Rencontre de Physique des Particules 2015

Thursday 15 January 2015 - Friday 16 January 2015

Institut Henri Poincaré

Recueil des résumés

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Higgs Physics and New Physics Scenarios / 21

A Light Singlet in Gauge Mediation

Robert Ziegler[1]

[1] *LPTHE*

I will discuss the possibility of a light supersymmetric singlet below 100 GeV in the context of a very predictive model that combines the NMSSM and Gauge Mediation. This model has been originally proposed by Delgado,Giudice and Slavich, but the LEP bound had been imposed on the lightest Higgs state. We re-analyzed this model and found new interesting regions in the parameter space with a light singlet state that mixes with the SM-like Higgs at 125 GeV. This mixing is small enough to evade LEP and LHC constraints, but large enough to give a substantial contribution to the tree-level Higgs mass, thus reducing the required mass scale of supersymmetric particles. Essentially only a single parameter is left undetermined that controls the gravitino phenomenology and can lead to novel collider signatures.

Cosmology / 16

A new look at the cosmic ray positron fraction.

Mathieu Boudaud[1]

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The positron fraction in cosmic rays has been recently measured with improved accuracy up to 500 GeV by the space-borne experiment AMS-02, and it was found to be a steadily increasing function of energy, above 10 GeV. This behaviour is in tension with standard astrophysical mechanisms, in which positrons are secondary particles, produced in the interactions of primary cosmic rays during their propagation in the interstellar medium. The observed anomaly in the positron fraction triggered a lot of excitement, as it could be interpreted as an indirect signature of the presence of dark matter species in the Galaxy – the so-called weakly interacting massive particles or WIMPs. Alternatively, it could be produced by nearby astrophysical sources, such as pulsars.

QCD-2 / 35

Ab-initio calculation of the neutron-proton mass difference

Laurent Lellouch[1]

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The difference between the masses of the neutron and the proton is only 0.14% of their average. Yet this difference has important implications for the existence and stability of ordinary matter. After explaining how electromagnetic and mass isospin breaking effects can be included in lattice QCD computations, I will show how this mass difference arises from a subtle cancellation of these two effects. I will also report on results for splittings in the Σ, Ξ, D and Ξ_{cc} isospin multiplets, some of which are predictions. As will be explained, the results are obtained from an ab-initio calculation in

full lattice QCD plus QED, that includes the effects of non-degenerate up, down, strange and charm quarks in the sea.

Higgs Physics and New Physics Scenarios / 47

Bridging Composite Higgs and Technicolor with Higgs data

Aldo Deandrea[1] ; Arbey Alexandre[2] ; Francesco Sannino[3] ; Giacomo Cacciapaglia[1] ; Haiying CAI[4] ; Marc Gillioz[5] ; Solene Le Corre[6]

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We focus on the possibility that the Higgs boson is a state which is either as a Pseudo Goldstone Boson of an effective Lagrangian description or as a composite state made of techini fermions. In this composite Higgs model, the symmetry breaking pattern is SU(4)/SP(4) and the light Higgs will further mix with a heavier techni-Higgs. We consider the constraints on the parameter space both from the Higgs coupling measurements and the EW precision test and mainly discuss the phenomenology related to the eta particle as well as the heavier Higgs.

QCD-2 / 9

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

Auteur(s): Josselin Proudom[1]

Co-auteur(s) Benjamin Fuks [2] ; Ingo Schienbein [1] ; Juan Rojo [3]

[1] *LPSC*

[2] *CERN/IPHC*

[3] *Rudolf Peierls for Theoretical Physics*

Motivations

- Status of New Physics searches at the LHC
- Why using polarized beams for New Physics searches?
- Future Accelerators & Polarized beams

Physics at polarized hadron colliders

- Polarized Parton Distribution Functions
- Parton luminosities & cross sections
- Longitudinal spin asymmetries

Physics case: Monotop signature

- Monotop production in the Standard model
- Monotop production in the RPV-MSSM
- Monotop production in the Hylogenesis model
- Monotop production in the X-model

Conclusions

Summary:

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.

