Lessons from the first phase of the LHC

Tuesday, 25 September 2012 - Friday, 28 September 2012

DESY Hamburg

Book of Abstracts

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The universal density profile of the central region of dark matter haloes

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We consider the density profile of the central region of dark matter haloes. It turns out that under very general conditions the profile is universal: it depends almost not at all on the properties of the initial perturbation and is very akin, but not identical, to the Einasto profile.

We estimate the size of the 'central core' of the distribution, i.e., the extent of the very central region with a respectively gentle profile, and show that the cusp formation is unlikely, even if the dark matter is cold. We also indicate that the density profile of the outer part ($r > 0.5R_{vir}$) of the haloes significantly depends on the initial conditions and should not be universal, in contrast to the central area. All these results can be useful both to indirect search of the dark matter and to N-body simulations of the structure formation.

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Maximal R-symmetry violating amplitudes in type IIB superstring theory.

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Calculating scattering amplitudes in a flat background is one of the first things to learn in string theory: the subject started after all with Veneziano's amplitude. Beyond four external legs however explicit computations get prohibitively complex quickly using standard world-sheet methods. In this talk I will show how one can use on-shell super-symmetry in type IIB superstring theory to bypass the complexity and arrive at astonishingly compact answers for a particular class of amplitudes. This class violates in a precise sense the R-symmetry maximally.

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Minimal Flavor Violation without R-parity

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We study the extension of the MFV hypothesis to the MSSM without R-parity. The novelty of our approach lies in the observation that supersymmetry enhances the global symmetry of the kinetic term and in the fact that we consider as irreducible sources of flavor breaking all the couplings of the superpotential, including the R-parity violating ones. When R-parity violation is responsible for neutrino masses, our setup can be seen as an extension of MFV to the lepton sector.

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NLO corrections to squark-squark production and decay at the LHC

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We present an analysis of the signature 2j + ETmiss (+X) via squark-squark production and direct decay into the lightest neutralino, pp -> squark squark -> j j chi_1^0 chi_1^0 (+X), in next-to-leading order QCD within the framework of the minimal supersymmetric standard model. In our approximation the produced squarks are treated on shell. Thus, the calculation of production and decay factorizes. In this way, we provide a consistent, fully differential calculation of NLO QCD factorizable corrections to the given processes. Clustering final states into partonic jets, we investigate the experimental inclusive signature 2j + ETmiss for several benchmark scenarios. We compare resulting differential distributions with leading-order approximations rescaled by a flat K-factor and examine a possible impact for cut-and-count searches for supersymmetry at the LHC.

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QCD threshold resummation for Gluino-pair production at NNLL

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We present improved predictions for the total hadronic cross section
of gluino pair production at hadron colliders including NNLO threshold
corrections. Here, we give analytic formulas for the color-decomposed
NLO and (approximated) NNLO scaling functions, which allow for a resummation of Sudakov logarythms up to NNLL. We perform the resummation in Mellin space and give analytic results for the hard matching coefficients.

Parallel Session 1: Particle Phenomenology / **35**

Extracting B –> K* Form Factors from Data

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Form factors for hadronic transitions are a leading error source in the theoretical estimate of observables whose experimental measurements might eventually uncover BSM physics.
Two theoretical approaches, depending on the kinematic region, for the determination of hadronic form factors are available, namely LCSR and Lattice QCD.
We extract ratios of $B \to K^*$ form factors at low hadronic recoil from recent data on $B \to K^* \mu^+ \mu^-$ decays in a model-independent way, building a bridge between the two theoretical determinations and the recently available data on this decays.
In the talk this new method will be presented, based on the publication “Extracting B –> K* Form Factors from Data” arXiv:1204.4444 in collaboration with Gudrun Hiller.

Parallel Session 2: Cosmology & Astroparticle Physics / **36**

Closing in on mass-degenerate dark matter scenarios with antiprotons and direct detection

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Over the last years both cosmic-ray antiproton measurements and direct dark matter searches have proved particularly effective in constraining the nature of dark matter candidates. The present work focusses on these two types of constraints in a minimal framework which features a Majorana fermion as the dark matter particle and a scalar that mediates the coupling to quarks. We derive antiproton and direct detection constraints using the latest data and paying close attention to astrophysical and nuclear uncertainties. Interestingly, these limits are orthogonal to ongoing collider searches at the Large Hadron Collider, making it feasible to close in on degenerate dark matter scenarios within the next years.

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

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We present predictions of the total production cross sections of pairs of squarks and gluinos at the LHC, which incorporate a combined resummation of soft logarithms and Coulomb singularities, including bound-state contributions. These terms dominate the threshold region of the partonic cross section and are resummed directly in momentum space using an effective-theory framework based on SCET and pNRQCD. This differs from the more conventional approach where soft logarithms are exponentiated in Mellin-moment space. The combined resummation of soft and Coulomb corrections can lead to much bigger effects than soft resummation alone, with corrections of up to 150% to the fixed-order NLO result for gluino-gluino production at 8 TeV, and smaller (but still sizeable) effects for the other production processes. The theoretical uncertainty of the cross sections is typically reduced to about \pm 10%. The finite widths of the squarks and gluinos have a small, negligible effect on the soft and Coulomb corrections of the total SUSY production cross section.

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Constraints on UED Models with LHC data

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Models with a universal extra dimension (UED), in which all Standard Model fields propagate, predict a rich LHC phenomenology at the TeV scale. We present bounds on the minimal UED, split UED, and non-minimal UED models from the data taken in the first phase of the LHC. We compare our results with existing bounds from flavor physics and electroweak precision tests, thereby showing how much current LHC data has already improved the constraints.

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Motivic multiple zeta values and superstring amplitudes

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String corrections to open superstring tree level amplitudes take a striking and elegant form once the contributions from different classes of multiple zeta values are appropriately disentangled. This novel organization of the alpha prime expansion makes use of a Hopf algebra structure underlying the motivic version of multiple zeta values: It induces an isomorphism which casts the amplitudes into a very symmetric form and represents the generalization of the symbol of a transcendental function. Equipped with these open string results, we can better understand the decoupling of even and higher depth zeta values from closed superstring tree amplitudes.

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2HDM+S effective potential approach to some Higgs decays

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We consider the most general CP-conserving renormalizable effective scalar potential involving two doublets plus one singlet Higgs and satisfying the electroweak gauge symmetry. After deriving the electroweak-symmetry breaking conditions, we focus our attention on specific cases, characterized by specific symmetry properties and/or relations to supersymmetry-inspired extensions of the Standard Model (e.g. n/NMSSM, UMSSM). We then investigate the question of the reconstruction of the potential parameters from the Higgs masses and mixing angles and show that in some specific cases, such as the one of an underlying NMSSM, an accuracy at the order of leading-logarithms is achievable with minimal effort. We finally study a few phenomenological consequences for this latter model: noteworthy effects in Higgs-to-Higgs decays indeed develop, with an impact on collider constraints or the Dark-Matter relic density. We performed a comparison of our procedure with two public codes, NMSSMTools and micromegas, and found some improvement in particular regions of parameter space.

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Naturalness of the Non-Universal MSSM in the light of the recent Higgs results

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We analyse the naturalness of the Minimal Supersymmetric Standard Model (MSSM) in the light of recent LHC results from the ATLAS and CMS experiments. We study non-universal boundary conditions for the scalar and the gaugino sector, with fixed relations between some of the soft breaking parameters, and find a significant reduction of fine-tuning for non-universal gaugino masses. For a Higgs mass of about 125 GeV, as observed recently, we find parameter regions with a fine-tuning of O(10), taking into account experimental and theoretical uncertainties. These regions also survive after comparison with simplified model searches in ATLAS and CMS. For a fine-tuning less than 20 the lightest neutralino is expected to be lighter than about 400 GeV and the lighter stop can be

as heavy as 3.5 TeV. On the other hand, the gluino mass is required to be above 1.5 TeV. For non-universal gaugino masses, we discuss which fixed GUT scale ratios can lead to a reduced fine-tuning and find that the recent Higgs results have a strong impact on which ratio is favoured. We also discuss the naturalness of GUT scale Yukawa relations, comparing the non-universal MSSM with the CMSSM.

