Rencontres de Physique des Particules

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Université Montpellier 2

Recueil des résumés

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Thermalization in scalar field theories

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The quark gluon plasma thermalization in heavy ion collisions is an open problem that gave rise to many works in recent years. One of the approaches developped to study this QCD non pertubative problem is a resummation scheme that amounts to averaging over classical fields with random initial conditions. Its numerical implementation is presented here in the case of a scalar field theory with a quartic coupling, that shares some important features with QCD (scale invariance at the classical level and the presence of instabilities). In particular, we will show the relevance of this resummation in capturing the physics relevant for thermalization.

Flavors / **3**

Theta 13 after Daya Bay

Auteurs: Hiroshi Nunokawa[1]; Hisakazu Minakata[2]; Pedro Machado[3]; Renata Zukanovich Funchal[4]

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The lepton mixing angle theta 13, the only unknown angle in the standard three-flavor neutrino mixing scheme, is finally measured by recent reactor and accelerator experiments. We perform a combined analysis of the data coming from T2K, MINOS , Double Chooz, and Daya Bay, extracting a 6.2 sigma significance for nonzero theta 13. We also discuss near future expectations on the precision of the theta 13 determination.

Beyond the Standard Model / **4**

Unlocking the Standard Model : the 1-generation case

Auteur: Bruno Machet[1]

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I show that the Standard Model of weak interactions cannot have less than two Higgs doublets as soon as they are considered (to transform) as $\bar{q}_i q_j$ and $\bar{q}_i \gamma_5 q_j$
bilinears. There are exactly two for one generation of quarks, which is the simple case under scrutiny here. All basic physical properties, not only of massive gauge bosons, but also of fermions and J=0 mesons are correctly described. Re-written in this way, the Standard Model appears to be "complete" in the sense that no extra physics, no heavy fermion nor any additional interaction is needed

to calculate the mass of the second Higgs bosons, which appears as a suitable dark matter candidate.

Flavors / **5**

Probing $N_f = 2$ chiral dynamics with topological zero-modes in the mixed chiral regim

Auteur: Gregory Vulvert[1]

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Lattice QCD benefits nowadays from numerous progess thanks to algorithmic enhancements to push down the quark masses to reach the physical masses and to increase the lattice geometry to avoid finite volume effects. However using fermions which do not break the chiral symmetry both in valence and sea sector is still a challenge. An alternative is to consider mixed action simulations, where one uses for example Ginsparg-Wilson respecting chiral symmetry to describe the valence quark whereas the sea is described by Wilson fermions, which break chiral symmetry and which are numerically cheaper but even in this case, using large volumes do avoid finite-volume effects is rather expensive.
Chiral perturbation theory (ChPT) can be done in finite-volume so that it can take into account the finite-volume effects. But we can use quarks that do not belong to the same chiral regime : some quarks can be in the so-called epsilon regime of ChPT which allows to compute large finite-size effects while other quarks are in the usual p regime. We thus consider a theory with N_v quarks in the epsilon regime and N_s quarks in the p-regime. These results can be used to match lattice QCD and the chiral effective theory in a large but finite box in which the Compton wavelength of the lightest pions is of the order of the box size. This approach allows us to test the chiral regime. I will present some results obtained in the case of the PP correlator.

QCD (dans tous ses états) / **7**

Reconstruction of non-analytic functions

Auteur: David GREYNAT[1]

Co-auteurs: Pere Masjuan [2]; Santiago PERIS [3]

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[2] *Universidad de Granada*

[3] *IFAE- Barcelona*

With the help of the Mellin-Barnes transform, we show how to simultaneously resum the expansion of any kind of non-analytic functions around 0, 1 and $infinity$ in a systematic way. We exemplify the method for the perturbative vector, axial scalar and pseudo-scalar correlator at $\mathcal{O}(\alpha_s^3)$. We show that the coefficients, $\Omega(n)$, of the Taylor expansion of the vacuum polarization function in terms of the conformal variable ω admit, for large n, an expansion in powers of $1/n$ (up to logarithms of n) that we can calculate exactly. This large-n expansion has a sign-alternating component given by the logarithms of the OPE, and a fixed-sign component given by the logarithms of the threshold expansion in the external momentum q^2.

Higgs boson(s) / **8**

Higgs and things (review talk)

Auteur correspondant zerwas@lal.in2p3.fr

Flavors / **9**

Lepton flavour violation and neutrinos (review talk)

Auteur correspondant mahirsch@ific.uv.es

Flavors / **10**

Lattice QCD and the search for new physics (review talk)

Auteur correspondant lellouch@cpt.univ-mrs.fr

Astroparticle physics and cosmology / **11**

Dark stuff (review talk)

Auteur correspondant malcolm.fairbairn@kcl.ac.uk

I will (extremely) briefly review the evidence for dark matter and then the ongoing efforts to detect it using indirect and direct detection. I will talk about recent developments in indirect detection including a couple of potential signals from Fermi and some recent pessimistic predictions from N-body simulations. I will then review the ongoing search for dark matter via direct detection. I will explain the astrophysical uncertainties in direct detection and estimate their errors. If I have time I will mention the situation in the world of dark energy and some recent work in this area.

