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Book of Abstracts

Contents

Kinematic Dependence in the Determination of Invariant Mass in FNAL-E690 1

Dark matter searches with displaced dimuons at the CMS experiment 1

Measurement of the Higgs boson decay in Z(ll)H, H $\rightarrow$ WW at the FCC-ee at [Pleaseinsertintopreamble]s = 240GeV 1

Generalized Michel parameters in the presence of massive Dirac and Majorana neutrinos 1

Measurement of J/ψ Prompt Double-Differential Cross Sections in pp Collisions at $\sqrt{s}$ =13.6 TeV 2

Modern scattering amplitudes: The Spin-Spinors formalism. 2

LABM status in Belle II 2

Studies of relative production of χc2/χc1 and (χc1 + χc2)/(J/ψ) in pPb collisions at $\sqrt{}$sNN = 8.16 TeV at the CMS experiment 3

Supersymmetric Expansion Algorithm: from heavy quarkonium to dark matter 3

Non minimal SU(5) modular flavor model 3

Modelado de halos de materia oscura de galaxias tipo LSB con un fermión autointeractuante 3

SpaceMath v2.0: A Mathematica Toolkit Enhanced with Machine Learning for BSM Parameter Space Exploration 4

Structure functions for semileptonic tau decays including heavy new physics. 4

Nonextensive description of charged particle production in pp collisions 4

Effect of the properties of the vector meson K^* on the process e^+ e^- \to K^+ K^- \pi^0 \pi^0 5

Charge-to-time conversion for characterisation of RPC detectors 5

$\tau^- \rightarrow \pi^- \eta \nu_\tau$ decay induced by QED one-loop effects. 6

Renormalization of Soft Logarithms: Analysis in Dijet Processes with Large Rapidity Gaps 6

New physics prospects in Higgs couplings 6

Phenomenology of a pseudo-scalar (A) decay at the LHC 7

Simulation of RPC detectors and comparison of their response at different gas gap lengths . . . 7

Simulation a Muon detector for the ALICE 3 experiment . . . 7

Searching for the Flavon in the diphoton channel at future super hadron colliders. . . . 8

First textbook on Particles and Fields with an author working in Mexico . . . 8

Higgs boson production by Higgs-Strahlung and vector boson fusion processes at a future Muon collider in the context of the bestest Little Higgs model. . . . 9

Simulating low-energy charged-current electron neutrino interactions on argon in the CCM experiment . . . 9

Searching for the $\gamma\gamma e\mu$ interaction at future linear e−e+ colliders . . . 9

Analysis of $e^+e^- \to W^+W^- \to \bar{\nu_e}\nu_e H, H \to \bar{b}b$ Process at Future Circular Collider (FCC-ee) examined at a $\sqrt{s} = 365$ GeV with a Luminosity of 3 ab^{-1} . . . 10

Neutral pion screening mass in a magnetized medium . . . 10

Calibration studies at the Coherent CAPTAIN-Mills Experiment Using Cosmogenic Muons and Michel Electrons . . . 11

Numerical calculation of the lowest order pomeron loop . . . 11

Quantum Generative Adversarial Networks for Multi-Channel Jets Image Generation. . . . 11

Vacuum structure in multi-scalar models . . . 12

Fotoproducción Nuclear del Vector Mesón J/Ψ . . . 12

Análisis de la Composición de Rayos Cósmicos mediante XGBoost usando eventos del Detector de Superficie del Observatorio Pierre Auger. . . . 12

Second order spin-1/2 bosons . . . 13

Study of East-West asymmetry of Cosmic rays at Puebla by MACARIO detector . . . 13

Pruebas de desepeño de Detectores RPC de CMS-BUAP: Pruebas de Eficiencia y Resistividad a 2100m de Altitud . . . 13

Perspectives of experimental Nuclear Physics . . . 14

EIC Science . . . 14

The ePIC Collaboration: detector and opportunities . . . 14

QCD, Hadron physics questions (theory overview) . . . 14

Hadronization in QCD: From color to confinement . . . 14

Gluon saturation physics (theory overview) . . . 14

QCD and forward physics (Experimental overview) . . . 14

Q&A session on the EIC ePIC experiment . . . 15

Lepton flavor violation via e to tau conversion in nuclei at the EIC 15

200 keV polarized photogun and Wien spin rotator R&D at Jefferson Lab 15

Nonextensive description of charged particle production in pp collisions at LHC energies 15

From pp to nuclear collisions: Analysis of B_s0 and B+ production and modificaitons in nuclear medium 15

AI assisted evaluation of the non-resonant contributions into pi+pi-proton electroproduction from the CLAS data 15

SSB, DSB and dark matter indirect detection 15

Simulation of RPC detectors and comparison of their response at different gas gap lengths 15

Calibration studies at the CCM experiment using cosmogenic muons and michels electrons. 15

Simulation of Muon detector for the ALICE 3 experiment 16

Simulating low-energy charged-current electron neutrino interactions on argon in the CCM experiment 16

