IRN Terascale @ Laboratori Nazionali di Frascati

Rapport sur les contributions

https://indico.in2p3.fr/e/Frascati2024

ID de Contribution: **2** Type: **Non spécifié**

Scientific management committee meeting

lundi 15 avril 2024 18:20 (40 minutes)

ID de Contribution: **4** Type: **Non spécifié**

Modular Symmetry: a new perspective on the Flavor Puzzle

lundi 15 avril 2024 17:30 (25 minutes)

Understanding the flavour structure of leptons, i.e. their mass pattern and mixing, is a major *unresolved* puzzle in theoretical particle physics. In the recent past, a substantial effort went into models based on discrete flavour symmetries, but that approach proved to be particularly challenging. In 2017 a new promising direction was suggested: a "bottom-up"approach based on modular invariance, a more predictive framework which may be able to provide testable predictions for incoming neutrino experiments. It is important to highlight both the strengths and the potential shortcomings of this new perspective. As an example, a recent model based on the modular group $\Gamma_2 \cong S_3$ will be presented (*JHEP09(2023)043*).

Auteur principal: PARRICIATU, Matteo (Università degli Studi Roma Tre)

Orateur: PARRICIATU, Matteo (Università degli Studi Roma Tre)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **5** Type: **Non spécifié**

Phenomenology of GeV-scale dark matter near p-wave resonance

We consider a light scalar dark matter candidate with mass in the GeV range whose p-wave annihilation is enhanced through a Breit-Wigner resonance. The annihilation proceeds in the s-channel via a dark photon mediator. We compute the temperature at which kinetic decoupling between dark matter and the primordial plasma occurs and show that including the effect of kinetic decoupling can reduce the dark matter relic density by orders of magnitude. We also find that μ and y-distortions of the CMB
spectrum and X-ray data from XMM-Newton strongly constrain the model and rule out the region where the dark matter annihilation cross-section is strongly enhanced at small dispersion velocities. Constraints from direct detection searches and the accelerator limits for dark photons offer complementary probes of the model.

Auteurs principaux: BELANGER, Genevieve (LAPTh, Annecy); CHAKRABORTI, Sreemanti (IPPP Durham); GENOLINI, Yoann (LAPTh, Annecy); SALATI, Pierre (LAPTh, Annecy)

Orateur: CHAKRABORTI, Sreemanti (IPPP Durham)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **7** Type: **Non spécifié**

The rise and fall of light stops in the LHC top quark sample

lundi 15 avril 2024 15:20 (25 minutes)

We discuss the possibility that light new physics in the top quark sample at the LHC can be found by investigating with greater care well known kinematic distributions, such as the invariant mass m_{bl} of the b-jet and the charged lepton in fully leptonic $t\bar{t}$ events. We demonstrate that new physics can be probed in the rising part of the *already measured* m_{bl} distribution. To this end we analyze a concrete supersymmetric scenario with light right-handed stop quark, chargino and neutralino. The corresponding spectra are characterized by small mass differences, which make them not yet excluded by current LHC searches and give rise to a specific end-point in the shape of the m_{bl} distribution. We argue that this sharp feature is general for models of light new physics that have so far escaped the LHC searches and can offer a precious handle for the implementation of robust searches that exploit, rather than suffer from, soft bottom quarks and leptons. Recasting public data on searches for new physics, we identify candidate models that are not yet excluded. For these models we study the m_{bl} distribution and derive the expected signal yields, finding that there is untapped potential for discovery of new physics using the m_{bl} distribution.

Auteur principal: SENGUPTA, Dibyashree (INFN, Laboratori Nazionali di Frascati)

Orateur: SENGUPTA, Dibyashree (INFN, Laboratori Nazionali di Frascati)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **8** Type: **Non spécifié**

Probing dark matter models with DarkPACK: present state and future developments

mardi 16 avril 2024 12:40 (15 minutes)

Nowadays, the research in Beyond Standard Model (BSM) scenarios aimed at describing the nature of dark matter is a very active field. DarkPACK is a recently released software conceived to help to study such models. It can already compute the relic density in the freeze-out scenario, and its potential can be used to compute other observables.