Parallel Session 3: Strings & Mathematical Physics / **48**

Towards a Holographic Realization of Homes' Law

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Gauge/gravity duality has proved to be a very successful tool for
describing strongly coupled systems in particle physics and heavy ion
physics. The application of the gauge/gravity duality to quantum matter is a promising candidate to explain questions concerning non-zero temperature dynamics and transport coefficients. To a large extent, the success of applications of gauge/gravity duality to the quark–gluon plasma is founded on the derivation of a universal result, the famous ratio of shear viscosity and entropy density. As a base for applications to condensed matter physics, it is highly desirable to have a similar universal relation in this context as well. A candidate for such a universal law is given by Homes' law: High Tc superconductors, as well as some conventional superconductors, exhibit a universal scaling relation between the superfluid density at zero temperature and the conductivity at the critical temperature times the critical temperature itself. In this work we describe progress in employing the models of holographic superconductors to realize Homes' law and to find a universal relation governing strongly correlated quantum matter. We calculate diffusive processes, including the backreaction of the gravitational matter fields on the geometry. We consider both holographic s-wave and p-wave superconductors. We show that a particular form of Homes'
law holds in the absence of backreaction. Moreover, we suggest further steps to be taken for holographically realizing Homes' law more generally in the presence of backreaction.

Parallel Session 1: Particle Phenomenology / **49**

Numerical evaluation of multi-loop integrals with SecDec

Authors: Gudrun Heinrich[1]; Jonathon Carter[2]; Sophia Borowka[1]

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In this talk the new version of the public program SecDec 2.0 for the
numerical evaluation of multi-loop integrals with several mass scales
is presented.
The program is based on sector decomposition to extract dimensionally regulated singularities. To deal with integrable singularities due to mass thresholds, the integration contour is deformed into the complex plane. As applications, numerical results for several two-loop integrals are given, including non-planar two-loop four-point functions entering heavy quark pair production at NNLO.

Parallel Session 1: Particle Phenomenology / **50**

New Physics Patterns in non-leptonic Charm Decays

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New Physics patterns of D decays to two pseudoscalars are studied in the framework of SU(3) flavor symmetry including breaking effects.

Parallel Session 2: Cosmology & Astroparticle Physics / 51

Smooth Hybrid Inflation and Non-Thermal Type II Leptogenesis

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We consider a smooth hybrid inflation scenario based on a supersymmetric SU(2)*L x SU(2)_R x U(1)*(B-L) model. The Higgs triplets involved in the model play a key role in inflation as well as in explaining the observed baryon asymmetry of the universe. We show that the baryon asymmetry can originate via non-thermal triplet leptogenesis from the decay of SU(2)_(B–L) triplets, whose tiny vacuum expectation values also provide masses for the light neutrinos.

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Nonequilibrium QFT approach to leptogenesis

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The observed baryon asymmetry of the Universe can be elegantly explained in the leptogenesis scenario, where a net lepton asymmetry produced by the decay of heavy right-handed neutrinos is then transfered to the baryon number through the Standard Model sphalerons.

Being an intrinsicly quantum effect the generation of such an asymmetry in the hot early Universe can be described systematically only using nonequilibrium quantum field theory tools. Starting

from first principles one derives a quantum Boltzmann equation which is free of the double counting problem and which incorporates consistently the medium corrections to the masses and decay widths.

Medium corrections are particularly large for the CP-violating parameters. The total decay widths are affected to a lesser extent. Moreover thermal corrections to the heavy neutrino mass play an important role in the case of quasi-degenerate and mildly-degenerate mass spectrum, and can even lead to an avoided level crossing. Therefore a resonant enhancement of the CP-violating parameter can be present at high temperature but absent in the vacuum case.

Parallel Session 3: Strings & Mathematical Physics / **53**

From rigid D-branes to particle physics

Author: Gabriele Honecker[1]

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D6-brane models provide a geometrically intuitive picture for string model building. Rigid D-branes on orbifolds with discrete torsion are of particular interest due to the absence of (some) moduli on the one hand and the power of CFT tools on the other hand.
In this talk, recent progress on constructing the Standard and GUT Models in such D-brane scenarios will be presented.

Parallel Session 1: Particle Phenomenology / **54**

Automated one loop calculations with GoSam

Author: Nicolas Greiner[1]

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In this talk I will present GoSam, a public package to compute one-loop corrections within and beyond the Standard Model. I will discuss how to use this package as well as phenomenological aspects and recent developments.

Parallel Session 2: Cosmology & Astroparticle Physics / **55**

Dark matter distribution in the Milky Way: microlensing and dynamical constraints

Author: Miguel Pato[1]

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Dark matter searches are entering a particularly exciting phase where the complementarity between different signals may finally be explored. This situation calls for a more accurate description of the dark matter distribution in our Galaxy. In this context, I will show that gravitational microlensing and dynamical observables can be combined to set interesting constraints on the dark matter local

density and profile slope. The most commonly discussed dark matter profiles are found compatible with microlensing and dynamical observations, while the local dark matter density is constrained to be in the range 0.20-0.56 GeV/cm^3. Future directions will be discussed.

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Chiral Superfluidity for the Heavy Ion Collisions

Author: Tigran Kalaydzhyan[1]

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In this talk I will argue that the strongly coupled quark-gluon plasma formed at LHC and RHIC can be considered as a chiral superfluid. The 'normal' component of the fluid is the thermalized matter in common sense, while the 'superfluid' part consists of long wavelength (chiral) fermionic states moving independently. I use several nonperturbative techniques to demonstrate that. First, I analyze the fermionic spectrum in the deconfinement phase (Tc < T < 2 Tc) using lattice (overlap) fermions and observe a gap between near-zero modes and the bulk of the spectrum. Second, I use the bosonization procedure with a finite cut-off and obtain a dynamical axion-like field out of the chiral fermionic modes. Third, I use relativistic hydrodynamics for macroscopic description of the effective theory obtained after the bosonization. Finally, solving the hydrodynamic equations in gradient expansion, I find that in the presence of external electromagnetic fields the motion of the 'superfluid' component gives rise to the chiral magnetic, chiral electric and dipole wave effects. Latter two effects are specific for a two-component fluid, which provides us with crucial experimental tests of the model.

Parallel Session 1: Particle Phenomenology / 58

Phenomenological Aspects of the GNMSSM

Author: Kai Schmidt-Hoberg[1]

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I will discuss phenomenological aspects of the GNMSSM.

Parallel Session 2: Cosmology & Astroparticle Physics / 59

Electrically charged curvaton

Author: Rose Lerner[1]

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We consider the possibility that the primordial curvature perturbation was generated through the curvaton mechanism from a scalar field with an electric charge, or precisely the Standard Model U(1) weak hypercharge. This links the dynamics of the very early universe concretely to the Standard Model of particle physics, and because the coupling strength is known, it reduces the number of free parameters in the curvaton model. We show that the model is compatible with CMB observations

for large Hubble rate and large curvaton mass. Charge fluctuations generated during inflation are screened by electron-positron pairs, and therefore do not violate observational constraints. The interaction with the gauge field leads to interesting dynamics after inflation, including resonant preheating, with non-trivial observational consequences.