Heavy ions / **12**

Symmetries and currents of the ideal and the unitary Fermi gases

Auteur: elisa meunier[1]

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The maximal algebra of symmetries of the free Schrodinger equation is determined. This algebra is an infinite dimensional extension of the Schrodinger algebra (by higher symmetries which are not kinematical transformations), it is isomorphic to the Weyl algebra of quantum observables, and it may be interpreted as a non-relativistic higher-spin algebra. The associated infinite collection of Noether currents bilinear in the fermions are derived from their relativistic counterparts via a light-like dimensional reduction.

Heavy ions / **13**

Heavy ions (review talk)

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Beyond the Standard Model / **14**

Physics beyond the Standard Model (review talk)

Auteur correspondant emilian.dudas@cpht.polytechnique.fr

QCD (dans tous ses états) / **15**

QCD in hadron collisions (review talk)

Auteur correspondant salam@lpthe.jussieu.fr

Higgs boson(s) / **16**

A Higgs signal Beyond the MSSM

Auteur: Guillaume Drieu La Rochelle[1]

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The BMSSM (Beyond the MSSM) framework is an effective theory approach that encapsulates a variety of extensions beyond the MSSM with which it shares the same field content. The lightest Higgs mass can be much heavier than in the MSSM without creating a tension with naturalness or requiring superheavy stops. The phenomenology of the Higgs sector is at the same time much richer. I discuss here the different predicted rates in the LHC channels ZZ->4l, 2 photons, 2 photons + 2 jets and WW, together with the constraint stemming from the non observation of other Higgses in all channels. A special stress is put on the correlations between the signal channels and how they can help to exclude or discriminate among different theoretical models. I show furthermore how those results behave when applying constraints from dark matter and flavour physics.

Astroparticle physics and cosmology / **17**

Lepton flavour violation in the inverse seesaw

Auteur: Cedric Weiland[1]

Co-auteurs: Avelino Vicente [1]; Debottam Das [2]; asmaa Abada [3]

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The inverse seesaw is a very appealing mechanism to generate neutrino masses since it provides natural neutrino Yukawa couplings ($Y_\nu \sim O(1)$) and a seesaw scale close to the electroweak one, thus within LHC reach.
In a previous work (arXiv:1111.5836) where we embedded the inverse seesaw in a supersymmetric extension of the Standard Model (MSSM), we have highlighted that the Higgs-mediated penguin diagrams contributing to lepton flavour violating observables like $\tau \to \mu\mu\mu$ or $B_d^0 \to e\mu$ are enhanced by as much as two orders of magnitude. It has recently been pointed out (arXiv:1202.1825) that the Z-mediated contributions could be enhanced in extensions of the MSSM that accommodate neutrino masses, the supersymmetric inverse seesaw being one of them.
This work is devoted to a comprehensive study of several LFV observables (mu-e conversion, \mu \rightarrow 3 e, \tau \rightarrow \mu \eta, etc) and their enhancements due to the effect of the inverse seesaw. It allows us to put new constraints on this model, given the present experimental bounds on these observables. Furthermore, LFV observables which are dominated by the Z- mediated contribution exhibit specific behaviour like a reduced dependence on the supersymmetric parameters or on the right-handed neutrino masses.

Astroparticle physics and cosmology / **18**

Neutralino relic density with Next to Leading Order (co)annihilation cross-section

Auteur: Quentin Le Boulc'h[1]

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The relic density of Dark Matter in the Universe imposes today one of the most stringent constraints on new physics models such as the Minimal Supersymmetric Standard Model (MSSM). The most recent analysis of the WMAP collaboration has already reached an accuracy of 3%, and the upcoming results obtained with the Planck satellite will be even more precise. It is therefore mandatory for the theoretical predictions to match this impressive experimental precision. An important contribution to the theoretical uncertainty of the relic density comes from higher-order corrections to the Dark Matter annihilation and coannihilation cross sections.

The DM@NLO ("Dark Matter at Next to Leading Order") project aims at providing a numerical code to compute these cross sections for the lightest neutralino
at NLO in the strong coupling. All relevant corrections to the annihilation of two neutralinos into quark-antiquark pairs have already been included and have been shown to modify significantly the predicted relic density. Neutralino-chargino and neutralino-squark coannihilation processes are in progress.

In this presentation I will first recall the motivations for a high-precision calculation of the relic density and show typical numerical results
for neutralino annihilation into quarks. I will then give a general overview of the DM@NLO project and discuss in some detail the specific case of neutralino-squark coannihilation.