Auteur principal: PALMIOTTO, MARCO (Université Claude Bernard Lyon 1)

Orateur: PALMIOTTO, MARCO (Université Claude Bernard Lyon 1)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **10** Type: **Non spécifié**

New Constraint for Isotropic Lorentz Violation from LHC Data

lundi 15 avril 2024 14:55 (25 minutes)

New calculations for the kinematics of photon decay to fermions *in vacuo* under an isotropic violation of Lorentz invariance (LV), parameterized by the Standard-Model Extension (SME), are presented in this paper and used to interpret prompt photon production in LHC data. The measurement of inclusive prompt photon production at the LHC Run 2, with photons observed up to a transverse energy of 2.5 TeV , provides the lower bound $\tilde{\kappa}_{\rm tr} > -1.06 \times 10^{-13}$ on the isotropic coefficient $\tilde{\kappa}_{\rm tr}$ at 95% confidence level. This result improves over the previous bound from hadron colliders by a factor of 55. The calculations for the kinematics of photon decay have further potential use to constrain LV coefficients from the appearance of fermion pairs, for instance, top-antitop.

Auteur principal: AMRAM, David (IP2I)

Orateur: AMRAM, David (IP2I)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **11** Type: **Non spécifié**

Unraveling Dark Matter and neutrino mysteries with a scotogenic approach

lundi 15 avril 2024 16:40 (25 minutes)

We present a study of a scotogenic model addressing the dark matter problem while generating three non-zero neutrino masses. We investigate the dual nature of a dark matter candidate emerging from distinct particle components across diverse energy regimes within the energy range of HL-LHC. Results highlight the behavior of the dark matter candidate in varied energy contexts, with a focus on correlations with neutrino masses. Furthermore, we will pay attention to experimental constraints, particularly from lepton flavor violating observables, delivering a comprehensive overview of the model's implications for advancing our understanding of fundamental particles.

Auteurs principaux: DE NOYERS, Ugo (LAPTh / Université Savoie Mont Blanc); SARAZIN, Maud (Lapth); HERRMANN, Björn (LAPTh / Université Savoie Mont Blanc)

Orateur: DE NOYERS, Ugo (LAPTh / Université Savoie Mont Blanc)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **12** Type: **Non spécifié**

Closing in on new chiral leptons at the LHC

lundi 15 avril 2024 15:45 (25 minutes)

We study the phenomenological viability of chiral extensions of the Standard Model, with new chiral fermions acquiring their mass through interactions with a single Higgs. We examine constraints from electroweak precision tests, Higgs physics and direct searches at the LHC. Our analysis indicates that purely chiral scenarios are perturbatively excluded by the combination of Higgs coupling measurements and LHC direct searches. However, allowing for a partial contribution from vector-like masses opens up the parameter space and non-decoupled exotic leptons could account for the observed 2σ deviation in $h \to Z\gamma$. This scenario will be further tested in the high-luminosity phase of the LHC.

Auteur principal: NARDECCHIA, Marco (Sapienza Università di Roma)

Orateur: NARDECCHIA, Marco (Sapienza Università di Roma)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **13** Type: **Non spécifié**

Modern Machine Learning Tools for Unfolding

mardi 16 avril 2024 12:00 (15 minutes)

Unfolding is a transformative method that is key to analyze LHC data. More recently, modern machine learning tools enable its implementation in an unbinned and high-dimensional manner. The basic techniques to perform unfolding include event reweighting, direct mapping between distributions and conditional phase space sampling, each of them providing a way to unfold LHC data accounting for all correlations in many dimensions. We describe a set of known and new unfolding methods and tools and discuss their respective advantages. Their combination allows for a systematic comparison and performance control for a given unfolding problem.

Auteur principal: MARIÑO VILLADAMIGO, Javier (Institut für Theoretische Physik - University of Heidelberg)

Orateur: MARIÑO VILLADAMIGO, Javier (Institut für Theoretische Physik - University of Heidelberg)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **14** Type: **Non spécifié**

Kicking it Off(-shell) with Direct Diffusion

mardi 16 avril 2024 11:40 (15 minutes)

Off-shell effects in large LHC backgrounds are crucial for precision predictions and, at the same time, challenging to simulate. We show how a generative diffusion network learns off-shell kinematics given the much simpler on-shell process. It generates off-shell configurations fast and precisely, while reproducing even challenging on-shell features.

Auteurs principaux: BUTTER, Anja (LPNHE); KUSCHICK, Mathias (Universität Münster); KLASEN, Michael (LPSC); PALACIOS SCHWEITZER, Sofia (ITP, Heidelberg University); PLEHN, Tilman (Heidelberg University); JEZO, Tomas (LPSC)

Orateur: PALACIOS SCHWEITZER, Sofia (ITP, Heidelberg University)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **15** Type: **Non spécifié**

Dark Matter Direct Detection in t-channel mediator models

mardi 16 avril 2024 16:46 (13 minutes)

We propose a comprehensive study of the Direct Detection phenomenology of singlet Dark Matter t-channel portal models. For that purpose, we present a complete computation of the loop induced direct detection cross-section for both scalar and fermionic Dark Matter candidates. We complete the study comparing the results with current and future bounds from Direct Detection experiments and requiring the correct Dark Matter relic density.