Search for Nuclear Modifications of [Pleaseinsertintopreamble]+ Meson Production in [Pleaseinsertintopreamble]-Pb Collisions at $\sqrt{}$[Pleaseinsertintopreamble]NN=8.16 TeV 16

Studies of relative production of χc2/χc1 and (χc1 + χc2)/(J/ψ) in pPb collisions at $\sqrt{}$sNN = 8.16 TeV at the CMS experiment 16

Recent Developments at NICA: MPD Experiment Highlights and the Mexican Contribution 16

Measurement of the Higgs boson decay in Z(ll)H, H $\rightarrow$ WW at the FCC-ee at $\sqrt{}$s = 240GeV 16

Neutral pion screening mass in a magnetized medium 16

Constraining fragmentation functions in ppbar. 16

Soft breaking in S3 flavored Higgs sector 17

New physics prospects in Higgs couplings 17

Study of East-West asymmetry of Cosmic rays at Puebla by MACARIO detector . . . 17

LABM status in Belle II 17

Auroras over Mexico City: detecting solar phenomena with a new cosmic ray detector 17

semi/exclusive collisions and intrajet collectivity probes at the LHC 17

$\tau^- \rightarrow \pi^- \eta \nu_\tau$ decay induced by QED one-loop effects. 17

Structure functions for semileptonic tau decays including heavy new physics effects. . 17

νe → νe scattering with massive Dirac or Majorana neutrinos and general interactions 17

Quarkonia in Lepton Flavor Violation 17

Amplitudes: From SUGRA to the top quark 18

Non minimal SU(5) modular flavor model 18

Xmax prediction with Machine Learning using data only from SD 18

Analysis of $e^+e^- \to W^+W^- \to \bar{\nu}_e\nu_e H, H \to \bar{b}b$ Process at Future Circular Collider (FCC-ee) examined at a $\sqrt{s} = 365$ GeV with a Luminosity of 3 ab^{-1} 18

Measurement of J/ψ Prompt Double-Differential Cross Section in pp Collisions at $\sqrt{s}$ =13.6 TeV 18

TBA 18

Discrete symmetries, spinors and amplitudes 18

Supersymmetric Expansion Algorithm: from heavy quarkonium to dark matter 18

First textbook on Particles and Fields with an author working in Mexico 18

Dark matter searches with displaced dimuons at the CMS experiment 18

Amplitudes: From SUGRA to the top quark 19

Modelado de halos de materia oscura de galaxias tipo LSB con un fermión autointeractuante 19

Supersymmetric Expansion Algorithm: from heavy quarkonium to dark matter 19

Asamblea 19

Second order spin-$1/2$ bosons 19

Constraining fragmentation functions in ppbar. 19

Continuum Schwinger methods and applications to EIC physics 19

SSB, DSB and DM indirect detection 19

0

Kinematic Dependence in the Determination of Invariant Mass in FNAL-E690

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In the E690 experiment at Fermilab, we studied the reaction pp → p_missing (Ks K π) p_fast, in search of hybrid states. In the present analysis, we study the Ks invariant mass resolution dependence in terms of different kinematic variables. In preparation for further kinematic studies, we also perform an analysis of the reconstruction of a supposed missing pion, assuming the Ks has been found and using the kinematics of the other pion, in Ks → π π. These studies provide insight into the precision and systematic uncertainties for the studied reaction in FNAL-E690.

1

Dark matter searches with displaced dimuons at the CMS experiment

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The search for dark matter particles at the LHC is one of its primary objectives. Well-motivated scenarios, such as the Hidden Abelian Higgs Model (HAHM) and Dark Supersymmetry (Dark-SUSY) scenarios predict the production of dark sector particles. These particles interact weakly with the Standard Model (SM) and, due to their interactions, can decay into SM particles. A key signature of these searches is the decay of such particles into a pair of muons (dimuons) displaced from the primary interaction vertex. Results obtained from the Run-2 and Run-3 data-taking campaigns at CMS have set limits on the production of these particles. These results are presented as a compilation of dark sector searches conducted in CMS, providing a comprehensive overview of current constraints. Additionally, the implications of these findings for future analyses are discussed.

2

Measurement of the Higgs boson decay in Z(ll)H, H → WW at the FCC-ee at $\sqrt{s} = 240$GeV

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We study the sensitivity of the measurement of the Higgs boson branching ratio to the hadronic channel of the W+W− final state, at the Future Circular Collider. The study involves the analysis of simulated event samples of the signal and background processes for e+e− collisions, assuming a center-of-mass energy $\sqrt{s} = 240$ GeV and an integrated luminosity of 10.8 ab−1. The signal primarily consists of Higgs-strahlung events from e+e− → ZH, where the Higgs boson subsequently decays into a pair of W bosons (H → W +W −), with both W bosons undergoing hadronic decays. The Z boson decays considered in this study are restricted to a pair of charged leptons (Z → ll with l = e, μ).

