5th ComHEP: Colombian Meeting on High Energy Physics

Monday 30 November 2020 - Friday 4 December 2020

Book of Abstracts

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Algebraic approach to scattering amplitudes

Author: Cristhiam Lopez Arcos[None]

Corresponding Author: crismalo@gmail.com

In this talk I will present our recent advances in the calculation of scattering amplitudes using strong homotopy algebras. This prescription inspired from string field theory allows to construct a generating function for all the tree-level scattering amplitudes. Several examples will be presented.

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Anisotropic Einstein Yang-Mills Higgs Dark Energy

Authors: JOHN BAYRON ORJUELA-QUINTANA[1]; Cesar A. Valenzuela-Toledo[2]; Yeinzon Rodriguez Garcia[3]; Miguel Álvarez[4]

[1] *UNIVERSIDAD DEL VALLE*

[2] *Universidad del Valle*

[3] *UAN & UIS (Colombia)*

[4] *Universidad Industrial de Santander*

Corresponding Authors: cesar.valenzuela@correounivalle.edu.co, john.orjuela@correounivalle.edu.co, yeinzon.rodriguez@uan.edu.co, miguel.alvarez1@correo.uis.edu.co

In the context of the dark energy scenario, the Einstein Yang-Mills Higgs model in the SO(3) representation was studied for the first time by M. Rinaldi (see JCAP **1510**, 023 (2015)) in a homogeneous and isotropic spacetime. We revisit this model, finding in particular that the interaction between the Higgs field and the gauge fields generates contributions to the momentum density, anisotropic stress and pressures, thus making the model inconsistent with the assumed background. We instead consider a homogeneous but anisotropic Bianchi-I spacetime background in this paper and analyze the corresponding dynamical behaviour of the system. We find that the only attractor point corresponds to an isotropic accelerated expansion dominated by the Higgs potential. However, the model predicts non-negligible anisotropic shear contributions nowadays, i.e. the current universe can have hair although it will lose it in the future. We investigate the evolution of the equation of state for dark energy and highlight some possible consequences of its behaviour related to the process of large-scale structure formation. As a supplement, we propose the "Higgs triad"as a possibility to make the Einstein Yang-Mills Higgs model be consistent with a homogeneous and isotropic spacetime.

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Prediction for Neutrino Masses, CP Violation, Leptogenesis and Neutrinoless Double Beta Decay from $\mathcal{T}_{13}$ Flavor Symmetry

Author: Moinul Hossain Rahat[1]

[1] *University of Florida*

Corresponding Author: mrahat@ufl.edu

We propose an $SU(5) \times \mathcal{T}_{13}$ model for both quarks and leptons. With tribimaximal (TBM) mixing for the seesaw matrix, symmetric Yukawa textures for down-quarks and charged leptons fail to

explain the experimentally observed reactor angle. We derive the minimal asymmetric texture that not only reproduces the three lepton mixing angles assuming TBM mixing with a single phase, but also predicts the CP violating angle $\delta_{CP} = 1.32\pi$, consistent with the current global fit. We show that a straightforward origin of the "asymmetric texture" is traced back to the family symmetry $\mathcal{T}_{13}$, an order 39 discrete subgroup of $SU(3)$. With minimal number of familons having simple vacuum expectation values, the $\mathcal{T}_{13}$ symmetry makes very definite prediction for the light neutrino masses of $28, 29$ and 58 meV and neutrinoless double beta decay with $|m_{\beta\beta}| = 25$ meV. We demonstrate that the CP violation predicted in the model can explain the baryon asymmetry of the universe through flavored leptogenesis with right-handed neutrino masses of $\mathcal{O}(10^9 - 10^{12})$ GeV.