Auteurs principaux: CABO ALMEIDA, David (University of Messina (Italy)); MESCIA, Federico (INFN-LNF); ARCADI, Giorgio (University of Messina); Dr VIRTO, Javier (Universitat de Barcelona)

Orateur: CABO ALMEIDA, David (University of Messina (Italy))

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **17** Type: **Non spécifié**

The inclusion of theory uncertainties in NNLO and N3LO NNPDF fits

mardi 16 avril 2024 10:30 (15 minutes)

We include uncertainties due to missing higher order corrections to QCD computations (MHOU) used in the determination of parton distributions (PDFs) in the recent NNPDF4.0 set of PDFs. We use our previously published methodology, based on the treatment of MHOUs and their full correlations through a theory covariance matrix determined by scale variation, now fully incorporated in the new NNPDF theory pipeline. We assess the impact of the inclusion of MHOUs on the NNPDF4.0 central values and uncertainties. We also show how this formalism can be used to produce approximate N3LO PDF sets, using N3LO ingredients when they are known and assessing the impact of the unknown ingredients through a theory covariance matrix.

Auteur principal: BARONTINI, Andrea (University of Milan)

Orateur: BARONTINI, Andrea (University of Milan)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **18** Type: **Non spécifié**

Accidentally light scalars and inflation

mardi 16 avril 2024 17:50 (13 minutes)

Scalar fields can be accidentally light if symmetries forbid their tree-level masses in the potential at the renormalizable level. We present some example models with small symmetry groups (typically SU(n) x U(1)) but with the scalars transforming in large representations. We discuss possible applications to generating natural hierarchies of scales in models with elementary scalars. In particular, we present a model of hybrid natural inflation where the inflaton potential is flat because it is an accidentally light scalar.

Auteur principal: BRUEMMER, Félix (LUPM Montpellier)

Co-auteurs: FERRANTE, Giacomo (LUPM); FRIGERIO, Michele ({CNRS}UMR5221)

Orateur: BRUEMMER, Félix (LUPM Montpellier)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **19** Type: **Non spécifié**

Improved bounds on the hot QCD axion

mardi 16 avril 2024 17:18 (13 minutes)

The QCD axion is the most robust explanation to the strong CP problem and provides a good dark matter candidate. A population of QCD axions can be produced in the early universe via scattering with SM particles, and can be searched for in cosmological datasets. I will present the state-of-the-art bound on the minimal QCD axion model by confronting momentum-dependent Boltzmann equations, from axion-pion scattering below the QCD cross-over, against up-to-date measurements of the CMB and abundances from BBN. Finally, I will present forecasts using dedicated likelihoods for future cosmological surveys and a new sphaleron rate from unquenched lattice QCD.

Auteur principal: GRILLI DI CORTONA, Giovanni (INFN - Laboratori Nazionali di Frascati)

Orateur: GRILLI DI CORTONA, Giovanni (INFN - Laboratori Nazionali di Frascati)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **21** Type: **Non spécifié**

Model-Independent Radiative Symmetry Breaking: Gravitational Waves, Primordial Black Holes and New Physics

mardi 16 avril 2024 17:02 (13 minutes)

First-order phase transitions, which take place when the symmetries are predominantly broken (and masses are then generated) through radiative corrections, produce observable gravitational waves and primordial black holes; also, if observed, they would signal new physics. I discuss a model-independent approach that is valid for large-enough supercooling to quantitatively describe these phenomena in terms of few parameters, which are computable once the model is specified. Among other things, I identify regions of the parameter space that correspond to the background of gravitational waves recently detected by pulsar timing arrays and others that are either excluded by the observing runs of LIGO and Virgo or within the reach of future gravitational wave detectors. These include LISA, BBO and DECIGO, which will test the TeV scale. Furthermore, I show regions of the parameter space where primordial black holes produced by large over-densities due to such phase transitions can account for dark matter. Finally, if time allows, I discuss how this model-independent approach can be applied to specific cases, including a phenomenological completion of the Standard Model with right-handed neutrinos and gauged B - L undergoing radiative symmetry breaking of the electroweak symmetry and B - L.