Parallel Session 3: Strings & Mathematical Physics / 60

Slow-Walking Inflation

Authors: Carlos Nunez[1]; Gianmassimo Tasinato[2]; Johanna Erdmenger[3]; Sebastian Halter[4]

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We propose a new model of D3-brane inflation in a recently constructed class of warped throat backgrounds of Type IIB Supergravity, which are modifications of the Klebanov-Strassler background in the IR region. The dilaton has a non-trivial profile along the radial direction and induces a potential for the D3-brane. This contribution to the D3-brane potential generically features an inflection point near the tip of the throat and thus may provide a new possibility to address the eta-problem.

Parallel Session 2: Cosmology & Astroparticle Physics / 61

PAMELA and FERMI limits on the neutralino-chargino mass degeneracy

Author: Jonathan Da Silva[1]

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Searches for Dark Matter particles with indirect detection techniques have reached an important milestone with the measurements of the anti-proton and positron spectra by the PAMELA experiment and the gamma-ray fluxes by the FERMI-LAT experiment. While the γ-ray results have been used to test the thermal Dark Matter hypothesis and constrain the Dark Matter annihilation cross section into Standard Model particles, the anti-proton flux measured
by the Pamela experiment remains relatively unexploited. Here we show that the latter can be used to set a constraint on the mass spectrum in the dark sector that can be as strong as that derived from the Fermi-LAT data. To illustrate our point we use a Supersymmetric model in which the gauginos are light, the sfermions are heavy and the lightest particle is the neutralino. In
this framework the WW production is expected to be very significant, thus leading to large p and γ-ray fluxes. We show that the neutralino-chargino mass difference can be constrained up to
20 GeV for a mixed neutralino, using PAMELA data. As a result, we can safely rule out the pure wino neutralino hypothesis if it constitutes all the Dark Matter.

Parallel Session 1: Particle Phenomenology / 62

Updates on the anomalous magnetic moment of the muon in the MSSM

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The anomalous magnetic moment of the muon, aμ , is an important quantity to test the Standard Model. The highly precise experimental and theoretical determination of aμ leads to a discrepancy of 3 to 4σ. This deviation could be explained by contributions of the MSSM. To be competitive to the high accuracy of the experiment, in particular the future improved measurements, and the SM theory prediction, also high accuracy of the MSSM theory prediction is necessary. Therefore, two-loop corrections to aμ need to be evaluated.
I present recent updates on this issue, in particular corrections to MSSM one-loop diagrams by a closed fermion–sfermion–loop. I introduce the class of Feynman diagrams and explain some details of their renormalisation. Finally, I show numerical results for interesting parts of the MSSM parameter space.

in collaboration with Helvecio Fargnoli, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
Christoph Gnendiger, Dominik Stöckinger and Hyejung Stöckinger-Kim, Institute for Nuclear and Particle Physics, TU Dresden, Dresden,
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Parallel Session 1: Particle Phenomenology / 63

Flavor violating Higgs decays

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Co-authors: Jure Zupan [2]; Roni Harnik [3]

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As experimental evidence for a Higgs boson with a mass around 125 GeV is mounting, the question whether its couplings are Standard Model-like is becoming more and more important. Deviations from the Standard Model predictions could for example point to the existence of secondary mechanism of electroweak symmetry breaking such as additional Higgs doublets, or to other types of new physics not too far above the electroweak scale. The flavor structure of such scenarios can be non-trivial, leading to the interesting observation that decays of the 125 GeV Higgs boson can be flavor-violating. In this paper, we derive constraints on flavor-violating Higgs decays into both leptons and quarks using data on rare decays, electric and magnetic dipole moment searches, and meson oscillations. We find that in some flavor-violating Higgs decay channels, for instance H -> \tau\mu, there is significant room for discoveries at the LHC, and we outline possible search strategies. We conclude that flavor violating Higgs decay may present an opportunity for discovery of new physics and in some cases may be easier to access experimentally than flavor conserving deviations from the Standard Model Higgs framework.

Parallel Session 2: Cosmology & Astroparticle Physics / 64

Prospects of antideuteron detection from dark matter annihilations/decays at AMS-02 and GAPS

Author: Sebastian Wild[1]

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The search for cosmic antideuterons has been proposed as a promising method to indirectly detect dark matter, due to the very small background flux from spallations expected at the energies relevant to experiments. The antideuteron flux from dark matter annihilation or decays is, however, severely constrained by the non-observation of an excess in the antiproton-to-proton fraction measured by PAMELA. In this talk we discuss, for various dark matter annihilation and decay channels, the prospects to observe a signal at AMS-02 and GAPS from requiring that the associated antiproton flux is in agreement with the PAMELA data.

Parallel Session 1: Particle Phenomenology / **65**

Associated ZH production in gluon fusion at NLO QCD

Authors: Heidi Rzehak[1]; Lukas Altenkamp[1]; Robert Harlander[2]; Stefan Dittmaier[1]; Tom Zirke[2]

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The associated production of a Higgs boson and one of the weak gauge bosons W or Z at hadron colliders can be understood mainly as the Drell-Yan production of a virtual vector boson, which subsequently radiates a Higgs. QCD corrections affect only the Drell-Yan part and are known through NNLO (alpha_S^2), leading to a small remaining dependence on the renormalization and factorization scale for the case of WH. For ZH however, another important contribution comes into play at this order, namely from diagrams with gluons in the initial state. Since alpha_S^2 corresponds only to the leading order for this channel, it increases the scale uncertainties for the ZH cross section. In this work, NLO corrections to gg to ZH are obtained by calculating the K factor in the limit of infinite top quark mass. We find large corrections and reduced scale uncertainties. This allows for a more reliable prediction of the ZH production cross section.

Parallel Session 1: Particle Phenomenology / **66**

Lorentz invariance in heavy particle effective theories

Authors: Johannes Heinonen Heinonen[1]; Mikhail Solon[1]; Richard Hill[1]

[1] *University of Chicago*

Based on my work arxiv:1208.0601 with R. Hill and M. Solon, I will present a formalism derived from Wigner's little group that allows the construction of heavy particle effective Lagrangians with a Lorentz invariant S-matrix. In contrast to some previous approaches this is achieved directly by field transformations without calculating the Lorentz charges and their commutation relations. I will show how this connects to what is known as "reparametrization" invariance (RPI) and point out a subtlety, that leads to a break down of RPI at order 1/M^4. Our approach is easily generalized to fields of arbitrary spin or self-conjugate fields and can also be modified to be used e.g. in theories of massless fields like SCET.

Parallel Session 2: Cosmology & Astroparticle Physics / **67**

Cosmology challenges brane scenarios in AdS_5

Author: Dominika Konikowska[1]

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We study a theory of dilaton gravity in a 5D brane scenario, with dilaton non-minimally coupled to the matter content of the universe localized on the brane. We investigate whether the observed large-scale structure of the universe can exist on the brane in the effective 4D dilaton gravity scenario with an exact anti de Sitter bulk. The corresponding constraint on the spatial derivative of the matter energy density is derived, and subsequently quantified using the current limits resulting from searches for variation of the Newton's constant. By confronting it with the observational data from galaxy surveys, we show that the derived bound does not allow for the existence of the large-scale structure as is observed today. Thus, such a dilaton gravity brane scenario is ruled out.