Flavor Physics / **34**

Constraining the Doublet Left-Right Model

Luiz Henrique Vale Silva[1]

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Left-Right Models (LRM) attempt at giving an understanding of the violation of parity (or charge-conjugation) by the weak interactions in the SM through a similar description of left- and right-handed currents at high energies. The spontaneous symmetry breaking of $SU(2)_L \times SU(2)_R \times U(1)_{(B-L)}$ is usually triggered by an enlarged Higgs sector, usually consisting of two triplet fields (left-right symmetry breaking) and a bi-doublet (electroweak symmetry breaking). I reconsider an alternative LRM with doublet instead of triplet fields. After explaining some features of this model, I discuss constraints on its parameters using electroweak precision observables (combined using the CKMfitter frequentist statistical framework) and neutral-meson mixing observables.

Dark Matter - Astroparticles / **10**

Current aspects of Dark Matter

Michel Tytgat[1]

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I briefly discuss the current status of dark matter
phenomenology, with an emphasis on simple (or simplified) models
and their possible experimental signatures.

Summary:

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phenomenology, with an emphasis on simple (or simplified) models
and their possible experimental signatures.

Dark Matter - Astroparticles / **36**

Dark matter effective field theory at present and future colliders

ANDREAS GOUDELIS[1]

[1] *HEPHY - Vienna*

The absence of BSM signals at the Large Hadron Collider and the strong cosmological evidence for dark matter (DM) have motivated a fairly model-independent Effective Field Theory (EFT) approach to describe the interactions of DM particles with the Standard Model. This approach is known to be both powerful, thanks to its simplicity, as well as subtle, due to its potential limitations. I will discuss up-to-date constraints on the corresponding effective operators coming from direct DM searches, the LHC and cosmic DM abundance measurements. I will moreover present relevant predictions for the reach of the next LHC run as well as that of a futuristic 100 TeV hadron collider and discuss the validity of the EFT description in the corresponding experimental environments.

Dark Matter - Astroparticles / **20**

Dark portal scenarios

Auteur(s): Giorgio Arcadi[1]

Co-auteur(s) Francois Richard [2] ; Yann Mambrini [1]

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We analyze some simple but general scenarios in which the interactions of a (fermionic) Dark Matter with Standard Model particles are mediated by a scalar/pseudoscalar or vector state. We discuss the impact of current Dark Matter searches, with particular focus on the interpretation of the recently reported gamma-ray excess. We will also illustrate the prospect of detection in next future experiments.

QCD-2 / **40**

Describing hadron structure using Dyson-Schwinger equations

Cédric Mezrag[1]

[1] *IRFU/SPhN*

Auteur(s) contact: cedric.mezrag@cea.fr

If at high energy QCD can be described using perturbation theory due to asymptotic freedom, when going at low energy the fundamental degrees of freedom of the theory, quarks are gluons, are bounded inside hadrons. The hadron structure in terms of partons has been studied since the 1960s. Today several objects have been both theoretically and experimentally studied, like for instance Generalized Parton Distributions (GPDs) which contains a three dimensional information about the parton structure of hadrons. However, it is still not possible to compute such objects directly from QCD first principles. As a first step toward this ideal goal, we have developed here a model for the pion GPD based on the Dyson-Schwynger equations, which are a way to compute QCD non perturbative Green functions. We have successfully compared our model with available experimental data of pion form factor and pion Parton Distribution Function (PDF), and managed to sketch the partonic 3D structure of the pion.

Higgs Physics and New Physics Scenarios / **43**

EFT analysis of New Physics searches: from neutrons to Higgses

Martin Gonzalez-Alonso[1]

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EFTs are a useful tool to analyze and compare different New Physics searches. I'll discuss the interplay between low-energy beta decay experiments and LHC searches, the application to Higgs decay data and the limitations of the method when light new particles are present.

Posters [exhibited during the Rencontre] / **44**

Effect of Degenerated Particles on Internal Bremsstrahlung of Majorana Dark Matter

Auteur(s): Takashi Toma[1]

Co-auteur(s) Hiroshi Okada [2]

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[2] *KIAS*

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Gamma-ray generated by annihilation or decay of dark matter can be its smoking gun signature. In particular, gamma-ray coming from internal bremsstrahlung of dark matter is promising since it can be a leading emission of sharp gamma-ray. However if thermal production of Majorana dark matter is considered, the derived cross section for internal bremsstrahlung becomes too small to be observed by future gamma-ray experiments. We consider a framework to achieve an enhancement of the cross section by taking into account degenerated particles with dark matter. We find that the enhancement of about order one is possible without conflict with the dark matter relic density. Due to the enhancement, it would be tested by the future experiments such as GAMMA-400 and CTA.