Auteur principal: SALVIO, Alberto (University of Rome and INFN Tor Vergata)

Orateur: SALVIO, Alberto (University of Rome and INFN Tor Vergata)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **22** Type: **Non spécifié**

Axion emission from strange matter in core-collapse SNe

mardi 16 avril 2024 16:30 (13 minutes)

Axion emission is known to be strongly constrained by neutrino-burst data from SN 1987A. Compton-like nucleon-pion to nucleon-axion scattering has recently been shown to be an important mechanism, due also to the large baryon densities involved. We perform a first quantitative study of the role of hadronic matter beyond the first generation – in particular strange matter. We consistently include the full baryon and meson octets in axion emission from Compton-like scattering and from baryon decay. We consider a range of supernova thermodynamic conditions as well as various motivated scenarios for the axion-quark couplings. Irrespective of either modelling aspect, we find that axion emissivity introduces non-trivial correlations between flavour-diagonal axial couplings and constrains the off-diagonal, flavor-violating counterpart. This constraint can be as small as O(10^{-2}) for the QCD axion, i.e. for f_a = 10^9 GeV.

Auteurs principaux: GUADAGNOLI, Diego (LAPTh Annecy); CAVAN-PITON, Maël (LAPTh Annecy)

Orateurs: GUADAGNOLI, Diego (LAPTh Annecy); CAVAN-PITON, Maël (LAPTh Annecy)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **23** Type: **Non spécifié**

Novel Weinberg-like operators from new scalar multiplets

lundi 15 avril 2024 17:05 (25 minutes)

The Weinberg operator, the unique dimension-5 effective operator LLHH, can generate tiny Majorana masses for neutrinos. In the presence of new scalar multiplets acquiring vacuum expectation values (VEVs), novel Weinberg-like operators emerge, subsequently contributing to Majorana neutrino masses. We consider scenarios involving one or two new scalars transforming under higher SU(2) representations $\mathcal{R}$, up to $\mathcal{R} \leq 5$. We start our analysis from an Effective Field Theory approach and subsequently investigate potential tree-level UV completions for the newly introduced dimension-5 operators.

Auteur principal: MARCIANO, Simone (INFN - Università Roma Tre)

Orateur: MARCIANO, Simone (INFN - Università Roma Tre)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **24** Type: **Non spécifié**

The inclusion of QED correction in the NNPDF4.0 fitting framework

mardi 16 avril 2024 10:10 (15 minutes)

The need of percent precision in high energy physics requires the inclusion of QED effects in theoretical predictions, for example like the contributions coming from photon initiated processes. It is trivial then, to correctly determine the photon content of the proton.
In this work, we extend the NNPDF4.0 NNLO determination of parton distribution functions (PDFs) with a photon PDF, determined within the LuxQED formalism, which evolves with the gluon and quark PDFs via DGLAP equations that contain NLO QED corrections.
We study the impact of the QED effects to the NNPDF4.0 methodology, we compare our results with NNPDF3.1QED and other recent QED PDF fits and we asses the impact of the photon PDF for photon-initiated processes for LHC processes.

Auteur principal: LAURENTI, Niccolò (University of MIlan and INFN)

Orateur: LAURENTI, Niccolò (University of MIlan and INFN)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **25** Type: **Non spécifié**

Resonances all over the place?

Given the very large number of searches for resonances at the LHC, it comes as no surprise, statistically speaking, that excesses are occasionally observed in the data, that might or might not stand the test of time.
However, when these excesses are found to occur at the same invariant mass in different search channels, a theoretical interpretation becomes instructive. Indications for a 95GeV electrically neutral scalar produced in association with a Z boson and decaying to bbar, have been around since the LEP. Further indications around the same mass came later on from CMS both in diphoton and tautau decays of a singly produced object, triggering various interpretations in terms of singlet/doublet extensions including SUSY.
Less popular, though, are the recent indications from CMS and ATLAS for a singly produced 650GeV electrically neutral scalar decaying to WW, to ZZ, to the SM Higgs and the 95GeV scalar, as well as to new lighter states in cascade or in association with a Z boson. Even more so, combining the corresponding p-values of these excesses gives a global significance of 4 sigma, higher than that for the 95GeV.
We argue that a theoretical framework accounting for the SM Higgs and these two hypothetical scalars is not straightforward: It disfavours singlet/doublet-only Higgs extensions, necessitates the existence of doubly charged scalar states while still disfavouring canonical triplet Higgs extensions like the Georgi-Mchacek model.
A viable BSM extension is then presented as well as the ensuing predictions for other scalar states.