Parallel Session 3: Strings & Mathematical Physics / 68

String theory on Determinantal Calabi-Yau Manifolds

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String compactifications and string model building have mainly been pursued on Calabi–Yau manifolds of a certain type: complete intersections in toric varieties. A powerful tool to study such Calabi-Yau manifolds is provided by the two-dimensional gauged linear sigma model with abelian gauge groups. In this talk I consider gauged linear sigma models with non-abelian gauge groups so as to describe the propagation of strings on determinantal Calabi-Yau manifolds, which furnish another broad class beyond complete intersection Calabi-Yau geometries. I demonstrate that the presented techniques provide a direct and powerful method to compute the spacetime Kähler potential exact in alpha'.

Calabi-Yau threefolds and for determinantal Calabi-Yau threefolds

Parallel Session 3: Strings & Mathematical Physics / 69

Supersound diffusion constants from black hole physics

Author: Stephan Steinfurt[1]

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We describe the holographic computation of supercharge diffusion constants in theories dual to gravitational theories on the background of AdS black brane solutions (of arbitrary dimension and at vanishing chemical potential for R charges).
The computation is performed via the low frequency, low momentum pole of the correlator of supercurrents, which describes the hydrodynamic "phonino" mode, and via the dual transversal gravitino mode using a Kubo formula.
Furthermore, the connection to a universal absorption cross section result is drawn analogous to the famous proof of the universality of eta / s. Similarities and differences to this result are discussed.

Parallel Session 3: Strings & Mathematical Physics / 70

Form factors at strong coupling via AdS/CFT

Author: Gang Yang[1]

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Form factors are very interesting observables to consider. For example, it has been shown that the two-loop form factor in N=4 SYM is equal to the leading transcendental part of a Higgs scattering amplitude in QCD. In this talk we report some progress on computing form factors in N=4 SYM at strong coupling based on AdS/CFT duality.

Parallel Session 3: Strings & Mathematical Physics / 71

Towards a metric-like higher-spin gauge theory in 2+1 dimensions

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Higher-spin gauge theories become particularly simple in 2+1 dimensions, where there are no propagating degrees of freedom. Nevertheless they are useful toy models to study e.g. higher-spin generalisations of black holes or holographic dualities. Most of the research on this subject has been done in the frame-like formalism with generalised vielbeins and spin connections. I will report on recent progress on the metric-like formulation. Such a formulation might shed light on the geometric structure of higher-spin gauge theories, and it allows to apply standard field theoretic techniques like the computation of the Wald entropy for higher spin black holes.

Parallel Session 1: Particle Phenomenology / 72

Neutralino Decays in the Complex MSSM at One-Loop: a Comparison of On-Shell Renormalization Schemes

Author: Aoife Bharucha[1]

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We evaluate two-body decay modes of neutralinos in the Minimal Supersymmetric Standard Model with complex parameters (cMSSM). Assuming heavy scalar quarks we take into account all two-body decay channels involving charginos, neutralinos, (scalar) leptons, Higgs bosons and Standard Model gauge bosons. The evaluation of the decay widths is based on a full one-loop calculation including hard and soft QED radiation. Of particular phenomenological interest are decays involving the Lightest Supersymmetric Particle (LSP), i.e. the lightest neutralino, or a neutral or charged Higgs boson. For the chargino/neutralino sector we employ two different renormalization schemes, which differ in the treatment of the complex phases. We concentrate on the decay of the heaviest neutralino and present the results in the two different schemes. These corrections are important for the correct interpretation of LSP and Higgs production at the LHC and at a future linear e+e- collider.

Parallel Session 3: Strings & Mathematical Physics / 73

New Dualities in Three-dimensional Scattering

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In recent years a host of new structures, such as Yangian symmetries and the duality between color and kinematics, have been discovered in the study of maximally supersymmetric scattering amplitudes. It is natural to question whether these structures can be found in a wider class of theories. In this talk we provide evidence for analogous structures in three-dimensional supersymmetric Chern-Simons matter theories.

Specifically we show that the tree-level amplitudes can be written so that the kinematic factors satisfy the fundamental identity of three-algebras. We further show that the amplitudes can be squared into the amplitudes of three-dimensional supergravity, thus providing evidence for a hidden three-algebra structure in the dynamics of the supergravity. We also study the Chern-Simons planar amplitudes at one-loop, demonstrating that their explicit form is consistent with, and determined by, their Yangian symmetry.

Parallel Session 2: Cosmology & Astroparticle Physics / 74

Towards a quantum treatment of leptogenesis

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Leptogenesis is an attractive mechanism for explaining the baryon asymmetry of the universe, and provides interesting links between cosmology and neutrino physics. In addition, within the scenario of resonant leptogenesis, models with implications for LHC and future colliders have been proposed. However, the predictions depend on a correct calculation of the generated asymmetry in terms of the fundamental masses and couplings. Typically, classical Boltzmann equations with vacuum matrix elements are used. Since the lepton asymmetry results from a quantum interference process that is out of equilibrium, it is desirable to study the mechanism within a purely quantum field theoretical description. We present a calculation of the resonant enhancement based on a first principle approach. We identify the correct behaviour when the mass difference of the right-handed neutrinos is of the order of their width, and show that the generated asymmetry is smaller compared to the Boltzmann approach.

Parallel Session 1: Particle Phenomenology / 75

Pure Gravity Mediation: Why do I believe in low energy SUSY more strongly than before the LHC?

Author: Tsutomu Yanagida[1]

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I will explain why I belive in low energy SUSY more strongly than before the LHC.

Parallel Session 1: Particle Phenomenology / 76

Long-lived staus in a simplified model approach

Author: Jan Heisig[1]

Co-author: Kersten Joern [1]

[1] *University of Hamburg*

We present the phenomenology of the gravitino dark matter scenario at the LHC. We consider the case that the next-to-lightest supersymmetric particle (NLSP) is the lighter stau. For a wide range of gravitino masses the lighter stau is stable on the scale of a detector. Such a particle will give rise to a prominent signature as a 'slow muon'. The dominant production channel of staus depends strongly on the hierarchy of the mass spectrum. However, due to the directly detectable stau one is not forced to rely solely on the observation of highly energetic standard model particles coming either from decay chains or from initial state radiation. This is why in a long-lived stau scenario there are barely any regions in parameter space where the theory is hidden from observation, compared to the neutralino LSP scenario where compressed spectra as well as highly stretched spectra are very hard to observe. We study the LHC sensitivity and examine its dependence on the spectrum with an emphasis on the strong production and decay. Unlike most existing studies we do not restrict ourselves to specific supersymmetry breaking models and benchmark points but aim for a signature driven analysis along the lines of the so-called simplified models. We will show that simplified models are particularly suitable in these classes of scenarios and, in fact, allow us to derive conservative model-independent limits on the SUSY mass parameters from the current LHC data.

Parallel Session 1: Particle Phenomenology / 77

NNLL threshold resummation for the total top-pair production cross section

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Results for the top-pair production cross section at the Tevtron and the LHC will be presented, including a combined resummation of threshold logarithms and Coulomb corrections at NNLL accuracy. The remaining theoretical and PDF uncertainties and prospects for the measurement of the top mass from the total cross section will be discussed.

Parallel Session 1: Particle Phenomenology / 78

One-loop approximation of Lattice HQET parameters

Author: Piotr Korcyl[1]

Co-authors: Dirk Hesse [2]; Rainer Sommer [1]

[1] *NIC DESY Zeuthen*

[2] *University of Parma*

We present a one-loop order lattice perturbation theory calculation of a subset of Heavy Quark Effective Theory parameters.
HQET being an effective theory is defined through a set of parameters which should be fixed in a process called matching, order by order in 1/m.
We consider 6 matching conditions which are needed for the determination of, for example, the f_B decay constant
and which include the 1/m corrections. The one-loop approximation of the matching conditions is obtained
using the pastor package for automated lattice perturbation theory calculations in the Schrodinger functional. We can study the discretization effects and the effects of higher orders in 1/m due to the matching.
Our results are complementary to the non-perturbative determination of HQET parameters by the ALPHA collaboration.