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Search for Long-Lived Heavy Neutrinos at the LHC with a VBF Trigger

Author: JOAQUIN MASIAS TEVES[1]

Co-authors: Jose Ruiz [2]; Joel Jones-Perez [1]

[1] *PUCP*

[2] *Universidad de Antioquia (CO)*

Corresponding Authors: a20131502@pucp.pe, jones.j@pucp.edu.pe, jose.ruiz@cern.ch

The charged current production of long-lived heavy neutrinos at the LHC can use a prompt charged lepton for triggering the measurement of the process. However, in order to fully characterize the heavy neutrino interactions, it is necessary to also probe Higgs or Z mediated neutral current production. In this case the charged lepton is not available, so other means of triggering are required.

In this work, we explore the possibility of using a vector boson fusion trigger in the context of a GeV-scale Type I Seesaw model. We consider a minimal model, where both Higgs and Z-mediated contributions produce one heavy neutrino, as well as an extended model where the Higgs can decay into two heavy ones. Both scenarios are tested through displaced dilepton and displaced multitrack jet searches

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Non-linear Regge trajectories with AdS/QCD

Authors: Miguel Angel Martín Contreras[1]; Alfredo Vega[None]

[1] *Universidad de Valparaíso*

Corresponding Authors: miguelangel.martin@uv.cl, alfredo.vega@uv.cl

In this work, we consider a non-quadratic dilaton $\Phi(z) = (\kappa\, z)^{2-\alpha}$ in the context of the static soft wall model to describe the mass spectrum of a wide range of vector mesons from the light up to the heavy sectors. The effect of this non-quadratic approach is translated into non-linear Regge trajectories with the generic form $M^2 = a\,(n+b)^{\nu}$. We apply this sort of fits for the isovector states of ω, ϕ, J/ψ, and Υ mesons and compare with the corresponding holographic duals. We also extend these ideas to the heavy-light sector by using the isovector set of parameters to extrapolate the proper values of κ and α through the average constituent mass $\bar{m}$ for each mesonic specie considered. In the same direction, we address the description of possible non-$q\,\bar{q}$ candidates using $\bar{m}$ as a holographic threshold, associated with the structure of the exotic state, to define the values of κ and α. We study the π_1 mesons in the light sector and the Z_c, Y, and Z_b mesons in the heavy sector as possible exotic vector states. Finally, the RMS error for describing these twenty-seven states with fifteen parameters (four values for κ and α respectively and seven values for $\bar{m}$) is 12.61%.

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Towards the one-loop galaxy bispectrum in the weak field approximation

Authors: Lina Castiblanco[1]; Jorge Noreña[None]

[1] *Pontificia Universidad Católica de Valparaíso*

Corresponding Authors: jorge.norena@gmail.com, linayuli2@gmail.com

The large scale structure bispectrum contains information about the dynamics of the early universe in the squeezed limit since it couples large scales and short scales. Therefore, we compute the dark matter and galaxy bispectrum in a framework that is non-linear and based on General Relativity. To start, we use the weak-field approximation and standard perturbation theory to find the fluid evolution for dark matter density contrast to fourth-order in perturbations. Hereafter, we compute the galaxy density contrasts through the bias expansion. To do that, we evolve the Lagrangian bias expansion. We write the Lagrangian bias expansion in terms of operators built on the curvature of early time hypersurface of a comoving observer and the dark matter density contrast. Before computing the galaxy bispectrum, we properly renormalized the bias operators by adding the counterterms that cancels the cut-off dependencies in the one-loop integrals. We find that in the squeezed limit, the non-linear relativistic corrections to the bispectrum are as large as the Newtonian ones and degenerates with the primordial non-gaussianity signal. Still, we have to add projection effects to our results. So, these are the first steps towards determining the gauge-invariant galaxy bispectrum.