Posters [exhibited during the Rencontre] / **39**

Fluctuation signatures of the QCD critical point

Jian Deng[1] ; Jiunn-Wei Chen[2] ; Lance Labun[3]

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[3] *University of Texas, Austin*

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Locating the QCD critical point is the goal of several major heavy ion collision experiments, and it may be possible to see signatures of critical behaviour in event-by-event fluctuations of conserved charges. We show characteristic peaks in the third χ_3 and fourth χ_4 fluctuation moments of baryon number as a function of chemical potential (or center of mass energy) and how they depend on proximity of freeze out to the critical point. In a model independent analysis, we explain qualitative features of the moments' dependence on chemical potential and temperature near the critical point, and we identify a few signatures, such as relative location of the χ_3 and χ_4 peaks, expected to be robust. Using the Gross Neveu model we provide a quantitative example of these predictions, which may support experimental observations of a peak in χ_4 as a signature of the critical point.

New Theoretical Developments / **29**

From OPE to Soft-Wall

David Greynat[1]

[1] *Universita di Napoli and INFN*

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We will show how it is possible to implement a chiral symmetry breaking mechanism in soft-wall model of holographic QCD. By perturbing a dilaton potential, we show also that it is possible to reproduce the exact Operator Product Expansion and the spectrum of the vector-vector and axial-axial correlators in the Large-N_c limit.

Posters [exhibited during the Rencontre] / **58**

Generating X-ray lines from annihilating dark matter

Auteur(s) contact: heurtier@cpht.polytechnique.fr

Posters [exhibited during the Rencontre] / **38**

Harnessing astrophysical uncertainties in the direct detection of dark matter

Auteur(s): Bradley Kavanagh[1]

Co-auteur(s) Anne Green [2] ; Mattia FORNASA [2]

[1] *IPhT Saclay*

[2] *University of Nottingham*

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In order to analyse data from direct detection experiments, it has previously been necessary to make assumptions about the dark matter (DM) speed distribution. However, it has been shown that for a future discovery, poor astrophysical assumptions may lead to a bias in the reconstructed DM mass and cross section. I will present a completely general parametrisation of the speed distribution which allows an unbiased measurement of the DM mass and, when combined with neutrino telescope data, of the DM cross section. As an added bonus, the method can be used to reconstruct the distribution function itself from future data, allowing us also to probe the dynamics and formation history of the Milky Way.

Cosmology / **55**

Hawking radiation in laboratory analogues

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Hawking radiation, despite being known to theoretical physics for 40 years, remains an elusive phenomenon. It also suffers, in its original context of gravitational black holes, from practical and conceptual difficulties. In order to gain better theoretical understanding and, it is hoped, experimental verification of Hawking radiation, much study is being devoted to laboratory systems which use moving media to model the spacetime geometry of black holes. I shall briefly describe the analogy between black holes and moving media, and show how it can shed new light on the seemingly exotic phenomenon of Hawking radiation.

Summary:

Hawking radiation, despite being known to theoretical physics for 40 years, remains an elusive phenomenon. It also suffers, in its original context of gravitational black holes, from practical and conceptual difficulties. In order to gain better theoretical understanding and, it is hoped, experimental verification of Hawking radiation, much study is being devoted to laboratory systems which use moving media to model the spacetime geometry of black holes. I shall briefly describe the analogy between black holes and moving media, and show how it can shed new light on the seemingly exotic phenomenon of Hawking radiation.

Higgs Physics and New Physics Scenarios / **3**

Higgs and New Physics

QCD / **27**

Impact factor for high-energy two and three jets diffractive production

Andrey Grabovsky[1] ; Lech Szymanowski[2] ; Renaud Boussarie[3] ; Samuel Wallon[4]

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[2] *Soltan Institute for Nuclear Studies, Department of Theoretical Physics*

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We present the calculation of the impact factor for the photon to quark, antiquark and gluon transition within Balitsky's high energy OPE. We also rederive the impact factor for photon to quark and antiquark transition within the same framework. These results provide the necessary building blocks for further phenomenological studies of inclusive diffractive DIS as well as for two and three jets diffractive production which go beyond approximations discussed in the litterature.