3

Generalized Michel parameters in the presence of massive Dirac and Majorana neutrinos

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We start by reproducing the results in the literature of leptonic decays of muon and tau leptons using the most general four-lepton effective interaction of dimension six. First, working in the decaying-lepton rest frame, we calculate the final charged-lepton distribution while incorporating the effects of the initial charged lepton polarization. We review the new generalized Michel parameters in terms of the Wilson coefficients of the effective interaction. As a next step, we want to extend this formalism to radiative charged-lepton decays, which allow us to extract new insights, such as the impact of heavy Dirac or Majorana neutrino masses on the diferential decay rate.

4

Measurement of J/ψ Prompt Double-Differential Cross Sections in pp Collisions at $\sqrt{s}$ =13.6 TeV

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Differential production cross section of prompt J/ψ is measured in proton–proton collisions at $\sqrt{s}$ = 13 TeV, with data collected by the CMS detector at the LHC, corresponding to an integrated luminosity of 34.74 fb−1. The quarkonium state is reconstructed in the dimuon decay channel, for dimuon rapidity |y| < 1.2. The double-differential cross sections is measured as a function of y and transverse momentum.

5

Modern scattering amplitudes: The Spin-Spinors formalism.

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In this work we do a revision of modern on-shell methods using a simple case (Z decay) compared to the traditional Feynman methods vs. Spin-Spinor (Arkani-Hamed - Huang - Huang) formalism.

6

LABM status in Belle II

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Talk

7

Studies of relative production of χc2/χc1 and (χc1 + χc2)/(J/ψ) in pPb collisions at $\sqrt{sNN} = 8.16$ TeV at the CMS experiment

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The production of χc states in pPb collisions at $\sqrt{sNN} = 8.16$ TeV, collected by CMS detector during 2016 and corresponding to an integrated luminosity of 180 nb−1, is studied via the ratios of χc2 to χc1 and χc to J/ψ. The ratios are presented as a function of transverse momentum, rapidity and primary track multiplicity. The corresponding kinematic ranges are $6.5 < pT < 30$ GeV/c in transverse momentum and $-2.4 < y < 2.4$ in laboratory rapidity.

8

Supersymmetric Expansion Algorithm: from heavy quarkonium to dark matter

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In this talk we review a novel procedure to obtain for the first time analytical solutions to the non-relativistic dynamics of several quantum systems of present interest, ranging from condensed matter to heavy quarkonium and to dark matter. We focus on a detailed analysis of the complete solutions for heavy quarkonium dynamics based on the Cornell potential which yields outstanding predictions for charmonium and bottomonium which nicely agree with data.

9

Non minimal SU(5) modular flavor model

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In this work, we analyze a non-minimal SUSY $SU(5)$ model extended with an S_3 modular flavor symmetry, a Higgs sector containing six electroweak doublets, and right-handed neutrinos (RHNs) as singlets under the gauge symmetry. The model is defined at the grand unified scale, and we aim to reproduce the mass hierarchy and the mixing pattern in the quark and lepton sectors at low energies. This will be accomplished by adjusting the model's free parameters using a χ^2 fitting procedure.

10

Modelado de halos de materia oscura de galaxias tipo LSB con un fermión autointeractuante

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En este trabajo, investigamos la posibilidad de modelar el contenido de materia oscura en galaxias mediante una estructura de core-halo. El core consiste en un gas degenerado de fermiones autointeractuantes y el halo se describe mediante un fluido perfecto o un perfil tipo Navarro-Frenk-White (NFW). El objeto autogravitante se utiliza para modelar los halos de materia oscura de las galaxias de bajo brillo superficial (LSB) y realizamos un ajuste del modelo a las curvas de rotación de las galaxias LSB, con el objetivo de comprender mejor las propiedades de la partícula fermiónica: su masa y la intensidad de sus autointeracciones.

11

SpaceMath v2.0: A Mathematica Toolkit Enhanced with Machine Learning for BSM Parameter Space Exploration

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SpaceMath v2.0 is an upgraded version of SpaceMath v1.0, now integrating Machine Learning techniques to enhance its capabilities in analyzing Flavor-Changing Neutral Current (FCNC) processes at both tree and one-loop levels. Specifically, it includes: i) radiative decays $\ell_i \to \ell_j \gamma$, ii) three-body decays $\ell_i \to \ell_j \ell_k \bar{\ell} k$ for $\ell_i = \tau, \mu$ and $\ell_{j,k} = \mu, e$ with $\ell_i \neq \ell_j \neq \ell_k$, iii) the anomalous magnetic moment of the muon $\delta a\mu$, and iv) rare decays $B^0_{s,d} \to \mu^+ \mu^-$.
SpaceMath v2.0 introduces a novel Machine Learning-based module that predicts Benchmark Points for efficient numerical evaluations of observables in particle physics. A detailed case study is presented for the type-III Two-Higgs Doublet Model (2HDM).

12

Structure functions for semileptonic tau decays including heavy new physics.