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Noncommutative momentum and torsional regularization

Author: Nikodem Poplawski[None]

Corresponding Author: nikodem.poplawski@gmail.com

We show that in the presence of the torsion tensor ${S^k}_{ij}$, the quantum commutation relation for the four-momentum, traced over spinor indices, is given by $[p_i, p_j] = 2i\hbar {S^k}_{ij} p_k$.
In the Einstein–Cartan theory of gravity, in which torsion is coupled to spin of fermions, this relation in a coordinate frame reduces to a commutation relation of noncommutative momentum space, $[p_i, p_j] = i\epsilon_{ijk} U p^3 p_k$, where U is a constant on the order of the squared inverse of the Planck mass.
We propose that this relation replaces the integration in the momentum space in Feynman diagrams with the summation over the discrete momentum eigenvalues.
We derive a prescription for this summation that agrees with convergent integrals:
$\int \frac{d^4p}{(p^2+\Delta)^s} \to 4\pi U^{s-2} \sum_{l=1}^{\infty} \int_0^{\pi/2} d\phi \frac{\sin^4\phi\, n^{s-3}}{[\sin\phi + U\Delta n]^s}$,
where $n = \sqrt{l(l+1)}$ and Δ does not depend on p.
We show that this prescription regularizes ultraviolet-divergent integrals in loop diagrams.
We extend this prescription to tensor integrals.
We derive a finite, gauge-invariant vacuum polarization tensor and a finite running coupling.
Including loops from all charged fermions, we find a finite value for the bare electric charge of an electron: $\approx -1.22\, e$.
This torsional regularization may therefore provide a realistic, physical mechanism for eliminating infinities in quantum field theory and making renormalization finite.

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On the very nature of neutrinos: the inverse beta-decay as a test bench

Author: Giuseppe Gaetano Luciano[1]

[1] *INFN - National Institute for Nuclear Physics*

Corresponding Author: gluciano@sa.infn.it

The lifetime of a particle is usually considered as one of its inherent features. On one hand, the lifetime of non-elementary quantum objects like pions or muons can be calculated from the knowledge of the interaction which rules their decay. On the other hand, other particles such as the electron are regarded as stable, in the sense that they do not decay at all (at least within Standard Model framework). In spite of this, decay properties are less fundamental than commonly thought, since they depend on the reference frame where they are evaluated. Along this line, the decay of accelerated protons was analyzed both in the laboratory frame (where the proton is accelerated) and in the comoving frame (where the proton is at rest and interacts with the Unruh thermal bath of electrons and neutrinos). The equality between the two rates was exhibited as a theoretical proof of the necessity of Unruh effect for the consistency of QFT. Recently, this formalism was refined, embedding the phenomenon of mixing for the emitted neutrinos. However, the question of whether to consider mass or flavor states for asymptotic neutrinos remained open. Here, we show that the only scenario compatible with: i) the general covariance of QFT, ii) the description of the phenomenologically observed neutrino oscillations, iii) CP-violation in neutrino oscillations is the one build upon flavor eigenstates. We further point out that Unruh radiation must be made up of oscillating neutrinos. For this purpose, we exploit previous results showing that Unruh bath for mixed fields loses its characteristic thermal spectrum. Possible experimental implications are investigated in connection with recent neutrino experiments such as Katrin and Ptolemy.

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Explaining muon g-2 anomaly in a non-universal U(1)X extended SUSY theory

Authors: Juan Sebastian Alvarado Galeano[1]; Roberto Enrique Martínez Martínez [1]

[1] *Universidad Nacional de Colombia*

Corresponding Authors: remartinezm@unal.edu.co, jsalvaradog@unal.edu.co

It is presented a non-universal $U(1)_X$ extension to the Standard Model with two scalar doublets, two scalar singlets, three additional quark singlets, two lepton singlets and three generations of right-handed and Majorana neutrinos is made to explain lepton mass hierarchy and muon anomalous magnetic moment in a chiral anomaly free framework. Besides, neutrino mass generation is achieved by implementing an inverse seesaw mechanism and it is found that the lightest fermions are tree-level massless but massive at one-loop level. Finally, the conditions that recreate the PMNS matrix and the Higgs boson as the lightests scalar are obtained to make a numerical approach to muon $g-2$. It is found that only contributions due to exotic neutrinos interacting with charged scalars are relevant, though they are negative. Nevertheless, they might explain the anomaly depending on the order of magnitude of v_χ which is achieved in the supersymmetric scenario when the contributions of exotic neutrinos interacting with W gauge bosons are positive and no longer negligible..