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Impact of sterile neutrinos in lepton flavour violating processes

Auteur(s): Valentina De Romeri[1]

Co-auteur(s) Ana M. Teixeira [2] ; Jean Orloff [3] ; Stephane MONTEIL [4] ; asmaa Abada [5]

[1] *CNRS*

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[4] *Laboratoire de Physique Corpusculaire de Clermont - UBP/IN2P3*

[5] *LPT-Orsay-*

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We address the impact of sterile fermion states on both lepton flavor conserving observables, namely the anomalous magnetic moment of charged leptons and neutrinoless double beta decays, and on lepton flavor violating (LFV) observables such as LFV Z decays.
We illustrate our results in a minimal, effective extension of the Standard Model by one sterile fermion state, and in a well-motivated framework of neutrino mass generation, embedding the Inverse Seesaw into the Standard Model.
Both the simple "3+1" toy model and the Inverse Seesaw realisation succeed in alleviating the tension related to the muon anomalous magnetic moment, albeit only at the 3σ level.
Concerning neutrinoless double beta decays, we show that a future $0\nu2\beta$ observation does not necessarily imply an inverted hierarchy for the active neutrinos.
We finally investigate the impact of the sterile neutrinos on LFV Z decays, focusing on potential searches at a high-luminosity Z factory such as FCC-ee.

Posters [exhibited during the Rencontre] / 19

Interpreting LHC searches for new physics with SModelS

Sabine Kraml[1]

[1] *LPSC Grenoble*

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SModelS is an automatised public tool for the interpretation of so-called Simplified Model Spectra (SMS) results from the LHC. I will discuss the working principle of SModelS and present some applications to supersymmetric models.

Dark Matter - Astroparticles / 11

Is Coy dark matter really coy?

Chiara Arina[1]

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Summary:

In this talk I will show that a Dirac dark matter particle interacting with ordinary matter via the exchange of a light pseudo-scalar, the so-called Coy dark matter, can accommodate the DAMA data while being compatible with all null direct DM searches and at the same time provide a DM explanation of the GC excess in gamma rays and achieve the correct relic density.

QCD / **45**

J/psi-Pair Production at Large Momenta: Indications for Double-Parton Scatterings and Large alpha_s^5 Contributions

Hua-Sheng Shao[1] ; Jean-Philippe Lansberg[2]

[1] *CERN*

[2] *IPNO - Paris-Sud U. - CNRS/IN2P3*

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The recent observations of prompt J/ψ-pair production by CMS at the LHC and by D0 at the Tevatron reveal the presence of different production mechanisms in different kinematical regions. We find out that next-to-leading-order single-parton-scattering contributions at α_s^5 dominate the yield at large transverse momenta of the pair. Our analysis further emphasises the importance of double-parton-scatterings –which are expected to dominate the yield at large rapidity differences– at large invariant masses of the pair in the CMS acceptance. In addition, we provide the first exact –gauge-invariant and infrared-safe– evaluation of a class of leading-P_T next-to-next-to-leading-order contributions, which are dominant in the region of large sub-leading transverse momenta, precisely where the colour-octet contributions can be non-negligible. Finally, we discuss the contribution from decays of excited charmonium states within both single- and double-parton scatterings and suggest measurements to distinguish them.

Flavor Physics / **28**

Kaon phenomenology, Delta I=1/2 rule and BSM kaon oscillations

Nicolas Garron[1]

[1] *University of Cambridge*

Kaon physics provides us with highly-non trivial tests of the Standard Model and is a rich source of information for Beyond the Standard Model (BSM) phenomenology. CP violation is among the most intriguing phenomena in particle physics and is very well measured in kaon decays, but a complete and quantitative theoretical prediction is still missing. However, the RBC-UKQCD collaborations have made tremendous progress in the last few years toward the computation of the $K \to \pi\pi$ amplitudes. I will present our work, including our new data points with physical quark masses.

From our results, I will show a possible explanation of the $\Delta I = 1/2$ rule. Finally, I will present our work on neutral kaon mixing, including the BSM contribution and the constraints it implies on the scale of new-physics.

Summary:

I report on our computation of $K \to \pi\pi$ amplitudes, including new points with physical quark masses, and on $K - \bar{K}$ oscillations within and beyond the standard model. I also show a possible explanation of the $\Delta I = 1/2$ rule.

Posters [exhibited during the Rencontre] / **41**

Lattice computation of the nucleon sigma terms

Christian Torrero[1]

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Besides connecting the pion-nucleon and the kaon-nucleon amplitudes to the hadron spectrum, nucleon sigma terms play an important role in the direct detection of Dark Matter. A lattice computation will be outlined, preliminary results for the up-down and strange sigma terms will be presented and strategies to improve on their precision will be illustrated.