Parallel Session 1: Particle Phenomenology / 79

Squark Flavor Implications from B –> K^(*) l^+ l^–

Authors: Arnd Behring[1]; Christian Gross[2]; Gudrun Hiller[1]; Stefan Schacht[1]

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Recent experimental and theoretical progress regarding B –> K^(*) l^+ l^– decays led to improved bounds on the Wilson coefficients C_9 and C_10 of four-fermion operators of the |ΔB| = |ΔS| = 1 effective Hamiltonian. We analyze the resulting implications on squark flavor violation in the MSSM and obtain new constraints on flavor-changing left-right mixing in the up-squark-sector. We find the dimensionless flavor mixing parameter (δu^23)_LR, depending on the flavor-diagonal MSSM masses and couplings, to be as low as ⊠ 0.1. This has implications for models based on radiative flavor violation and leads to BR(B_s –> μ^+ μ^–) ⊠ 1×10^–9. Rare top decays t –> c γ, t –> c g, t –> c Z have branching ratios predicted to be below ⊠ few × 10^–8, 10^–6 and 10^–7, respectively.

Parallel Session 1: Particle Phenomenology / 80

Spin Correlations in Double-Parton Scattering

Author: Tomas Kasemets[1]

[1] *DESY*

In double parton interactions the two hard scatterings are correlated via double parton densities. We study the double Drell-Yan process and investigate the impact of the correlations on the differential cross section. In particular the spin of the quarks originating from the same proton can be correlated, affecting both the magnitude and the distributions of the cross section. We set upper limits on such spin-correlations following from positivity conditions on parton densities.

Parallel Session 1: Particle Phenomenology / 81

A 125 Gev Higgs boson with enhanced gamma gamma rate in Supersymmetry

Author: Lisa Zeune[1]

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We confront the discovery of a boson decaying to two photons, as reported recently by ATLAS and CMS, with the corresponding predictions in the Minimal Supersymmetric Standard Model (MSSM) and the Next-to-Minimal Supersymmetric Standard Model (NMSSM). We show that a Higgs with a mass around 125 GeV and a significant enhancement of the rate in the two photon channel, compatible with the observed signal strenghts, is possible in both the MSSM and the NMSSM and we analyse in detail different mechanisms that can give rise to such an enhancement. We find that besides the interpretation of a possible signal at about 125 GeV in terms of the lightest CP-even Higgs boson, both the MSSM and the NMSSM permit also a viable interpretation where an observed state at about 125 GeV would correspond to the second-lightest CP-even Higgs boson in the spectrum.

Parallel Session 2: Cosmology & Astroparticle Physics / 82

Dark radiation from the axino solution of the gravitino problem

Author: Jasper Hasenkamp[1]

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Current CMB observations could confirm an increase of the effective neutrino degrees of freedom at photon decoupling. We show that, if the gravitino problem is solved by a light axino, dark (decoupled) radiation emerges naturally after nucleosynthesis but before CMB times leading to a new upper bound on the reheating temperature < 10^10 GeV. In turn, successful thermal leptogenesis predicts such an increase. The LHC might endorse this opportunity. We identify several consistent cosmologies.

Parallel Session 2: Cosmology & Astroparticle Physics / 83

Axions and saxions from the primordial supersymmetric plasma and extra radiation signatures

Authors: Frank Steffen[1]; Peter Graf[1]

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We calculate the rate for thermal production of axions and saxions via scattering of quarks, gluons, squarks, and gluinos in the primordial supersymmetric plasma. Systematic field theoretical methods such as hard thermal loop resummation are applied to obtain a finite result in a gauge-invariant way that is consistent to leading order in the strong gauge coupling. We calculate the thermally produced yield and the decoupling temperature for both axions and saxions. For the generic case in which saxion decays into axions are possible, the emitted axions can constitute extra radiation already

prior to big bang nucleosynthesis and well thereafter.We update associated limits imposed by recent studies of the primordial helium-4 abundance
and by precision cosmology of the cosmic microwave background and large scale structure. We show that the trend towards extra radiation seen in those studies can be explained by late decays of thermal saxions into axions and that upcoming Planck results will probe supersymmetric axion models with unprecedented sensitivity.

Parallel Session 3: Strings & Mathematical Physics / 84

The superconducting QCD vacuum at large magnetic field from holography

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It has been shown by Chernodub et al. that the rho meson of QCD in the presence of a very large magnetic field condenses, giving a superconducting ground state. The solution takes on a lattice form of an Abrikosov type. We calculate the holographic dual of this phenomenon. In particular we show that for magnetic fields close to the critical value, the lattice takes on a triangular form, in agreement with the field theory calculations.

Parallel Session 1: Particle Phenomenology / 85

Top-mass effects in differential Higgs production through gluon fusion at order αs^4

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Effects from a finite top quark mass on differential distributions in the Higgs+jet production cross section through gluon fusion are studied at next-to-leading order in the strong coupling, i.e. O(αs^4). Terms formally subleading in 1/mTop are calculated, and their influence on the transverse momentum and rapidity distribution of the Higgs boson are evaluated. We find that, for the differential K-factor, the heavy-top limit is valid at the 2-3% level as long as the transverse momentum of the Higgs remains below about 150 GeV.

Parallel Session 1: Particle Phenomenology / 86

S_hat_min resurrected

Author: Tania Robens[1]

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We discuss the use of the variable s_hat_min, which has been proposed in order to measure the hard scale of a multi parton final state event using inclusive quantities only, on a SUSY data sample for a 14TeV LHC. In its original version, where this variable was proposed on calorimeter level, the direct correlation to the hard scattering scale does not survive when effects from soft physics are taken into account. We here show that when using reconstructed objects instead of calorimeter energy and momenta as input, we manage to actually recover this correlation for the parameter point considered here. We furthermore discuss the effect of including W + jets and t¯t+ jets background in our analysis and the use of pˆsmin for the suppression of SM induced background in new physics searches.

Parallel Session 2: Cosmology & Astroparticle Physics / **87**

Multi-Component Dark Matter Systems and Their Observation Prospects

Author: Michael Duerr[1]

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Conversions and semi-annihilations of dark matter (DM) particles in addition to the standard DM annihilations are considered in a three-component DM system. We find that the relic abundance of DM can be very sensitive to these non-standard DM annihilation processes, which has been recently found for two-component DM systems. To consider a concrete model of a three-component DM system, we extend the radiative seesaw model of Ma by adding a Majorana fermion \chi and a real scalar boson \phi, to obtain a Z_2 \times Z'_2 DM stabilizing symmetry, where we assume that the DM particles are the inert Higgs boson, \chi and \phi. It is shown how the allowed parameter space, obtained previously in the absence of \chi and \phi, changes. The semi-annihilation process in this model produces monochromatic neutrinos. The observation rate of these monochromatic neutrinos from the Sun at IceCube is estimated. Observations of high energy monochromatic neutrinos from the Sun may indicate a multi-component DM system. Based on arXiv:1207.3318.

Parallel Session 3: Strings & Mathematical Physics / **88**

Multi-Regge Limit of Scattering Amplitudes in Strongly Coupled N=4 SYM

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In this talk, I will investigate n-gluon scattering amplitudes in the multi-Regge region of N=4 supersymmetric Yang-Mills theory at strong coupling. To leading order, the amplitude at strong coupling is given in terms of a minimal surface in AdS5. The area of this surface can be calculated by a set of non-linear integral equations, which, however, do not allow an analytic solution for arbitrary kinematics.
I will demonstrate that in the multi-Regge limit these equations simplify drastically and become algebraic equations.