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Quantum Machine Learning concepts for HEP

Authors: Javier Orduz-Ducuara[1]; Vijayasri Iyer[2]

[1] *UNAM*

[2] *Department of Information Technology*

Corresponding Authors: thisisvij98@gmail.com, jaorduz@ciencias.unam.mx

This contribution explores the Machine Learning techniques and Quantum Computing concepts and applications in High Energy Physics considering a phenomenological and theoretical view. Besides, we show the main tools to explore the Standard Model extensions, decay process and the parameter space. With this set of tools, we want to explore the bounds and define exclusion regions, those bounds might be relevant to explore in the next generation of colliders and could be tested in order to
understanding of phenomena.

Dark matter / **23**

Effective Theory of Freeze-in Dark Matter

Authors: Basabendu Barman[None]; Debasish Borah[1]; Rishav Roshan[1]

[1] *Indian Institute of Technology Guwahati*

Corresponding Authors: basabendu88barman@gmail.com, rishav.roshan@gmail.com, debasish.phy19@gmail.com

We perform a model independent study of *freeze-in* of massive particle dark matter (DM) by adopting an effective field theory framework. Considering the dark matter to be a gauge singlet Majorana fermion, odd under a stabilising symmetry Z_2 under which all standard model (SM) fields are even, we write down all possible DM-SM operators upto and including mass dimension eight. For simplicity of the numerical analysis we restrict ourselves only to the scalar operators in SM as well as in the dark sector. We calculate the DM abundance for each such dimension of operator considering both *UV and IR freeze-in* contributions which can arise before and after the electroweak symmetry breaking respectively. After constraining the cut-off scale and reheat temperature of the universe from the requirement of correct DM relic abundance, we also study the possibility of connecting the origin of *neutrino mass* to the same cut-off scale by virtue of lepton number violating Weinberg operators. We thus compare the bounds on such cut-off scale and corresponding reheat temperature required for UV freeze-in from the origin of light neutrino mass as well as from the requirement of correct DM relic abundance. We also briefly comment upon the possibilities of realising such DM-SM effective operators in a UV complete model.

Dark matter / **24**

Dark Matter in the Time of Primordial Black Holes

Authors: Nicolás Bernal[1]; Oscar Alberto ZAPATA NOREÑA[None]

[1] *Universidad Antonio Nariño*

Corresponding Authors: oalberto.zapata@udea.edu.co, nicolas.bernal@uan.edu.co

The evaporation of primordial black holes (PBH) with masses ranging from ˜10ˆ-1 to ˜10ˆ9 g could have generated the whole observed dark matter (DM) relic density. It is typically assumed that after being produced, its abundance freezes and remains constant. However, thermalization and number-changing processes in the dark sector can have a strong impact, in particular enhancing the DM population by several orders of magnitude. Here we estimate the boost from general arguments such as the conservation of energy and entropy, independently from the underlying particle physics details of the dark sector. Two main consequences can be highlighted: i) As the DM abundance is increased, a smaller initial energy density of PBHs is required. ii) Thermalization in the dark sector decreases the mean DM kinetic energy, relaxing the bound from structure formation and hence, allowing light DM with mass in the keV ballpark.

Heavy flavour / 25

Light pseudoscalar and axial meson spectroscopy via an AdS/QCD modified soft wall model

Authors: Santiago Cortes[1]; Miguel Angel Martin Contreras[2]; Alfredo Vega[2]

[1] *Universidad de los Andes*

[2] *Universidad de Valparaíso*

Corresponding Author: jscortesg@unal.edu.co

We describe the mass spectrum of light pseudoscalars and axial mesons using a modified softwall model with an UV cutoff. These mesons are included using an anomalous dimension that shift the conformal dimension of the non-interacting bulk fields. Using the extra UV cutoff approach, we can fit six eta and six a1 states organized in radial trajectories with an error close to 21.1%. We also confirm that chiral symmetry is restored in this model after checking that highly excited rho and a1 states become degenerate.