Paper to appear (in collaboration with Anirban Kundu (Clacutta University) & Poulami Mondal (Kanpur University))

Auteurs principaux: Prof. KUNDU, Anirban (Calcutta University); MOULTAKA, Gilbert (L2C Montpellier, UMR5221-UM2/INP/CNRS); Dr MONDAL, Poulami (Kanpur University)

Orateur: MOULTAKA, Gilbert (L2C Montpellier, UMR5221-UM2/INP/CNRS)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **26** Type: **Non spécifié**

Probabilistic theory uncertainties from missing higher orders

mardi 16 avril 2024 09:50 (15 minutes)

I present a probabilistically founded definition of theory uncertainties in perturbative computations due to the unknown higher orders. I show its performance against canonical recipes such as scale variation. I finally discuss future directions.

Auteur principal: BONVINI, Marco (INFN Roma)

Orateur: BONVINI, Marco (INFN Roma)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **27** Type: **Non spécifié**

Feynman integrals in QFT

mercredi 17 avril 2024 10:00 (25 minutes)

In this talk, I will review theoretical and phenomenological aspects of multi-loop amplitudes, focusing on the their wide range of physical applications. I will gently introduce the method employed in the calculation of the gg -> HH NLO SM and Beyond cross section to show where Feynman integrals enter, and where calculation bottleneck may arise.
The increasing mathematical understanding of Feynman integrals brought impact on fields from higher-order perturbative QFT predictions to Cosmology and Classical Gravity.
I will introduce some of the main state-of-the-art methods for evaluating Feynman integrals, and I will show how such object are connecting a broad spectrum of techniques from differential geometry, differential equation, machine learning and numerical approaches.
In conclusion, I will show some applications of these methods on scattering processes of phenomenological interest, like q \bar q -> t \bar t virtual amplitude contribution at NNLO.

Auteur principal: RONCA, JONATHAN

Orateur: RONCA, JONATHAN

Classification de Session: Higgs and EW

Classification de thématique: Higgs and EW physics

ID de Contribution: **28** Type: **Non spécifié**

Overview and challenges of semi-leptonic B decays and implications for new physics

lundi 15 avril 2024 14:30 (25 minutes)

We discuss the status of b⟶sℓ+ℓ− decays in the post-RK(∗) era. We present a model-independent analysis of the b⟶sℓ+ℓ− data and investigate the implications of the different sets of observables. Special emphasis will be given to the theoretical uncertainties and challenges.

Auteur principal: MAHMOUDI, Nazila (Lyon University)

Orateur: MAHMOUDI, Nazila (Lyon University)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **31** Type: **Non spécifié**

Exploring Higgs Boson Properties: Insights from the ATLAS Group at LNF

mercredi 17 avril 2024 11:45 (25 minutes)

Since the discovery of the Higgs boson, the ATLAS group at LNF has been studying its properties, particularly in the four-lepton decay channel. Known as the "golden channel,"this process played a crucial role in the discovery of the Higgs boson in 2012 and continues to be one of the primary final states for precise measurements of its properties, such as mass, spin/CP, and couplings with other Standard Model (SM) particles. These studies aim also to identify possible deviations from the SM and signs of New Physics. The state-of-the-art research on the Higgs boson in the four-lepton channel will be discussed, focusing on studies conducted by the LNF group, along with an outlook on future prospects.

Auteur principal: ARCANGELETTI, Chiara (INFN-LNF)

Orateur: ARCANGELETTI, Chiara (INFN-LNF)

Classification de Session: Higgs and EW

Classification de thématique: Higgs and EW physics

ID de Contribution: **32** Type: **Non spécifié**

Search for Light-Feebly Interacting Particles with the PADME experiment

mardi 16 avril 2024 15:10 (15 minutes)

The elusive nature of dark matter has prompted innovative and open-minded experiments across a broad spectrum of energies employing high-sensitivity detectors, but despite the numerous attempts none has yielded up to now any evidence [1]. Inserted into this landscape is the Positron Annihilation into Dark Matter Experiment (PADME) at the Laboratori Nazionali di Frascati of INFN [2].

PADME is currently investigating a Dark Photon signal by analyzing the missing-mass spectrum of single photon final states resulting from positron annihilation events on electrons within a fixed target. The PADME approach not only enables the search for a Dark Photon signal but also allows for the exploration of any new particle produced in e^+e^- collisions, including long-lived Axion-Like-Particles (ALPs), proto-phobic X bosons, Dark Higgs, and more.