This result implies that there exists an auxiliary system of algebraic Bethe ansatz equations which encode valuable information on the analytical structure of amplitudes at strong coupling.

Parallel Session 3: Strings & Mathematical Physics / 89

The Higgs from Remote Supersymmetry

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We interpret the recently discovered Higgs candidate as a standard Higgs Boson originating from an underlying string-derived supersymmetric theory.
The observed mass range of 124...126 GeV points towards a vanishing quartic coupling at intermediate to high scales. This compels us to study a class of String/F-Theory based models in which symmetries enforce a vanishing quartic Higgs coupling near the soft scale. We discuss the impact of radiative corrections to these symmetries and explore possible stringy realizations.

Parallel Session 1: Particle Phenomenology / 90

Constraining SUSY models beyond vanilla supersymmetry at the LHC

Author: Kazuki Sakurai[1]

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ATLAS and CMS collaborations have searched for multi-jet plus large missing energy signatures and their null results have put a stringent constraint on the CMSSM parameter space. Such "vanilla" supersymmetry with squark/gluino mass below 1-1.4 TeV have already excluded. However in some scenarios, for example split generation, compressed SUSY and R-parity violation scenarios, low energy supersymmetry below 1 TeV is still allowed. Excluding such possibilities would be one of the next important goals of the LHC. I would like to talk about our recent study to exclude the compressed SUSY models using leptonic signatures. I would also like to mention our recent work on RPV model exclusion using a large jet multiplicity search.

Parallel Session 3: Strings & Mathematical Physics / 91

Loop corrections in certain (super) conformal Yang-Mills theories

Author: Christoph Sieg[1]

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In the talk I will motivate why direct perturbative calculations in N=4 SYM theory and in ist (super9 conformal deformations are of interest and I will summarize some of our recent results and work in progress.

Parallel Session 3: Strings & Mathematical Physics / 92

Special class of SU(2) two-point functions on the torus

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I discuss two-point functions on the torus in the SU(2) Wess-Zumino-Witten model. I construct an explicit expression for the current blocks of the spin-k/2-spin-k/2 torus two-point function. As a first check, I consider the factorization limits of the current blocks as well as their monodromy properties. I then prove that the current blocks solve the corresponding Knizhnik-Zamolodchikov-like equations, which are constructed by the method of Mathur, Mukhi and Sen.

Parallel Session 2: Cosmology & Astroparticle Physics / 93

Dark matter constraints from box-shaped gamma-ray features

Author: Sergio Lopez Gehler[1]

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The observation of a sharp spectral feature in the gamma-ray sky would be one of the cleanest ways to identify dark matter and pinpoint its properties. Over the years a lot of attention has been paid to two specific features, namely gamma-ray lines and internal bremsstrahlung. Here, we explore a third class of spectral signatures, box-shaped gamma-ray spectra, that naturally arise in dark matter cascade annihilations or decays into intermediate particles that in turn decay into photons. Using Fermi-LAT data, we derive constraints on the dark matter parameter space for both annihilating and decaying dark matter, and show explicitly that our limits are competitive to strategies employing standard spectral features. More importantly, we find robust limits even in the case of non-degenerate dark matter and intermediate particle masses. This result is particularly relevant in constraining dark matter frameworks with gamma-ray data. We conclude by illustrating the power of box-shaped gamma-ray constraints on concrete particle physics scenarios.

Parallel Session 1: Particle Phenomenology / 94

TeV scale Mirage Mediation in the NMSSM

Author: Takashi Shimomura[1]

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[3] *Kyoto Univ., Japan*

We study the next-to-minimal supersymmetric standard model.
We consider soft supersymmetry breaking parameters, which are induced by the mirage mediation mechanism of supersymmetry breaking. We concentrate on the mirage mediation, where the so-called mirage scale is
the TeV scale. In this scenario, we can realize the effective mu-term
the up-type Higgs soft mass of O(200) GeV, while other masses such as
gaugino masses and stop masses are heavy such as 1 TeV or more.
Cancellation between the effective mu-term and the down-type Higgs soft mass ameliorates
the fine-tuning in the electroweak symmetry breaking even for mu=O(500) GeV.
The lightest Higgs mass can be $115 - 130$ GeV. The higgsino and singlino are light and their linear combination is the lightest superparticle. We also discuss the new false vacua in the Higgs potential. The significant parameter region can be excluded by requiring the realistic vacuum to be deeper than false vacua and the couplings to be perturbative up to the GUT scale, which result in constraints on the properties of the lightest Higgs boson.

Parallel Session 1: Particle Phenomenology / 95

Impact of the Higgs Discovery on the Standard Model with Three and Four Fermion Generations

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In this talk I present results of a global analysis of electroweak
precision data and Higgs signal strengths in the context of the Standard
Model with three and four fermion generations. I re-examine the SM electroweak fit with the new input on the Higgs mass and discuss the effect of a fourth fermion generation on the Higgs signal strengths. To quantify the level at which a fourth fermion generation is ruled out one must deal with the statistics of so-called non-nested models, because the three-family case is not recovered in any limit of the four-family model. To this end the computer package myFitter has been developed, which I will describe in my talk.

Parallel Session 1: Particle Phenomenology / 96

Scattering in General Gauge Mediation, Vector Meson Dominance and Holography

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We examine what scattering cross sections of Visible to Hidden sectors that break SUSY and are strongly coupled can tell us about supersymmetry breaking and its mediation. We apply Vector Meson Dominance and Holographic techniques to encode resonances in visible to hidden sector processes. We draw on analogies with QCD and the AdS/QCD programme.

Parallel Session 1: Particle Phenomenology / 97

Sterile neutrinos in flavor symmetry models

Author: He Zhang[1]

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In this talk, I will briefly review the phenomenology of light sterile neutrinos. Then I will concentrate on the theoretical realizations of light sterile neutrinos, in particular a model based on flavor A4 symmetry and Froggatt-Nielsen mechanism.

Parallel Session 1: Particle Phenomenology / 98

New exact wavefunctions and generic 2-vertex processes, in two strong electromagnetic fields

Author: Anthony Hartin[1]

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In future linear colliders, ultrarelativistic charge bunches with associated electromagnetic fields approaching or exceeding the Schwinger limit, will interact at the IP. With such strong fields, vacuum polarisation becomes significant and, in order to quantify
the effect on physics processes, new analytic calculations in the Furry interaction picture are necessary. Up to now, Furry picture calculations - most notably the beamstrahlung, only consider one external field, that of the oncoming bunch. However, for particles with significant transverse momentum, there is potentially an effect from both bunch fields. To that end we present here new solutions of the equations of motion obtained from the Furry picture Lagrangian for the exact interaction with the two electromagnetic fields
associated with each interacting charge bunch. These enable more physically correct cross-section calculations to be performed.

Parallel Session 1: Particle Phenomenology / 99

The Constrained MSSM and NMSSM in light of a 125 GeV Higgs and other constraints

Author: Enrico Maria Sessolo[1]

Co-authors: Andrew Fowlie [2]; Kamila Kowalska [1]; Leszek Roszkowski [1]; Malgorzata Kazana [1]; Sebastian Trojanowski [1]; Shoaib Munir [1]; Yue-Lin Sming Tsai [1]

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We present an updated global analysis of the GUT-constrained models CMSSM and CNMSSM, taking into account the recent observation of a SM Higgs-like signal at the LHC. In both our analyses, we implement the CMS razor limit on supersymmetry, based on ~5/fb datasets, with an approximate but accurate likelihood map constructed through a simulation of the detector efficiency.