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Probing the properties of relic neutrinos using the cosmic microwave background, the Hubble Space Telescope and galaxy clusters

Author: Alexander Bonilla Rivera[1]

[1] *UFJF*

Corresponding Author: alex.acidjazz@gmail.com

We investigate the observational constraints on the cosmic neutrino background (CNB) given by the extended ΛCDM scenario (ΛCDM $+N_{\rm eff} + \sum m_\nu + c^2_{\rm eff} + c^2_{\rm vis} + \xi_\nu$) using the latest observational data from *Planck* CMB (temperature power spectrum, low-polarisation and lensing reconstruction), baryon acoustic oscillations (BAOs), the new recent local value of the Hubble constant from *Hubble Space Telescope* (*HST*) and information of the abundance of galaxy clusters (GCs). We study the constraints on the CNB background using CMB + BAO + *HST* data with and without the GC data. We find $\Delta N_{\rm eff} = 0.614 \pm 0.26$ at 68 per cent confidence level when the GC data are added in the analysis. We do not find significant deviation for sound speed in the CNB rest frame. We also analyze the particular case ΛCDM $+N_{\rm eff} + \sum m_\nu + \xi_\nu$ with the observational data. Within this scenario, we find $\Delta N_{\rm eff} = 0.60 \pm 0.28$ at 68 per cent confidence level. In both the scenarios, no mean deviations are found for the degeneracy parameter.

Heavy flavour / 27

Flavored axions and the flavor problem

Authors: Eduardo Rojas[1]; Roberto Martinez[2]; Yithsbey Giraldo[1]; Juan Carlos Salazar[1]

[1] *Universidad de Nariño*

[2] *Universidad Nacional de Colombia*

Corresponding Authors: jusala@gmail.com, eduro4000@gmail.com, yithsbey@gmail.com, remartinezm@unal.edu.co

A Peccei-Quinn˜(PQ) symmetry is proposed, in order to generate in the Standard Model˜(SM) quark sector a realistic mass matrix ansatz with five texture-zeros. Limiting our analysis to Hermitian mass matrices we show that this requires a minimum of 4 Higgs doublets. This model allows assigning values close to 1 for several Yukawa couplings, giving insight into the origin of the mass scales in the SM. Since the PQ charges are non-universal the model features Flavor-Changing Neutral Currents˜(FCNC) at the tree level. We calculate the FCNC couplings of the most general low-energy effective Lagrangian for the axion in a procedure valid for an arbitrary number of Higgs doublets. Finally, we report the allowed region in the parameter space obtained from the measurements of branching ratios of semileptonic meson decays.

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A Guidance for Building Dark Energy Models

Author: Gómez Gabriel [1]

[1] *Departamento de Física, Universidad de Santiago de Chile*

Corresponding Author: gabrielphysics@gmail.com

We discuss in this talk several physical principles as well as emerging observational constraints, as the speed of gravitational waves, that any dark energy model has to face in order to ensure its cosmological viability. In particular dark energy models based on modified gravity theories find a major challenge for addressing the late-time dynamics in a consistent way due to the presence of instabilities. We present a guidance for building dark energy models with some necessary conditions that must be fulfilled, and illustrate this point showing some simple but suitable examples.

Dark matter / 29

Diophantine scotogenic models

Author: Diego Restrepo[1]

[1] *Universidad de Antioquia*

Corresponding Author: restrepo@udea.edu.co

We propose a general method to find anomaly free Abelian standard model extensions with radiative Dirac netrino masses and DM matter candidates

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External Momentum Dependence from the Higgs Boson Mass

Author: Edilson Alfonso Reyes Rojas[1]

[1] *UNAL, DESY*

Corresponding Author: eareyesro@unal.edu.co

The three-loop corrections to the Higgs boson mass are usually computed in the on-shell scheme using the effective potential approach, where the external momentum are put equal to zero. In this

presentation we are going to discuss the technical details for the Feynman diagrammatic computation of the external momentum dependence coming from the three-loop self-energy corrections to the Higgs boson mass in both the Standard Model (SM) as in the minimal supersymmetric standard model with real parameters (rMSSM).