Flavor Physics / **2**

Lepton Flavor (Review)

Auteur(s) contact: michele.frigerio@um2.fr

Flavor Physics / **23**

Lepton flavour violating lepton decays in the inverse seesaw: SUSY and non-SUSY contributions

Avelino Vicente[1] ; Cedric Weiland[2] ; Florian Staub[3] ; Manuel Krauss[4] ; Werner Porod[4] ; asmaa Abada[5]

[1] *LPT Orsay*

[2] *IFT UAM/CSIC*

[3] *CERN*

[4] *University of Würzburg*

[5] *LPT-Orsay-*

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 $\tau \to \mu\mu\mu$ are strongly enhanced in the supersymmetric inverse seesaw model. It has recently been pointed out (Phys.Rev.D90(2014)013008) that an error in the literature for the Z-penguins form factors would lead to a non-physical non-decoupling behaviour. This work (JHEP11(2014)048) 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.

Higgs Physics and New Physics Scenarios / 25

Light-by-light scattering with intact protons at the LHC: from Standard Model to New Physics

sylvain fichet[1]

[1] *ICTP/SAIFR*

We discuss the discovery potential of light-by-light scattering at the LHC, induced by the SM and by new exotic charged particles. Our simulation relies on intact proton detection in the planned forward detectors of CMS and ATLAS. The full four-photon amplitudes generated by any electrically charged particles of spins 1/2 and 1, including the SM processes involving loops of leptons, quarks and W bosons are implemented in the Forward Physics Monte Carlo generator. Our method provides model-independent bounds on massive charged particles, only parametrized by the spin, mass and "effective charge" Qeff of the new particle. We also discuss the sensitivities to neutral particles such as a strongly-interacting heavy dilaton and warped Kaluza-Klein gravitons, whose effects could be discovered for masses in the multi-TeV range.

QCD-2 / 50

Magnetic Wilson loops in the classical field of high-energy heavy-ion collisions

Elena Petreska[1]

[1] *CPHT - Ecole Polytechnique*

The field configuration in the first moments of high-energy heavy-ion collisions is represented by strong longitudinal chromo-electric and chromo-magnetic fields. The form of these fields is obtained by solving the classical Yang-Mills equations of motion for two color charge sheets passing through each other with appropriate boundary conditions on the light cone. We calculate perturbatively the expectation value of the magnetic Wilson loop operator in the first moment of the collision. For the magnetic flux we obtain a first non-trivial term that is proportional to the square of the area of the loop. The result agrees with numerical calculations for small area loops. Screening effects are not present in the analytical calculation. A numerical result for larger loops gives an area law behavior of the flux, which indicates existence of independent magnetic vortices over distance scales up to few times the inverse saturation scale.

Cosmology / 14

Making sense of the local Galactic escape speed estimates in direct dark matter searches

Julien Lavalle[1] ; Stefano Magni[2]

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[2] *Université Montpellier 2*

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The knowledge of the high velocity tail of the WIMP velocity distribution function has a strong impact on the way direct detection (DD) may constrain or discover light WIMPs in the GeV mass range. Recently, there have been important observational efforts to estimate the so-called Galactic escape speed at the position of the Earth, like for instance the analysis published in early 2014 by the RAVE Collaboration (Piffl et al., 2014), which is of interest in the perspective of reducing the astrophysical uncertainties in DD. Nevertheless, these new estimates cannot be used blindly as they rely on assumptions in the dark halo modelling, which induce tight correlations between the escape speed and other local astrophysical parameters (circular velocity, dark matter density, distance to the Galactic center). We make a self-consistent study of the implications of the RAVE results on DD assuming isotropic DM velocity distributions, both Maxwellian and ergodic. Taking as reference the experimental sensitivities currently achieved by LUX, CRESST2, and SuperCDMS, we show that the uncertainties inferred for the exclusion curves in the low WIMP mass region are moderate. We discuss the level of (dis)agreement of these results with other independent astrophysical constraints.

Table Ronde organisée par le BTP2 / **60**

Minutes - TABLE RONDE 2015

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Posters [exhibited during the Rencontre] / **22**

Multi-tops at the LHC

Aldo Deandrea[1] ; Nicolas Deutschmann[1]

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One of the most interesting sectors to look for new physics at the LHC is that of the top quark, both for theoretical and phenomenological reasons. A number of possible final states involving the top have been considered by the experimental collaborations and they have successfully constrained many Beyond the Standard Model scenarios. In this presentation, I will describe a study intended to address the question of how the occurrence of much more exotic final states, namely many-top events, can be constrained using existing analyses, and whether they could be improved using a different selection procedure. I will show that current data allows to put constraints on the production of six-top final states in a toy model created for the purpose of studying this signature and that this is the multiplicity limit one can hope to reach with Run 1.