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1. SMEFT lagrangian and chiral perturbation theory with tensor sources.
2. Semileptonic 4-body decays of polarized τ leptons phase space distribution derivation including tensor structures.
3. Some Lorentz and SO(3)relevant structures.
4. Structure functions derivation.
5. Wigner D functions representation.
6. Statistical properties of Wigner D functions.

13

Nonextensive description of charged particle production in pp collisions

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In string models, the production of charged particles can be described by the convolution of the Schwinger mechanism with string tension fluctuations, usually modeled as a Gaussian distribution. However, by incorporating q-Gaussian string tension fluctuations, we can fully describe the p_T-spectrum of charged particles produced in pp collisions obtaining Tricomi's function, which captures both asymptotic behaviors at low and high p_T values. We prove that heavy-tailed distributions describing string tension fluctuations are necessary to produce high p_T particles (rare events involving intense color interactions). Consequently, the system created in the collision departs from the thermal description, where temperature fluctuations are a local property occurring in a small part of the system.

14

Effect of the properties of the vector meson K^* on the process e^+ e^- \to K^+ K^- \pi^0 \pi^0

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Vector mesons possess 2s+1 electromagnetic properties (where s=1 is their spin). Specifically, these are the electric charge, the magnetic dipole moment (MDM), and the electric quadrupole moment (EQM). Among these, only the electric charge is experimentally well-determined due to charge conservation laws; the remaining multipoles are merely estimated using effective QCD models, for which no experimental counterpart currently exists. One approach to determine the K^* meson's MDM is to study the e^+e^− \to 2K 2\pi process, analogous to the method used for the W gauge boson in e^+e^− \to 4 leptons reactions. In this work, we investigate this process in the low-energy regime. We propose to evaluate the sensitivity of the e^+e^− \to K^+K^−\pi^0\pi^0 cross-section to the K^*MDM, incorporating all relevant intermediate channels to describe the cross-section, as measured by BaBar, and explore whether it is possible to obtain, for the first time, a value for the magnetic dipole moment of the K^* meson.

15

Charge-to-time conversion for characterisation of RPC detectors

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In the present work, the conversion of charge to time is studied for the characterisation of an RPC type gaseous detector. For this purpose, a 32-channel front-end ASIC, the WEEROC PETIROC2A board, was characterised and calibrated. Using an array of four detectors, two RPCs each with four panels and two plastic scintillators together with their respective PMTs,

the latter being used as external triggers, the time of flight of the atmospheric muons was studied for the characterisation of the time response of the RPC type detectors, together with the measurement and calibration of the charge for each panel of the RPC detectors.

17

$\tau^- \to \pi^- \eta \nu_\tau$ decay induced by QED one-loop effects.

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The $\tau^- \to \pi^- \eta \nu_\tau$ decay is forbidden in the Standard Model in the limit of exact G-parity, it becomes a rare decay due to isospin symmetry breaking and it is very sensitive to the effects of effective scalar interactions. Since the parameters driving isospin breaking, $(m_d - m_u)/(m_s - \bar{m})$ and α, are of the same order, one may expect their G-parity breaking effects in this decay can be of similar magnitudes. In this work, we evaluate the effects of isospin-breaking amplitudes originated from a virtual photon at one-loop in a resonance dominance model to describe photon-hadron interactions. We find that these effects can shift the leading SM predictions for the decay rate based on the $u - d$ quark mass difference by roughly $(13.5)\%$, and should be taken into consideration in a precision comparison of theory and experiment in order to draw meaningful conclusions on New Physics. The effects in the decay rate of the analogous $\tau^- \to \pi^- \eta' \nu_\tau$ decay can be larger, $(78 \pm 38)\%$, within the approximations assumed in this model. The uncertainty in the former channel is dominated by the input parameters of the resonance model, while the uncertainty in the latter is due to the $\pi^0 \eta'$ mixing parameter.

18

Renormalization of Soft Logarithms: Analysis in Dijet Processes with Large Rapidity Gaps

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This work analyzes gluon-gluon scattering processes with a focus on dijet production in large rapidity gaps. The study applies perturbative QCD techniques, emphasizing the resummation of soft logarithms $\log(Q/Q_0)$ and the incorporation of contributions from the BFKL approach. Through the use of color space factorization and renormalization methods, we investigate the evolution of scattering amplitudes, highlighting the dominant role of the octet color channel. The results validate the Double Leading Logarithmic Approximation (DLLA) while demonstrating the importance of including subleading corrections to achieve precise theoretical predictions in the high-energy limit relevant to LHC phenomenology.

19

New physics prospects in Higgs couplings

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The LHC has reported an excess in the decay $H \to Z\gamma$, measuring twice the prediction made by the SM. Additionally, contributions from an off-shell Higgs boson in producing a pair of Z bosons

have been announced for the first time. These results allow for the investigation of new physics contributions in the $HZ\gamma$ and HZZ vertices. This study explores the potential effects of CP violation on these Higgs boson couplings.