Significantly, the PADME setup offers the unique opportunity to validate or disprove the particle nature of the X17 anomaly observed in ATOMKI nuclear physics experiments that study the de-excitation via Internal Pair Creation of light nuclei [3]. The data-taking conducted by the PADME collaboration during 2022 was conceived to collect approximately 10^11 positrons-on-target, 10^10 for each of the 47 beam energy values ranging from 262 to 298 MeV, in order to produce resonantly the X17. This fine energy scan aims to identify the reaction $e^+e^- \to X17 \to e^+e^-$.

The talk will provide an overview of the experiment's scientific program and the ongoing data analyses.

References
[1] P. Agrawal et al., Eur. Phys. J. C 81 (2021) 11, 1015.
[2] P. Albicocco et al., JINST 17 (2022) 08, P08032.
[3] L. Darmé et al., Phys. Rev. D 106 (2022) 11, 115036.

Auteur principal: GIANOTTI, Paola (LNF - INFN)

Orateur: GIANOTTI, Paola (LNF - INFN)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **34** Type: **Non spécifié**

On the Proof of Chiral Symmetry Breaking from Anomaly Matching in QCD-like Theories

mardi 16 avril 2024 17:34 (13 minutes)

Confining QCD-like sectors are often present in BSM phenomenology. We critically reconsider the argument based on 't Hooft anomaly matching that aims at proving chiral symmetry breaking in 4d confining QCD-like theories with $N_c > 2$ colors and N_f flavors. We provide a detailed proof and clarify under which (dynamical) conditions the historical approach of N_f-independence holds, as a property of the solutions of the anomaly matching and persistent mass equations. The validity of N_f-independence was assumed in previous works based on qualitative arguments, but it was never proven rigorously. Then, we furnish a novel strategy, called 'downlifting', that allows to prove chiral symmetry breaking for any $N_f \geq p_{min}$, where p_{min} is the smallest prime factor of N_c. Contrary to earlier attempts, our results do not rely on ad-hoc assumptions on the spectrum of massless bound states. The proof can be extended to $N_f < p_{min}$ under the additional assumption on the absence of phase transitions when quark masses are sent to infinity.

Auteurs principaux: LUZIO, Andrea (Scuola Normale Superiore & INFN Pisa); XU, Ling-Xiao (Abdus Salam International Centre for Theoretical Physics); CIAMBRIELLO, Luca (Interdisciplinary Laboratories for Advanced Materials Physics (i-LAMP) & Università Cattolica del Sacro Cuor); ROMANO, Marcello (IPhT, CEA, CNRS, Université Paris-Saclay); CONTINO, Roberto (Sapienza Università di Roma & INFN Roma)

Orateur: ROMANO, Marcello (IPhT, CEA, CNRS, Université Paris-Saclay)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **36** Type: **Non spécifié**

Exploring evaluation methods for generative models in HEP

mardi 16 avril 2024 12:20 (15 minutes)

Deep generative models have emerged as a powerful paradigm for enhancing and maximising the potential for discovery at collider experiments. They can be deployed for multiple tasks, including fast simulations, data augmentation and anomaly detection. As novel methods continue to be developed, there is a pressing need to advance techniques for model selection and evaluation, particularly in high-dimensional scenarios. Such studies are crucial in a precision-driven field like high-energy physics. In this presentation, I will discuss some recent work in this direction, focusing on normalising flows, a popular class of methods for density estimation that allows both sampling and evaluation by construction.

Auteurs principaux: COCCARO, Andrea (Universita' di Genova/INFN); Dr REYES GONZALEZ, Humberto (RWTH Aachen University); LETIZIA, Marco (MaLGa Center, University of Genoa and INFN); Dr TORRE, Riccardo (INFN, Sezione di Genova)

Orateur: LETIZIA, Marco (MaLGa Center, University of Genoa and INFN)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **38** Type: **Non spécifié**

The Cygno experiment

mardi 16 avril 2024 15:30 (13 minutes)