Cosmology / **56**

Non relativistic Operators in Direct Dark Matter Searches

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New Theoretical Developments / **48**

Nonrenormalizablity of nonequilibrium quantum field theory in the classical approximation

Bin Wu[1] ; Francois Gelis[2] ; Thomas Epelbaum[2]

[1] *IPhT, CEA/Saclay*

[2] *IPhT*

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Nonequilibrium quantum field theory in the classical statistical approximation (CSA) has a broad range of applications to understanding thermalization of systems with a large occupation number both in cosmology and in ultra-relativistic heavy-ion collisions. In my talk, I would like first to give a brief introduction to the CSA in the $g^2\phi^4$ theory. Then, I will present our discovery of nonrenormalizability of such an approximation (Phys. Rev. D 90, 065029 (2014)). I shall also show the Boltzmann equation in two types of classical approximations, which are equivalent to the CSA in the case that the distribution function f satisfies $\frac{1}{g^2} \gg f \gg 1$. The numerical results to the Boltzmann equation in one of the classical limits presented in another paper of ours (arXiv:1409.0701, to appear in PRD) further confirm nonrenormalizability of the CSA. Besides, I would also like to discuss the features of forming a Bose-Einstein condensate in the classical approximations.

QCD-2 / 30

Octet baryon masses in covariant baryon chiral perturbation theory

Auteur(s): Xiu-Lei REN[1]

Co-auteur(s) Jie MENG [2] ; Li-Sheng GENG [3]

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We study the ground-state octet baryon masses and sigma terms using the covariant baryon chiral perturbation theory (ChPT) with the extended-on-mass-shell (EOMS) renormalization scheme up to next-to-next-to-next-to-leading order (N^{3}LO). In order to systematically study the lattice QCD data and to fix the low-energy constants (LECs), the finite-volume corrections (FVCs) and finite lattice spacing discretization effects of LQCD simulations are included self-consistently.

Through a simultaneous fit of all the publicly available $n_f = 2+1$ lattice QCD data from the PACS-CS, LHPC, HSC, QCDSF-UKQCD and NPLQCD collaborations, it shows that the N^{3}LO EOMS BChPT can give a reasonable fit with $\chi^2/\mathrm{d.o.f.} = 1.0$ and the various lattice simulations seem to be consistent with each other. We also conclude that the finite lattice spacing discretization effects up to $\mathcal{O}(a^2)$ can be safely ignored. Finally, the octet baryon sigma terms are predicted via the Feynman-Hellmann theorem. In particular, the pion- and strangeness-nucleon sigma terms are $\sigma_{\pi N} = 55(1)(4)$ MeV and $\sigma_{sN} = 27(27)(4)$ MeV, respectively.

Posters [exhibited during the Rencontre] / 46

Off-shell and on-peak measurements intertwined

Aldo Deandrea[1] ; Giacomo Cacciapaglia[2] ; Guillaume Drieu La Rochelle[1] ; Jean-Baptiste Flament[1]

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As the LHC experimental collaborations have released results about the influence of the existence of the Higgs boson outside of its mass shell, interpreting it as a constraint on its total width, we propose a more model-independent way to recast these observations. We advocate for the use of the parametrisation previously introduced in hep-ph:0901.0927 and hep-ph:1210.8120 to use conjointly on-peak and off-shell measurements. Using a simple toy-model, we show that a degeneracy existing on-peak in the parameters can be lifted by also including off-shell data.

Cosmology / **49**

On pair-instability Supernovae explosions

Pascal Chardonnet[1]

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According to theoretical models, massive stars with masses within the 100- 250 solar mass range should explode as pair-instability supernovae (PISNe). Since the first stars of the Universe are believed to be very massive, these supernovae should play a signicant role in the early stages of its history. But these stars represent the last unobserved population, owing to detection limits of current telescopes. In this presentation, we analyze pair-instability supernovae explosions using various numerical codes. We evolve series of the congurations of oxygen cores to establish a range of masses and initial conditions where this type of explosion is possible. We also study the role of possible instabilities in the propagation of shockwaves during the last stage of the explosion. This investigation could help us to predict the observational properties of PISNe for future space and ground telescopes and the possible connections with Gamma-Ray Bursts.