In the CNMSSM we consider three possible scenarios: i) H1 is SM-like with mass around 125 GeV, ii) H2 is SM-like, with a mass of ~125 GeV and H1 escaped detection, and iii) H1 and H2 are almost degenerate in mass.
We identify the 68% and 95% credible posterior probability regions in both models employing a Bayesian approach. We find that it is possible to accomodate the recent observation of the Higgs in both models, although a 125-GeV Higgs mass shows some tension with various constraints.

Parallel Session 1: Particle Phenomenology / 100

A generalised narrow-width approximation for interference effects in the MSSM

Authors: Elina Fuchs[1]; Georg Weiglein[1]; Silja Thewes[1]

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The "narrow-width approximation" is a convenient tool for the factorisation of a more complicated process into production and subsequent decay of a particle with a small width compared to its mass. However, this approximation cannot be applied in the case of sizable interferences between propagator contributions of different particles that are close to their mass shell. The spectrum of the MSSM may contain particles with a mass difference of the order of their decay widths. In order to deal with such a situation, a generalisation of the usual narrow-width approximation is analysed which allows for a consistent treatment of interference effects between such nearly mass-degenerate particles. This can be useful for the application to processes for which the factorisation into different sub-processes will be essential to enable the computation of higher-order contributions.
Phenomenological consequences with interference effects between neutral MSSM Higgs bosons will be discussed for the example process of Higgs boson production and subsequent decay from the decay of a heavy neutralino. Vertex corrections are included at the one-loop level in an on-shell renormalisation of the neutralino sector.

Parallel Session 1: Particle Phenomenology / 101

Impact of QCD and SUSY-QCD corrections on the neutralino dark matter relic density

Author: Julia Harz[1]

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A powerful method to constrain the parameter space of theories beyond the Standard Model is to compare the predicted dark matter relic density with data from cosmological precision measurements, in particular from the WMAP and in future also from the PLANCK satellite.
On the particle physics side, the main uncertainty in the relic density calculation arises from the (co-)annihilation cross sections of the dark matter particle. While dedicated public tools like DarkSUSY and micrOMEGAs compute the relic abundance using an effective tree-level calculation, it is, however, crucial to take into account higher order corrections in order to meet the future experimental precision.
We will present the numerical package DM@NLO, which allows to compute the (co-)annihilation cross sections of the neutralino including the full one-loop QCD and SUSY-QCD corrections. We will show recent results illustrating the significant impact of the one-loop corrections on the neutralino (co-)annihilation cross-section and, in consequence, on the dark matter relic density.

Parallel Session 1: Particle Phenomenology / 102

\theta^PMNS_13 = \theta_C / \sqrt2 from GUTs

Authors: Christian Gross[1]; Constantin Sluka[1]; Stefan Antusch[1]; Vinzenz Maurer[1]

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The recent observations of the leptonic mixing angle \theta^PMNS_13 are consistent with \theta^PMNS_13 = \theta_C / \sqrt2 (with \theta_C being the Cabibbo angle \theta^CKM_12). We discuss how this relation can emerge in Grand Unified Theories (GUTs) via charged lepton corrections. The key ingredient is that in GUTs the down-type quark Yukawa matrix and the charged lepton Yukawa matrix are generated from the same set of GUT operators, which implies that the resulting entries are linked and differ only by group theoretical Clebsch factors. This allows a link \theta^e_12 = \theta_C to be established, which can induce \theta^PMNS_13 = \theta_C / \sqrt2 provided that the 1-3 mixing in the neutrino mass matrix is much smaller than \theta_C. We find simple conditions under which \theta^PMNS_13 = \theta_C / \sqrt2 can arise via this link in SU(5) GUTs and Pati-Salam models. We also discuss possible corrections to this relation. Using lepton mixing sum rules different neutrino mixing patterns can be distinguished by their predictions for the Dirac CP phase \delta^PMNS.

Parallel Session 1: Particle Phenomenology / 103

Strong Signatures of Right-handed compositeness

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Right-handed light quarks could be largely composite compatibly with experimental searches at the LHC and precision tests on Standard Model couplings. In these scenarios, which are also motivated by flavor physics, one expects large cross-section for the production of new resonances coupled to light quarks. We study the possible experimental signatures of right-handed compositeness at the LHC and constrain the parameter space of these scenarios with recent results by Atlas and CMS. We show that the LHC sensitivity could significantly improve if dedicated searches were performed in particular in multi-jet signals.

Parallel Session 1: Particle Phenomenology / 104

Higgs Decays in the Low Scale Type I See-Saw Model

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The couplings of the low scale type I See-Saw model are severely constrained by the requirement of reproducing the correct neutrino mass and mixing parameters, by the non-observation of lepton number and charged lepton flavour violating processes and by electroweak precision data. We show that all these constraints still allow for the possibility of an exotic Higgs decay channel into a light neutrino and a heavy neutrino with a sizable branching ratio. We also estimate the prospects to observe this decay at the LHC and discuss its complementarity to the indirect probes of the low scale type I see-saw model from experiments searching for the $\mu \to e\gamma$ decay.

Parallel Session 3: Strings & Mathematical Physics / 105

D-brane superpotentials from a Landau-Ginzburg perspective

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D-branes on Calabi-Yau manifolds can be described by matrix factorizations at the Landau-Ginzburg (LG) point. In this talk I will discuss methods for the study of D-brane moduli spaces and superpotentials within this framework. An emphasis will be put on non-toric complex structure deformations, which arise as bulk moduli from twisted sectors in the LG orbifold. I will outline how the contributions to the effective superpotential from these fields can be computed by considering appropriate defects in the unonrbifolded LG model.

Parallel Session 2: Cosmology & Astroparticle Physics / 106

Relaxed Dark Matter

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In standard cosmology the present ratio of the dark matter (DM) and baryon energy densities is set by two completely unrelated mechanisms: the DM production mechanism and baryogenesis. Therefore, the fact that the observed value for this ratio is close to one may appear as a puzzling coincidence.
A scalar field interacting differently with DM and baryons
can explain dynamically why the ratio of their cosmic densities is of
order unity today: In the model presented in this talk, the initial DM and baryon densities “relax” to a ratio of coupling constants, which can be naturally of the order of one. Implications of this scenario for cosmology (e.g. structure formation and gravity tests) and particle physics (e.g. impact on SUSY parameter space) will be also discussed.

Parallel Session 2: Cosmology & Astroparticle Physics / 107

Observational degeneracy between non-canonical and canonical single field inflation

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We discuss observational degeneracy between non-canonical and canonical single field inflation. We map the dynamics of the non-canonical inflationary trajectory to a Lagrangian with canonically normalized kinetic term and a scalar potential. At the level of the two-point function, the two theories are observationally degenerate at all times. To obtain observationally degeneracy at the level of the three-point function, we add sinusodial contributions to the scalar potential. These give rise to resonant non-Gaussianities, whose superpositions are shown to approximately match equilateral

non-Gaussianity which is characteristic for non-canonical inflation. We discuss explicit examples such as DBI-inflation.

Parallel Session 3: Strings & Mathematical Physics / 108

Integrability and scattering amplitudes in N=4 SYM

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In this talk I will present some work in progress on the interplay between scattering amplitudes in N=4 SYM and the Yang-Baxter equation. I will start by reviewing the notions of Yangian symmetry and Grassmannian formulation and recall the recently observed connection between the leading part of the dilatation operator for the integrable spin chain and the tree-level amplitudes. I will then merge these concepts and present the spectral parameter deformation of scattering amplitudes and the interpretation of the spectral parameter itself. Finally I will discuss the possibility of a new (spectral) regularization for loop amplitudes.