In the last decades, the existance of dark matter (DM) has become one of the key elements of modern physics. Direct evidence of this exotic form of matter can be found by searching for extremely rare nuclear recoils of regular matter with energy of the order of few keV. The peculiar motion of the Earth around the centre of the Galaxy induces a strongly anisotropical structure in the angular distribution of the recoils. Thus, the measurement of the directional information would greatly benefit this field of research, by providing a better tool to positively claim for a DM discovery than only-energy sensitve detectors, and allowing to reject scattering induced by neutrinos, making directional detectors the only viable option to deeply venture into the neutrino fog. The CYGNO experiment follows this innovative path by developing a high-precision gaseous Time Projection Chamber to exploit the advantages of a directional detector in the rare event search field, such as few GeV DM. A large demonstrator of the final detector is going to be installed at the Gran Sasso National Laboratories (LNGS) and consists in a TPC filled with He:CF4 gas mixture operating with a triple GEM amplification stage. The gas scintillating properties allow the realization of an optical readout which comprises photomultiplier tubes and extremely low-noise granular sCMOS camera sensors.We will present the characteristics of the directional TPC focusing on the set of information on the recoil tracks it can provide. In addition, we will present the latest results of the underground operation at LNGS of a 50 l, 50 cm prototype.

Auteur principal: DHO, Giorgio (INFN - LNF)

Orateur: DHO, Giorgio (INFN - LNF)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **40** Type: **Non spécifié**

Local Analytic Sector Subtraction: a Numerical Implementation

mardi 16 avril 2024 09:30 (15 minutes)

Within the framework of the Local Analytic Sector Subtraction we briefly present the method for removing infrared singularities at Next-to-Leading Order (NLO) in QCD for processes involving massless coloured particles either in the initial or in the final state. We present an extension of Local Analytic Sector Subtraction to the case involving massive emitter. This process also allows us to test the efficiency and stability of our numerical implementation, and, in this sense, a comparison with other existing tools has been performed.

Auteur principal: LIMATOLA, Giovanni

Orateur: LIMATOLA, Giovanni

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **41** Type: **Non spécifié**

The COSINUS experiment: utilizing cryogenic NaI crystals for direct dark matter detection

mardi 16 avril 2024 14:30 (15 minutes)

The COSINUS (Cryogenic Observatory for SIgnatures seen in Next-generation Underground Searches) experiment is a state-of-the-art cryogenic initiative in the field of dark matter direct detection. Operating at millikelvin temperatures and utilizing ultrapure NaI detectors, COSINUS employs a two-channel readout system utilizing transition edge sensors (TESs), allowing for effective particle discrimination. COSINUS aims to independently verify the DAMA/LIBRA dark matter signal. Conducted at the Laboratori Nazionali del Gran Sasso in Italy, COSINUS will contribute crucial insights into the global pursuit of understanding dark matter's unknown properties. This talk will go through the latest results, updates on ongoing efforts, and perspectives for the future.

Auteur principal: CABABIE, Mariano

Orateur: CABABIE, Mariano

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **42** Type: **Non spécifié**

Status and prospects of the SABRE experiment for Dark Matter search in the two hemispheres

mardi 16 avril 2024 14:50 (15 minutes)

SABRE aims to deploy arrays of ultra-low background NaI(Tl) crystals to carry out a model-independent search for dark matter through the annual modulation signature. SABRE will be a double-site experiment, made up of two separate detectors which rely on a joint crystal R&D activity, located in the North (LNGS) and South hemisphere (SUPL). SABRE has carried out, since more than 10 years, an extensive R&D on ultra radio-pure NaI(Tl) crystals. Several crystals have been grown and tested in active and passive shields at LNGS. Based on these results SABRE North is proceeding to a full scale design with purely passive shielding. To reach an unprecedented level of radiopurity for NaI(Tl) crystals, SABRE is exploiting zone refining purification of the NaI powder prior to growth. We will present the status of SABRE North installation at LNGS, and recent results from the R&D towards the ultimate radio purity achievable for the crystals.

Auteur principal: CLAUDIA, Tomei (INFN Roma)

Orateur: CLAUDIA, Tomei (INFN Roma)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **43** Type: **Non spécifié**

The Impact of Theory Uncertainties in Global EDM Analyses

mardi 16 avril 2024 10:50 (15 minutes)

We investigate the impact of theory uncertainties on a global EDM analysis in the low-energy sector. For this analysis, we employ SFitter as our tool of choice. In contrast to previous analyses, in the EDM sector, theory uncertainties are heavily contingent upon the model parameters and thus cannot be disentangled from the prediction as readily as for SMEFT global analyses.