20

Phenomenology of a pseudo-scalar (A) decay at the LHC

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In this work, we review the phenomenology of decays of hypothetical pseudoscalar particles interacting with vector particles such as the Z boson or the photon, through a fermionic loop or other mechanisms, with the aim of studying the observables to which these internal interactions could contribute.

21

Simulation of RPC detectors and comparison of their response at different gas gap lengths

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Resistive plate chambers (RPCs) consist of a pair of parallel electrode plates that have high resistivity, typically built out of glass or Bakelite; a high voltage is applied between the electrodes. The plates are separated by a gap in which a mixture of gases circulate, this gap can be from 0.1 mm up to several millimeters. The length of this gas gap is a factor that determines the response velocity of the RPC and its detecting capability. Because RPCs have high temporal and spatial resolution, and they are not too expensive to construct, they have been used in many practical applications as well as for investigation. Several simulations have been described in literature. The simulation of a detector is an important tool for its development and construction because it allows you to test the design and make predictions about its functionality.
In this work we study the response of an RPC with gas gap lengths of 1 mm, 0.5 mm and 0.3 mm with the objective to determine the ideal length that gives the best charged particle detection, temporal resolution and number of particles per area and time. This study is made using the GARFIELD++ framework, using MAGBOLTZ and HEED to generate the simulation of the detector's geometry, the gas composition as well as the fields and electromagnetic interactions that happen inside the detector. The data analysis is done using Python.

22

Simulation a Muon detector for the ALICE 3 experiment

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The quark-gluon plasma, QGP, is a state of matter with an energy density such that it exceeds the temperature of the Sun's core by approximately one hundred thousand times. The QGP is the primary object of study for the ALICE (A Large Ion Collider Experiment) experiment at the LHC (Large Hadron Collider). The experiment will be upgraded to operate during the High-Luminosity LHC phase. The name of this update is ALICE 3. One of the detectors that will be part of ALICE 3 is the MID (Muon Identifier), which will have the capacity to identify the trajectory of low transverse momentum dimuons produced in heavy-ion collisions for $|\eta| \approx 0$. It is planned that the MID will be formed by an array of plastic scintillators and wavelength-shifting optical fibers coupled to silicon photomultipliers (SiPM).
The thesis project consists of simulating the interaction between particles that are produced by a heavy-ion collisions and the arrangement of bars and SiPMs using the Geant4 software. The interactions will be between the particles and a uniform magnetic field, a steel absorber and the plastic scintillators. Inside the bars, photons are generated and subsequently detected by the SiPM. Afterward, we analyze information about the number of detected photons, the time of flight, the deposited energy, the position of detection in the scintillators, etc. The main results are the particle detection efficiency for different plastic configurations and using different primary particles. The efficiency will be analyzed as a function of the particles momentum, the type of incident particle (muons, kaons, protons, and pions) and the hit definition in the scintillators array in terms of deposited energy, the number of scintillation photons produced and detected. Additionally, we expect to simulate the particle fluxes expected under the High-Luminosity LHC conditions at the MID level.

23

Searching for the Flavon in the diphoton channel at future super hadron colliders.

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We study the production of a CP-even flavon H_F in proton-proton collisions and the prospects for its detection via the diphoton channel at future super hadron colliders, i.e., $pp \to H_F \to \gamma\gamma$. The theoretical framework adopted is a model that invokes the Froggatt-Nielsen mechanism with an Abelian flavor symmetry, which includes a Higgs doublet and a complex singlet. We confront the free parameters of the model against theoretical and experimental constraints to find the allowed parameter space, which is then used to evaluate the production cross section of the flavon and the branching ratio of its decay into two photons. We find promising results based on specific benchmark points, achieving signal significances at the level of 5σ for flavon masses in the interval $200 \leq M_{H_F} \leq 450$ and integrated luminosities in the range $5 - 12$ ab^{-1} at the future High-Energy LHC. On the other hand, the Future hadron-hadron Circular Collider could probe masses up to 1 TeV if it reaches an integrated luminosity of at least 2 ab^{-1}.

24

First textbook on Particles and Fields with an author working in Mexico

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In January of this year, Cambridge University Press published the textbook "Uncovering Quantum Field Theory and the Standard Model: From Fundamental Concepts to Dynamical Mechanisms",

co-authored by Uwe-Jens Wiese and myself. Spanning 732 pages, the book comprises 26 chapters and 9 appendices. I will outline the motivation and development of this book and provide an overview of some selected topics from its contents, as far as time allows.

25

Higgs boson production by Higgs-Strahlung and vector boson fusion processes at a future Muon collider in the context of the bestest Little Higgs model.