Parallel Session 1: Particle Phenomenology / 109

Soft-gluon resummation for squark- and gluino hadroproduction

Author: Silja Christine Thewes[1]

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The production of SUSY particles at the LHC is dominated by processes involving coloured sparticles in the final state. Due to the high importance of these processes for SUSY searches at the LHC, precise theoretical predictions are needed. Higher-order QCD corrections are dominated by large logarithmic terms due to the emission of soft gluons from initial and final state particles. A systematic treatment of these logarithms to all orders in perturbation theory is provided by resummation methods. In this talk we discuss the resummation of soft gluon emission at next-to-leading-logarithmic (NLL) accuracy and beyond for squark and gluino pair-production processes. We present the analytical ingredients needed for the calculation and discuss numerical predictions for the LHC.

Parallel Session 2: Cosmology & Astroparticle Physics / 110

The 130GeV gamma-ray line and dark matter model building constraints from continuum gamma rays, radio and antiproton data

Authors: Guenter Sigl[1]; Martin Vollmann[2]; Masaki Asano[3]; Torsten Bringmann[4]

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An analysis of the Fermi gamma ray space telescope data has recently revealed a resolved gamma-ray feature close to the galactic center which is consistent with monochromatic photons at an energy of about 130 GeV. If interpreted in terms of dark matter (DM) annihilating into gamma gamma (gamma Z,gamma H), this would correspond to a DM article mass of roughly 130 GeV (145 GeV, 155 GeV). The rate for these loop-suppressed processes, however, is larger than typically expected for thermally produced DM. Correspondingly, one would generically expect even larger tree level production rates of standard model fermions or gauge bosons. Here, we quantify this expectation in a rather model-independent way by relating the tree level and loop amplitudes with the help of the optical theorem. As an application, we consider bounds from continuum gamma rays, radio and antiproton data on the tree level amplitudes and translate them into constraints on the loop amplitudes. We find that, independently of the DM production mechanism, any DM model aiming at explaining the line signal in terms of charged standard model particles running in the loop is in strong tension with at least one of these constraints.

Parallel Session 2: Cosmology & Astroparticle Physics / **111**

Superconformal D-Term Inflation

Authors: Kai Schmitz[1]; Valerie Domcke[1]; Wilfried Buchmueller[1]

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In superconformal D-term inflation, dangerous supergravity corrections to the scalar potential are controlled by a superconformal symmetry of the matter sector of the Lagrangian, a concept which has received recent interest in the context of Higgs inflation. Working out this idea in the context of D-term inflation, we find an interesting phenomology, in particular a two-field inflationary phase once one allows for a breaking of the exact superconformal symmetry and predictions for the observables of the primordial power spectrum within current experimental bounds for reasonable values of the model parameters. Furthermore, we show that this simple model can be embedded in the context of Grand Unified Theories, with the U(1) symmetry broken at the end of D-term inflation identified as the U(1)_{B-L}.

Parallel Session 1: Particle Phenomenology / **112**

Natural supersymmetric spectrum in mirage mediation

Author: Masaki Asano[1]

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Current results of LHC experiments exclude large area of light new particle region, namely natural parameter space, in supersymmetric extension models. One of the possibilities for achieving the correct electroweak symmetry breaking naturally is low scale messenger scenario. Actually, the next-to-minimal supersymmetric standard model with TeV scale mirage mediation realizes the natural electroweak symmetry breaking with various mass spectra. In this paper, we show the possible mass spectrum in the scenario, e.g. degenerate and/or hierarchical mass spectrum, and discuss these features.

Parallel Session 2: Cosmology & Astroparticle Physics / **113**

From Dirac neutrino masses to baryonic and dark matter asymmetries

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In this talk I will introduce a unified picture of Dirac neutrino masses, baryon asymmetry and dark matter relic density. Specifically, we consider an $SU(3)'_c \times SU(2)'_L \times U(1)'_Y$ dark sector, parallel to the $SU(3)_c \times SU(2)_L \times U(1)_Y$ ordinary sector. The hypercharges, baryon numbers and lepton numbers in the dark sector are opposite to those in the ordinary sector. We further introduce three types of messenger sectors: (i) two or more gauge-singlet Dirac fermions, (ii) two or more $[SU(2)_L \times SU(2)'_L]$-bidoublet Higgs scalars, (iii) at least one gauge-singlet Dirac fermion and at least one $[SU(2)_L \times SU(2)'_L]$-bidoublet Higgs scalar. The lepton number conserving decays of the heavy fermion singlet(s) and/or Higgs bidoublet(s) can simultaneously generate a lepton asymmetry in the $[SU(2)_L]$-doublet leptons and an opposite lepton asymmetry in the $[SU(2)'_L]$-doublet leptons to account for the cosmological baryon asymmetry and dark matter relic density, respectively. The dark proton and/or neutron as the dark matter particle thus should have a mass about $5\,\mathrm{GeV}$. By integrating out the heavy fermion singlet(s) and/or Higgs bidoublet(s), we can obtain three light Dirac neutrinos composed of the ordinary and dark left-handed neutrinos. If a mirror symmetry is further imposed, our models will not require more parameters than the traditional type-I, type-II or type-I+II seesaw models.

Parallel Session 3: Strings & Mathematical Physics / **114**

Light-cone lattice from the universal R-matrix

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I will discuss a systematic approach to the construction of lattice regularizations of a certain class of 1+1 dimensional integrable quantum field theories.
The method is based on the identification of the relevant algebraic structure combined with a systematic analysis of its representations.
I will focus on the example of affine Toda theories.
Remarkable factorization/fusion properties of some degenerate representations of the underlying quantum affine algebra are connected to the separation/recombination of left- and right-movers in 1+1 dimensional conformal field theory.
I will present a derivation of the so called quantum discrete-time evolution equations on a light-cone lattice for affine Toda theories.
I will conclude with some considerations on the construction of Baxter's Q-operators for these models.

Parallel Session 2: Cosmology & Astroparticle Physics / **115**

WIMP Dark Matter from Gravitino Decays and Leptogenesis

Authors: Kai Schmitz[1]; Valerie Domcke[1]; Wilfried Buchmueller[1]

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The spontaneous breaking of B-L symmetry naturally accounts for the small observed neutrino masses via the seesaw mechanism. We have recently shown that the cosmological realization of B-L breaking in a supersymmetric theory can successfully generate the initial conditions of the hot early universe, i.e. entropy, baryon asymmetry and dark matter, if the gravitino is the lightest superparticle (LSP). This implies relations between neutrino and superparticle masses. Here we extend our analysis to the case of very heavy gravitinos which are motivated by the discovery of the Higgs boson at the LHC. We find that the nonthermal production of 'pure' wino or higgsino LSPs, i.e. weakly interacting massive particles (WIMPs), in heavy gravitino decays can account for the observed amount of dark matter while simultaneously fulfilling the constraints imposed by primordial nucleosynthesis and leptogenesis within a range of LSP, gravitino and neutrino masses. For instance, a mass of the lightest neutrino of 0.05 eV would require a higgsino mass below 900 GeV and a gravitino mass of at least 10 TeV.

Parallel Session 1: Particle Phenomenology / 117

Recent results on NNLO Heavy Flavor Corrections to Deep-Inelastic Scattering

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We present recent results on the 3-loop fermion-loop corrections to the asymptotic heavy flavor Wilson coefficients of the structure function $F_2(x, Q^2)$ in the asymptotic region $Q^2 \gg m^2$. This includes results on contributions with two different masses m_c, m_b which first emerge at 3-loop level. We also obtained first results on more advanced toplogies of ladder- or benz-type using a method based on hyperlogarithms, a generalization of harmonic polylogarithms.