido@cern.ch

Direct searches for New Physics particles at BABAR

Formal SUSY and Strings / 304

Systematic F-theory model building with extra U(1)s

Dr. SCHAFER-NAMEKI, Sakura [1]

[1] *King's College London*

Corresponding Author: ss299@kcl.ac.uk

I will first review recent advances in F-theory GUT model building, including the construction of globally well-defined compactification geometries, which realize additional U(1) symmetries, for instance to disallow proton decay operators, which are vital in building realistic models. I will then explain how to determine the complete set of possible U(1) charge patterns using Tate's algorithm.

Quark Flavour Violation / 305

Supersymmetric Higgs boson with General Flavour Violation

Dr. KOWALSKA, Kamila [1]

[1] *National Center for Nuclear Research*

Corresponding Author: kamila.kowalska@fuw.edu.pl

We discuss the consequences of relaxing the Minimal Flavour Violation assumption in the up-squark sector for the mass of the lightest Higgs scalar and we derive the approximate analytical formulae that quantify this effect. We show that m_h can be enhanced by up to $13-14$ GeV in the case of the phenomenological MSSM with the inverted hierarchy of masses in the squark sector and zero stop mixing, and up to $4-5$ GeV in GUT-constrained scenarios where the magnitude of the enhancement is mitigated by renormalization group effects. We also confront the scenarios allowing for the Higgs mass enhancement with the experimental constraints on the off-diagonal SSB entries coming from the FCNC processes.

Higgs Phenomenology / 306

Two-Higgs-Doublet Model Phenomenology after LHC Run 1

GUNION, John [1]

[1] *U.C. Davis*

Corresponding Author: jfgucd@physics.ucdavis.edu

I discuss the current 2HDM situation after including Higgs data from the completed Run 1 of the LHC. Prospects for discovering the additional 2HDM Higgs bosons (beyond the 125.5 GeV state) are reviewed as are implications should the next LHC Run show increasingly SM-like results for the 125.5 GeV state. The role of a non-decoupling charged Higgs boson loop contribution to the Higgs-photon-photon coupling is briefly surveyed

Precision SUSY / 307

Boosted di-boson from mixed heavy top squarks

Mr. GHOSH, Diptimoy [1]

[1] *INFN, Rome*

Corresponding Author: diptimoy.ghosh@gmail.com

The lighter mass eigenstate (~t1) of the two top squarks, the scalar superpartners of the top quark, is extremely difficult to discover if it is almost degenerate with the lightest neutralino (~N1). The current experimental bound
on ~t1 mass in this scenario stands only around 250 GeV. For such a light ~t1, the heavier top squark
~t2 can also be around the TeV scale. I will argue that in such an MSSM scenario, because of the high value of the measured higgs(h) mass, ~t2 is expected to have considerable branching ratios in the two channels
(~t2 -> ~t1 h) and (~t2 -> ~t1 Z). This leads to a spectacular di-boson + missing transverse energy final state which can also
be used to probe the (~t1 - ~N1) coannihilation region of the MSSM parameter space.
Moreover, the h- and/or the Z bosons can be sufficiently energetic if the ~t1 is light enough allowing the use of jet substructure
technique to dig them out from the SM background.

Particle Cosmology / 309

Searches for Dark Matter Production with Mono-objects and MET in ATLAS

SALEK, David [1]

[1] *Nikhef*

Corresponding Author: david.salek@cern.ch

Searches for Dark Matter Production with Mono-objects and MET in ATLAS

Alternative Theories / 310

ADMX Results on Axion Searches

Dr. DAW, Ed [1]

[1] *The University of Sheffield*

Corresponding Author: e.daw@sheffield.ac.uk

I present a progress report on the direct search for dark matter axions with ADMX upgraded with low noise RF SQUID amplifiers and cryogenics. Axions are a well motivated candidate to explain the discrepancy between the observed baryonic matter density and that inferred from precision measurements of the microwave background anisotropy, gravitational lensing, and the dynamics of spiral galaxies. As a pseudo-Goldstone boson associated with spontaneous breaking of the PQ symmetry, axions gain further credibility from the Higgs discovery. The ADMX experiment utilises a cryogenic tuneable electromagnetic resonator immersed in a static magnetic field to search for axions at micro electron volt scales. The axion field undergoes Primakov conversion into microwave photons when the frequency of a TM resonance of the cavity corresponds to the energy per axion. Background originates from the physical cavity temperature added to the effective noise temperature of the receiver electronics. By reducing the temperature of the axion receiver, we aim for an improved rate of search of the allowed window of axion masses.

Formal SUSY and Strings / 311

A Low-scale Z' in Heterotic String Models

Dr. MEHTA, Viraf [1]; Mr. ATHANASOPOULOS, Panagiotis [1]; Prof. FARAGGI, Alon [1]

[1] *University of Liverpool*

Corresponding Author: viraf.mehta@liverpool.ac.uk

Although additional low scale U(1)s have been discussed extensively in SUSY GUTs and superstring models, having a viable light, extra U(1) in worldsheet heterotic string constructions has proven to be a challenge. Here, we present the construction of heterotic string models using the free fermionic formulation and focus on how viable U(1)s may arise. We motivate an example as an appealing proposition to explain the suppression of proton decay mediating operators, induced in supersymmetric models. The additional symmetry forbids the undesired operators, and therefore must be light to accommodate proton lifetime constraints. We discuss and contrast two classes of superstring models with a desirable additional U(1): those with charges embedded in E6 and those without embedding. We show that the gauge coupling data at the electroweak scale necessitate that the Z' charges are embeddable in E6 but that anomaly free U(1) combinations require no such embedding. We present a recipe of how enhancement may circumvent this conundrum and construct a standardlike model with desirable properties.