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In this work, we study the production of the Higgs bosons h_0 and H_0 within the framework of the Bestest Little Higgs Model, a candidate for physics beyond the Standard Model that addresses the hierarchy problem through an extended scalar sector. We analyze six key production processes at a muon collider: $\mu\bar{\mu} \to Zh_0$, $\mu\bar{\mu} \to ZH_0$, $\mu\bar{\mu} \to \nu_\mu\bar{\nu}_\mu h_0$, $\mu\bar{\mu} \to \nu_\mu\bar{\nu}_\mu H_0$, $\mu\bar{\mu} \to \mu\bar{\mu}h_0$, and $\mu\bar{\mu} \to \mu\bar{\mu}H_0$. These include both annihilation channels and vector boson fusion, which are expected to be dominant at high energies.
We consider center-of-mass energies of $\sqrt{s}$ = 1, 3, and 10 TeV, and integrated luminosities of 0.3, 1, 4, and 10 ab^{-1}, in alignment with proposed future muon collider scenarios. Our results show that such a collider provides a favorable environment to explore these processes and enhance the discovery potential of new scalar particles. The study highlights the relevance of lepton colliders in probing extended Higgs sectors in scenarios beyond the Standard Model.

26

Simulating low-energy charged-current electron neutrino interactions on argon in the CCM experiment

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The Coherent CAPTAIN-Mills (CCM) experiment at Los Alamos National Laboratory employs a 10-ton liquid argon detector instrumented with 200 PMTs to detect scintillation light. The experiment is designed to investigate neutrino interactions, search for dark matter signals, and explore new physics scenarios. This work focuses on the modeling of charged-current (CC) interactions of electron neutrinos with argon nuclei at energies on the order of tens of MeV, a process that has not yet been measured experimentally in this regime. The lack of data on this interaction poses a limitation for future experiments aiming to detect supernova neutrinos, such as DUNE. We present the implementation of a full simulation framework that incorporates neutrino-argon interactions using the MARLEY event generator, event injection via the SIREN software package, and propagation through the detector using Geant4. Event reconstruction is performed using the CCMAnalysis framework. Preliminary simulation results are discussed, including observables related to energy deposition and scintillation photon production. This study lays the groundwork for an eventual measurement of this important low-energy cross section.

27

Searching for the $\gamma\gamma e\mu$ interaction at future linear $e-e+$ colliders

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We study the possibility of detecting the Lepton Flavor Violating (LFV) process e−e+ → e−e+e μ (e = e−, e+; μ = μ−, μ+) at the forthcoming e−e+ colliders Compact LInear Collider (CLIC) and the International Linear Collider (ILC). Our predictions are based on an effective operator framework that induces the LFV interaction γγeμ. We propose three benchmark points that are consistent with both theoretical and current experimental constraints. We find that all of them are experimentally feasible, predicting signal significances S ≥ 5σ at both colliders for relatively low integrated luminosities and center-of-mass energies in the interval 500 − 1000 GeV.

28

Analysis of $e^+e^- \to W^+W^- \to \bar{\nu_e}\nu_e H, H \to \bar{b}b$ Process at Future Circular Collider (FCC-ee) examined at a $\sqrt{s} = 365$ GeV with a Luminosity of 3 ab^{-1}

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- Simulation of signal (\(eˆ+eˆ-\to\bar\nu_e\nu_eH,\,H\to b\bar b\)) and dominant backgrounds (ZH, ZZ, WW, \(t\bar t\)) at \(\sqrt{s}=365\) GeV, 3 ab\(ˆ{-1}\), using \textsc{Whizard}, \textsc{Pythia} and \textsc{Delphes}.\\
- Preselection requiring = 2 jets and \(\cos\theta_{\rm miss}<0.98\).\\
- Reconstruction of key observables: dijet invariant mass (\(M_{bb}\)), missing transverse energy (MET), recoil mass, \(b\)-tagged jet kinematics and \(\cos\theta_{\rm miss}\).\\
- Multivariate analysis: training and hyperparameter tuning of a MVA BDT and XGBoost classifier via cross-validation.\\
- Performance comparison through ROC curves, Importance and BDT_Score, demonstrating the XGBoost model's superior separation and % improvement over cut-based selection.\\
- Implications for precise measurement of the \(H\to b\bar{b}\) coupling in the FCC-ee VBF channel.

29

Neutral pion screening mass in a magnetized medium

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We use the linear sigma model with quarks to study the magnetic-field-induced modifications on the longitudinal and transverse screening masses for the neutral pion at one-loop level. The effects of the magnetic field are introduced into the self-energy, which contains the contributions from all the model particles. We find that, to obtain a reasonable description for the behavior with the field strength, we need to account for the magnetic field dependence of the particle masses. We also find that the couplings need to decrease fast enough with the field strength to then reach constant and smaller values as compared to their vacuum ones. The results illustrate

the need to treat the magnetic corrections to the particle masses and couplings in a self-consistent manner, accounting for the backreaction of the field effects for the magnetic field dependence of the rest of the particle species and couplings in the model.