Heavy ions / **19**

Jet evolution in the QGP

Auteur: Yacine Mehtar-Tani[1]

Co-auteurs: Edmond Iancu [1]; Fabio Dominguez [1]; Jean-Paul Blaizot [1]

[1] *IPhT*

We study the perturbative evolution of a jet via multiple gluon emissions induced by the interactions between the jet constituents and a dense QCD medium like a quark-gluon plasma. We focus on the typical medium-induced gluon emissions, for which the gluon formation time is much smaller than the overall size of the medium. We show that the typical time between two subsequent emissions is parametrically larger than the formation time for one gluon (in contrast to jet fragmentation in the vacuum, where these two scales get identified with each other). This separation of scales has a remarkable physical consequence: it implies that coherence phenomena are negligible and therefore successive emissions can be treated as independent from each other and ordered in time. This is important as it allows for a probabilistic interpretation of the in-medium jet fragmentation as a classical branching process, which is in particular suitable for implementation as an event generator.

Beyond the Standard Model / **20**

Baryon and lepton number violation at the LHC

Auteur: Christopher Smith[1]

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Baryon (B) and lepton (L) numbers are conserved in the standard model lagrangian, but generally not in new physics models. In this talk, we adopt an effective approach to analyze, in a model-independent way, the possible signatures of B and L violating interactions at the LHC. Then, we particularize the discussion to the minimal supersymmetric standard model, where such interactions may now be much welcome since they allow to bypass the already tight constraints on sparticle masses.

Astroparticle physics and cosmology / **21**

Probing the supersymmetric inflaton and dark matter link

Auteur: Jonathan Da Silva[1]

[1] *Laboratoire d'Annecy-Le-Vieux de Physique Théorique*

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In this talk I will present a study on the NUHM2 supersymmetric model where both the cosmic inflation and the observed dark matter abundance can be explained, with a Higgs boson mass in the range favoured by the latest LHC data. The two inflaton candidates
LLe and udd are embedded within the MSSM therefore their decay naturally excites all the relevant degrees of freedom which thermalizes the lightest supersymmetric particle (LSP) during reheating. Many configurations in the NUHM2 parameter space predict the correct relic density for the LSP, the right amplitude and tilt of the power spectrum. We find also that the dark matter interactions with XENON nuclei fall within the projected
range for XENON1T. Hence, such a scenario will be significantly constrained by this experiment.

Flavors / **22**

A Minimal Model of Neutrino Flavor

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N.N.

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Mot de bienvenue / Welcome address

Astroparticle physics and cosmology / **25**

Neutrinos are not in a rush

Auteur: philippe brax[1]

[1] *IPHT Saclay*

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I will describe how neutrinos could go faster than the speed of light in a dense environment if gravity were modified by a scalar field. I will show that the speed difference would almost always be unobservable for natural values of the couplings of scalars to matter.

Beyond the Standard Model / **26**

LHC phenomenology of general SU(2)xSU(2)xU(1) models

Auteur: Tomas Jezo[1]

Co-auteurs: Ingo Schienbein [1]; Michael Klasen [1]

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General SU(2)xSU(2)xU(1) models represent a well-motivated intermediate step towards the unification of the Standard Model gauge groups. Based on a recent global analysis of low-energy and LEP constraints of these models, we perform numerical scans of their various signals at the LHC. We show that total cross sections for lepton and third-generation quark pairs, while experimentally easily accessible, provide individually only partial information about the model realized in Nature. In contrast, correlations of these cross sections in the neutral and charged current (CC) channels may well lead to a unique identification.

Flavors / **28**

Fitting neutrino physics with a U(1)_R lepton number

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Flavors / **29**

Lepton flavour violation at the LHC in SUSY seesaw type-I

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Flavors / **31**

Lattice computation of $K \to \pi\pi$ amplitudes

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Flavors / **32**

Isospin breaking corrections to light hadron masses

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Higgs boson(s) / **35**

Implications of a 125 GeV Higgs

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Beyond the Standard Model / **45**

Ultraviolet clues from infrared fingerprints

Auteur correspondant alfredo.urbano@le.infn.it

QCD (dans tous ses états) / **47**

Model independent view of $b \to s l^- l^+$

Auteur correspondant nejc.kosnik@ijs.si

We discuss the advantages of combining the experimental bound on B(Bs->mu+ mu-) and the measured B(B->Kl+l-) to get the model independent constraints on physics beyond the Standard Model. Since the two decays give complementary information, one can study not only the absolute values of the Wilson coefficients that are zero in the Standard Model, but also their phases. We also emphasize the importance of measuring the forward-backward asymmetry in B->Kl+l- decay at large q2's.

QCD (dans tous ses états) / 50

Strong coupling constant from first principles

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Astroparticle physics and cosmology / 52

Mixed sneutrino dark matter in light of recent experimental results

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Beyond the Standard Model / 54

Indirect dark matter signals and backgrounds in cosmological simulations

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