Posters [exhibited during the Rencontre] / **59**

On the CP-odd Higgs boson

QCD-2 / **32**

Pion couplings to the scalar B meson

Antoine Gérardin[1] ; Benoit Blossier[2] ; Nicolas Garron[3]

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Computing the quark propagator on the lattice gets more and more difficult as the light quark becomes small and approach its physical value. Therefore, most simulations are performed at unphysical light quark masses and the results are extrapolated to the physical mass using fit formulae

inspired by chiral perturbation theory. In the case of heavy-light mesons, one can use the Heavy Meson Chiral Perturbation Theory parametrized, at leading order, by three couplings g, $\tilde{g}$ and h.
In this talk, I will present a lattice computation of the couplings $\tilde{g}$ and h which appear when positive parity states are taken into account. In particular, I will show that the coupling h is large and cannot be neglected in chiral loops.
The lattice simulations are performed on a set of $N_f = 2$ dynamical quarks configurations made available by the Lattice Coordinated Simulations effort.

Flavor Physics / **54**

Quark Flavor (Review)

QCD / **24**

Quarkonia suppression in a quark-gluon plasma produced in heavy ion collisions at high energies.

Roland Katz[1]

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The theory of elementary particles predicts the existence of a new state of matter: the Quark-Gluon Plasma (QGP). The latter may have existed at the first moments of the Universe following the Big Bang and can be, in theory, re-produced in heavy ion collisions at high energy colliders (e.g. the LHC). One of the QGP possible observables is the suppression of the quarkonia (heavy quark/antiquark bound states), i.e. a characteristic decrease of the their detected amount in comparison to proton-proton collisions, in which no QGP production is possible. This suppression has indeed been observed, but the latest observations expose a puzzling saturation of the suppression when the collision energy increases. A dynamical scenario is proposed to describe these kinetic dependences.

QCD-2 / **12**

Random Matrix Theory for Wilson-Dirac Operator

Savvas Zafeiropoulos[1]

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We summarize recent analytical results obtained for the discretization effects of the non-Hermitian Wilson Dirac operator. We include the effect of all three leading low energy constants in our analysis. In particular we discuss the results for the eigenvalue densities close to the continuum limit but we also consider the case of large lattice spacing which is closely related to the mean field limit. Finally, we extract simple relations between measurable spectral quantities and the low energy constants. These relations serve as a new way to measure the additional low energy constants of Wilson chiral perturbation theory.

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New Theoretical Developments / **37**

Recent developments in formal high energy physics

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I will review several recent important developments in high energy physics, including:
-Perturbative and non-perturbative results in supersymmetric non-abelian gauge theories (AdS / CFT, Localisation, non-Langrangian theories).
-Superstring and supergravity amplitudes, 3-loop amplitude in string theory, color kinematic duality and double copy, BMS symmetry and infrared behaviour.
-Black hole information paradox, Mathur conjecture and exact counting through localisation.

New Theoretical Developments / **57**

Renormalization Group Flows for Quantum Gravity

We shall review briefly some current approaches to quantum gravity, focusing in particular on the recent progress on tensor-based models which sum over all discretized space-time geometries and can be shown renormalizable and asymptotically free.

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New Theoretical Developments / **26**

Renormalization Group Optimized Perturbation: some illustrations at zero and finite temperature.

Jean-Loic Kneur[1]

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We discuss our recently developed variant of the so-called optimized perturbation (OPT), 'RGOPT', consistently resumming renormalization group dependence generically for zero or finite temperature theories. It is illustrated with a rather precise determination of 1) the QCD basic scale and coupling from the pion decay constant F_π: $\alpha_S(m_Z)[\overline{MS}] \simeq 0.1174 \pm 0.002$;
2) the quark condensate $< \bar{q}q >$ in the chiral limit.
3) At finite temperature the pressure for the illustrative ϕ^4 model is calculated to second (modified perturbation) order.
Our method and results differ sharply from other similar resummation approaches, in particular the notoriously bad stability and scale dependence of thermal perturbative expansions for moderately large coupling is shown to drastically improve, with anticipated similar properties in thermal QCD.