30

Calibration studies at the Coherent CAPTAIN-Mills Experiment Using Cosmogenic Muons and Michel Electrons

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The Coherent CAPTAIN-Mills (CCM) experiment is a 10-ton liquid argon detector located at Los Alamos National Laboratory. It is designed to study neutrino interactions, search for dark matter candidates, and explore physics beyond the Standard Model. Positioned 23 meters from the stopped pion source at the Lujan Facility, CCM is currently undergoing a three-year run cycle, during which it will receive 1.5×10^{22} protons on target (POT). The detector is instrumented with 200 eight-inch PMTs and 40 one-inch veto PMTs. Cosmogenic muons provide a valuable tool for calibrating the detector in the energy range of 100 to 600 MeV of deposited energy. Simulations of the cosmogenic flux offer important insights into the detector's overall response. In addition, Michel electrons represent a significant background for studying interactions in the 10 to 60 MeV energy range. In this talk, I present progress toward developing a calibration method based on the predicted shape and rate of the muon energy spectrum at CCM. I also describe efforts to model the detector's response in the energy range where Michel electrons become relevant, applying the same strategy used for cosmogenic muons. Finally, some prospects of the experiment's physics reach are also presented.

31

Numerical calculation of the lowest order pomeron loop

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We perform a numerical calculation of the lowest-order Pomeron loop contribution to high-energy elastic scattering in Quantum Chromodynamics (QCD). While the BFKL equation captures leading-order Pomeron exchange, loop corrections are essential to account for unitarity effects and non-linear QCD dynamics. Using advanced numerical integration techniques, we evaluate the loop contribution and analyze its behavior as a function of rapidity and transverse momentum. These corrections are particularly relevant in the regime where saturation effects become important. Our results provide insight into the structure of Reggeon interactions and serve as a step toward more complete and realistic descriptions of high-energy QCD processes, with potential implications for future phenomenological studies.

32

Quantum Generative Adversarial Networks for Multi-Channel Jets Image Generation.

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Quantum computing offers promising prospects over classical approaches, especially when exploring innovative strategies for High Energy Physics simulations. In this study, we present the implementation of a Quantum Generative Adversarial Network designed to simultaneously synthesize gluon-initiated jet images across both electromagnetic calorimeter and hadronic calorimeter detector channels, an essential component for realistic simulations at the Large Hadron Collider. The generated outputs exhibit strong agreement with the original data in terms of energy deposition patterns and successfully retain key underlying features learned during training. This work lays the groundwork for future developments in multi-channel image generation and the extension to quark-initiated jet simulations using quantum computational techniques.

33

Vacuum structure in multi-scalar models

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In this work we study the possibility of spontaneous CP breaking of the Georgi Machacek model by adding complex phases to the original vacuum, as well as electric charge breaking by adding vacuum expectation values to the charged components of the Higgs multiplets. The minimum conditions for these vacua are determined along with their mass matrices, and we examine the possibility of aligning these vacua using the eigenvalues of the mass matrices, considering that they must be greater than or equal to zero.

34

Fotoproducción Nuclear del Vector Mesón J/Ψ

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Ultra-peripheral collisions (UPCs) serve as a powerful tool to investigate the strong interaction in high-energy regimes through the exclusive photoproduction of vector mesons. In this work, we focus on the production of the vector meson J/ψ in Pb–Pb and Pb–p collisions, using data reported by the ALICE and CMS collaborations. We explore whether the energy dependence of the production cross section can be described using the Balitsky–Fadin–Kuraev–Lipatov (BFKL) evolution equation, without the explicit inclusion of gluon saturation effects.
To complement this analysis, we also consider a phenomenological approach based on the Golec-Biernat–Wüsthoff (GBW) model to study the energy dependence of photoproduction off a proton. Furthermore, the role of next-to-leading-order (NLO) corrections within the BFKL formalism is investigated to assess their impact on the description of the data.
This study aims to shed light on gluon dynamics at small Bjorken-x, contributing to the understanding of the transition between perturbative and non-perturbative regimes in Quantum Chromodynamics (QCD).

35

Análisis de la Composición de Rayos Cósmicos mediante XGBoost usando eventos del Detector de Superficie del Observatorio Pierre Auger.

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Este trabajo desarrolla un método para predecir Xmax (profundidad atmosférica del máximo de lluvias cósmicas) usando únicamente datos del Detector de Superficie (SD), mediante un modelo de XGBoost entrenado con datos híbridos (FD+SD). Los resultados muestran una coherencia física con modelos teóricos y datos experimentales, validando la eficacia del enfoque. La metodología supera limitaciones operativas del FD, ofreciendo una alternativa viable para el análisis de rayos cósmicos de ultra alta energía cuando los datos de fluorescencia son escasos.

37

Second order spin-1/2 bosons

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Recently, the canonical quantization of massive spin-1/2 fermions obeying Klein-Gordon like dynamics has been shown to become consistent by introducing a redefinition of the dual field that renders the theory pseudohermitian. In this work, we show that pseudohermiticity also allows for the consistent canonical quantization of this field but imposing bosonic statistics instead of the conventional fermionic one, and so the spin-statistics connection is evaded. The resulting theory admits renormalizable self interactions and belongs to a novel class of pseudo-Hermitian QFTs.