Orateur: ELMER, Nina (Heidelberg University)

Classification de Session: Methods and tools

Classification de thématique: Methods and tools

ID de Contribution: **45** Type: **Non spécifié**

Recent results and future perspective in the search for Axion dark matter at LNF.

mardi 16 avril 2024 15:45 (13 minutes)

In ecent years, we witnessed an increasing growth in the research of light Dark Matter (DM) candidates, addressing in particular axions and axion-like particles (ALPs). If axions are found to exist, they would untie the long-standing DM problem, after being originally postulated as a solution to the strong CP problem. The nature of a pseudoscalar, electrically neutral and feebly interacting particle make the axion a
strong DM candidate, and its cosmological evolution and astrophysical constraints indicate a favorable mass range between 1 μeV < m_a < 10 meV.
The axion observation technique is based upon its inverse Primakoff conversion into one photon, stimulated by a static magnetic field. The essential elements required to run a haloscope are a superconducting magnet to generate a strong magnetic field, a microwave resonant cavity where the electromagnetic field excitation builds up, an ultra-low noise receiver, a tuning mechanism to scan over the axion mass range and a cryogenic system to grant operation at low temperature.
We report on the first operation of the new QUAX haloscope located at the National Laboratories of Frascati (LNF). The experiment is conducted using a resonant cavity equipped with a tuning rod mechanism allowing to exclude the existence of dark matter axions with coupling gaγγ down to 0.861 × 10−13 GeV−1 in the mass window (36.5241 − 36.5510) μeV. We also report on future development in that haunt for axions showcasing the features of FLASH (FINUDA magnet for Light Axion SearcH), a future experiment that will be host at
LNF.

Auteur principal: D'ELIA, Alessandro (LNF- INFN)

Orateur: D'ELIA, Alessandro (LNF- INFN)

Classification de Session: Dark universe

Classification de thématique: Dark universe

ID de Contribution: **46** Type: **Non spécifié**

Electroweak W±Z production measurement at √⊠=13 TeV with the ATLAS detector and an EFT interpretation.

mercredi 17 avril 2024 10:50 (25 minutes)

Orateur: KASIMI, Eirini (Aristotle U., Thessaloniki)

Classification de Session: Higgs and EW

ID de Contribution: **47** Type: **Non spécifié**

Probabilistic theory uncertainties from missing higher orders

I present a probabilistically founded definition of theory uncertainties in perturbative computations due to the unknown higher orders. I show its performance against canonical recipes such as scale variation. I finally discuss future directions.

Orateur: BONVINI, Marco (INFN Roma)

Classification de Session: Higgs and EW

ID de Contribution: **48** Type: **Non spécifié**

A Cosmological Solution to the Doublet-Triplet Splitting Problem

mercredi 17 avril 2024 10:25 (25 minutes)

We propose a model that can solve simultaneously the doublet-triplet splitting problem of grand unified theories, the electroweak hierarchy problem and the strong CP problem. The mechanism is based on the dynamics of two light scalars that can crunch the universe at the QCD phase transition if triplets are light or if the doublets are heavy or do not have a vev. The same mechanism was previously discussed as an explanation for the small value of the weak scale and of the QCD θ-angle. The two problems are solved also in our context by the same dynamics that explains the splitting between Higgs doublets and triplets. The only traces left at low energies are two light axion-like particles weakly coupled to the Standard Model.

Orateur: SESMA, Pablo (IPhT Saclay)

Classification de Session: Higgs and EW

ID de Contribution: **49** Type: **Non spécifié**

Top mass uncertainties in double Higgs production

mercredi 17 avril 2024 12:10 (25 minutes)

I will discuss the uncertainties due to the top-mass renormalization scheme allowing the trilinear Higgs boson self-coupling to vary around its Standard Model value including parton shower effects.

Orateur: DEGRASSI, Giuseppe (Universita' Roma Tre, INFN sez. Roma Tre)

Classification de Session: Higgs and EW

ID de Contribution: **50** Type: **Non spécifié**

Higgs prospects at the FCC-ee

mercredi 17 avril 2024 12:35 (30 minutes)

Orateur: MORANGE, Nicolas (IJCLab)

Classification de Session: Higgs and EW

ID de Contribution: **51** Type: **Non spécifié**

The Baryon Asymmetry from Supercooled Confinement

lundi 15 avril 2024 17:55 (25 minutes)

Orateur: NAVA, Jacopo (University of Bologna)

Classification de Session: Beyond the Standard Model

Classification de thématique: Beyond the Standard Model

ID de Contribution: **52** Type: **Non spécifié**

Social dinner in Frascati

mardi 16 avril 2024 19:45 (2 heures)

ID de Contribution: **53** Type: **Non spécifié**

Famous last words

mercredi 17 avril 2024 13:05 (5 minutes)