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Cosmology / **8**

Review Talk

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QCD / **0**

Review of Recent Developments in QCD

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Higgs Physics and New Physics Scenarios / **17**

Searching for the Higgs bosons of the NMSSM

Filippo Sala[1]

[1] *IPhT CEA-Saclay*

The search for signs of more scalars is a primary task of current and future experiments.
In particular, in the next-to-minimal supersymmetric Standard Model, the extra Higgs bosons could well be the lightest new particles around. I will outline a possible overall strategy to look for the extra CP-even scalars, comparing the impact of measurements of the SM Higgs couplings with the direct searches of the new states, at current and future facilities.
In doing so, I will rely on an analytical understanding of the Higgs system, to keep under control the complications due to the proliferation of model parameters.

Table Ronde organisée par le BTP2 / **62**

Slides_BTP2

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QCD / **18**

Small radius jets to all orders

Frédéric Dreyer[1]

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As hadron collider physics continues to push the boundaries of precision, it becomes increasingly important to have methods for predicting properties of jets across a broad range of jet radius values R, and in particular for small R.
In this presentation we will start with a brief review of jet physics at hadron colliders, and introduce a method to resum all leading logarithmic terms, $\alpha_s \ln R$, in the limit of small R, for a wide variety of observables. These include the inclusive jet spectrum, jet vetoes for Higgs physics and jet substructure tools. We will examine and comment on the underlying order-by-order convergence of the perturbative series for different R values.

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Testing the SU(5) Nature of supersymmetry at LHC

Björn Herrmann[1] ; sylvain fichet[2] ; yannick stoll[3]

[1] *LAPTh / Université de Savoie*

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[3] *LAPTh*

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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. This test relies on a Markov Chain Monte Carlo simulation whose results will be presented and which allows to test, given an observed low energy spectra, with which significance the spectra points toward a high scale SU(5) dynamic.
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 (partially) based on arXiv:1403.3397

Dark Matter - Astroparticles / **31**

The Dark Side of Naturalness Beyond the MSSM

Auteur(s): Cedric Delaunay[1]

Co-auteur(s) ANDREAS GOUDELIS [2] ; Genevieve Belanger [1]

[1] *LAPTH*

[2] *LAPTh - Annecy*

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Direct searches of neutralino dark matter in underground scattering experiments constitute a significant pressure on weak scale naturalness in the MSSM. The resulting neutralino fine-tuning is almost as severe as that arising from the heavy stops required by a125GeV Higgs boson. We analyse in an effective field theory framework the implication for neutralino fine-tuning of MSSM extensions which solve the little hierarchy problem of the Higgs mass through the introduction of a heavy, non-decoupled supersymmetric sector. We argue that in these models the neutralino fine-tuning is parametrically worse than in the MSSM for gaugino dark matter. Thermally produced Higgsino dark matter typically displays a comparable level of fine-tuning with the noteworthy exception of dark matter below the WW annihilation threshold. This light Higgsino scenario is only mildly fine-tuned and, in contrast with the MSSM, it does not conflict with the LEP bound on chargino. Any improvement on either charged higgsino searches or direct dark matter detection would test this scenario.

Dark Matter - Astroparticles / **13**

The gamma-ray excess at the Galactic Center and the antiproton constraints.

Marco Taoso[1]

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A GeV gamma-ray excess has possibly been individuated in Fermi-LAT data from the Galactic Center and interpreted in terms of Dark Matter annihilations, either in hadronic or leptonic channels. In order to test this tantalizing interpretation, we address two issues: (i) we improve the computation of secondary emission from DM, confirming it to be very relevant for determining the DM spectrum in the leptonic channels, (ii) we consider the constraints from antiprotons on the DM hadronic channel, finding that the uncertainties on the propagation model and the solar modulation play a major role. The limits that we obtain severely constrain the DM interpretation of the excess in the hadronic channel, for standard assumptions on the Galactic propagation parameters and solar modulation. However, they considerably relax if more conservative choices are adopted.

QCD / **53**

Universality of perturbative QCD soft radiation in ee, ep, and pp collisions

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Soft radiation consists of coherent low energy gluons that interact with initial and final state jets at wide angles from the jet axis, and we show that this soft radiation in ee, ep and pp collisions is universal to order α_s^2 in perturbation theory. We factor this soft radiation out of the multi-scale cross-section using Soft Collinear Effective Theory, which is an effective field theory of QCD for processes

with high energy, light-like degrees of freedom interacting via soft degrees. The universality of soft radiation suggests that low energy QCD radiation is independent of the process and can be decoupled from the high-energy, short-distance jet structure.

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