38

Study of East-West asymmetry of Cosmic rays at Puebla by MACARIO detector

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MACARIO is a detector based on resistive plate chambers (RPCs) technology, using freon gas as a revealing medium. The study of East-West asymmetry is a fundamental phenomenon which happens in every place of the world but depends on the latitude and altitude of the detector which relates with the geomagnetic cutoff rigidity. This kind of detector is particularly useful for training students who are starting to get involved in astroparticle and particle physics and for education and outreach activities due to the compact size which allows them to familiarize themselves with instrumentation and reconstruction techniques employed on bigger projects.

39

Pruebas de desepeño de Detectores RPC de CMS-BUAP: Pruebas de Eficiencia y Resistividad a 2100m de Altitud

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\section{Introducción} \section{Instalaciones} \section{Equipo} \section{Pruebas de corriente} \section{pruebas de resistividad} \section{discusión} \section{Trabajo a futuro}

40

Perspectives of experimental Nuclear Physics

41

EIC Science

42

The ePIC Collaboration: detector and opportunities

43

QCD, Hadron physics questions (theory overview)

Corresponding Author(s): alfredo.raya@umich.mx

44

Hadronization in QCD: From color to confinement

45

Gluon saturation physics (theory overview)

Corresponding Author(s): farid.salazar@temple.edu

46

QCD and forward physics (Experimental overview)

47

Q&A session on the EIC ePIC experiment

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48

Lepton flavor violation via e to tau conversion in nuclei at the EIC

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49

200 keV polarized photogun and Wien spin rotator R&D at Jefferson Lab

50

Nonextensive description of charged particle production in pp collisions at LHC energies

51

From pp to nuclear collisions: Analysis of B_s0 and B+ production and modificaitons in nuclear medium

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52

AI assisted evaluation of the non-resonant contributions into pi+pi-proton electroproduction from the CLAS data

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53

SSB, DSB and dark matter indirect detection

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54

Simulation of RPC detectors and comparison of their response at different gas gap lengths

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55

Calibration studies at the CCM experiment using cosmogenic muons and michels electrons.

56

Simulation of Muon detector for the ALICE 3 experiment

57

Simulating low-energy charged-current electron neutrino interactions on argon in the CCM experiment

58

Search for Nuclear Modifications of $B+$ Meson Production in p-Pb Collisions at $\sqrt{s}$NN=8.16 TeV

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59

Studies of relative production of χc2/χc1 and (χc1 + χc2)/(J/ψ) in pPb collisions at $\sqrt{s}$NN = 8.16 TeV at the CMS experiment

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60

Recent Developments at NICA: MPD Experiment Highlights and the Mexican Contribution

LUIS HERNÁNDEZ[None]

61

Measurement of the Higgs boson decay in Z(ll)H, H → WW at the FCC-ee at $\sqrt{s}$ = 240GeV

62

Neutral pion screening mass in a magnetized medium

63

Constraining fragmentation functions in ppbar.

64

Soft breaking in S3 flavored Higgs sector

65

New physics prospects in Higgs couplings

66

Study of East-West asymmetry of Cosmic rays at Puebla by MACARIO detector

67

LABM status in Belle II

68

Auroras over Mexico City: detecting solar phenomena with a new cosmic ray detector

69

semi/exclusive collisions and intrajet collectivity probes at the LHC

70

$\tau^- \to \pi^- \eta \nu_\tau$ decay induced by QED one-loop effects.

71

Structure functions for semileptonic tau decays including heavy new physics effects.

72

$\nu e \to \nu e$ scattering with massive Dirac or Majorana neutrinos and general interactions

73

Quarkonia in Lepton Flavor Violation

74

Amplitudes: From SUGRA to the top quark

75

Non minimal SU(5) modular flavor model

76

Xmax prediction with Machine Learning using data only from SD

77

Analysis of $e^+e^- \to W^+W^- \to \bar{\nu_e}\nu_e H, H \to \bar{b}b$ Process at Future Circular Collider (FCC-ee) examined at a $\sqrt{s} = 365$ GeV with a Luminosity of 3 ab^{-1}

78

Measurement of J/ψ Prompt Double-Differential Cross Section in pp Collisions at $\sqrt{s}$ =13.6 TeV

79

TBA

80

Discrete symmetries, spinors and amplitudes

81

Supersymmetric Expansion Algorithm: from heavy quarkonium to dark matter

82

First textbook on Particles and Fields with an author working in Mexico

83

Dark matter searches with displaced dimuons at the CMS experiment

84

Amplitudes: From SUGRA to the top quark

85

Modelado de halos de materia oscura de galaxias tipo LSB con un fermión autointeractuante

86

Supersymmetric Expansion Algorithm: from heavy quarkonium to dark matter

87

Asamblea

88

Second order spin-1/2 bosons

89

Constraining fragmentation functions in ppbar.

90

Continuum Schwinger methods and applications to EIC physics

91

SSB, DSB and DM indirect detection