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Three level FCNC from Models with a flavored Peccei-Quinn Symmetry

Authors: Yithsbey Giraldo[1]; Eduardo Rojas[1]; Roberto Martínez[2]; Juan Carlos Salazar[1]

[1] *Universidad de Nariño*

[2] *Universidad Nacional de Colombia*

Corresponding Authors: remartinezm@unal.edu.co, jusala@gmail.com, yithsbey@gmail.com, eduro4000@gmail.com

A Peccei-Quinn˜(PQ) symmetry is proposed, in order to generate a realistic mass matrix ansatz with five texture-zeros for both quark and lepton sector in the Standard Model˜(SM). Limiting our analysis to Hermitian mass matrices we show that this requires a minimum of 4 Higgs doublets. The price we pay is to have Yukawa values in the lepton sector much lower than 1, but consistent with the experimental values. Since the PQ charges are non-universal the model features Flavor-Changing Neutral Currents˜(FCNC) at the tree level. We calculate the FCNC couplings of the most general low-energy effective Lagrangian for the axion in a procedure valid for an arbitrary number of Higgs doublets. Finally, we report the allowed region in the parameter space obtained from the measurements of branching ratios of semileptonic meson decays.

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Addressing the R (D) and R (D*) anomalies within a charged scalar boson scenario

Author: Nestor Quintero[1]

Co-authors: J. H. Muñoz [2]; J. Cardozo [2]; E. Rojas [3]

[1] *Universidad Santiago de Cali*

[2] *Universidad del Tolima*

[3] *Universidad de Nariño*

Corresponding Authors: eduro4000@gmail.com, jcardozon@ut.edu.co, jhmunoz@ut.edu.co, nestor.quintero01@usc.edu.co

The experimental measurements collected by the BABAR, Belle and LHCb experiments on the $R(D)$ and $R(D^*)$ observables indicate the existence of disagreement with respect to the Standard Model (SM) predictions. This discrepancy has been referred to as the "$R(D)$ and $R(D^*)$ anomalies", and consequently, a large number of studies considering the effects of new physics (NP) beyond MS have been discussed in the literature. In this talk, we will present a review of the current state (experimental and theoretical), and a possible scenario to address the $R(D)$ and $R(D^*)$ anomalies through a charged scalar boson will be discussed. We will show the recent results of the phenomenological study to the parameter space allowed by these NP models. We will discuss the implications of parametric space that would be obtained from the projections of the Belle II experiment.

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Generation of Carroll-Field-Jackiw term in Horava-Lifshitz z=3 CPT-violating QED

Authors: Ricardo Martínez [1]; Tiago Mariz[1]; José Roberto Nascimento[2]; Albert Petrov[2]

[1] *Universidade Federal de Alagoas*

[2] *Universidade Federal da Paraíba*

Corresponding Author: rmartinez@fis.ufal.br

Theories with anisotropy between space and time, also called Horava-Lifshtiz (HL) theories, has been studied in many works since the seminal paper of P. Horava was published, where the Lifshitz scaling is used to construct a power counting renormalizable gravity model. The Lifshitz scaling is described by the transformation $x \to bx$, $t \to b^z t$, where the integer z is so-called critical exponent. In the case of quantum gravity, if $z = 3$, the dimension of gravitational constants turns out to be zero, a necessary condition for the renormalizability. Then, other theories started to be studied within the Horava-Lifshitz context, for example, theories with four fermion interaction and spinor QED.
An interesting problem to be studied is the HL-like theory where CPT symmetry is broken and the calculating the generation of a Carrol-Field-Jackiw (CFJ) term. The aim of this study could be the search for a generalized description of Lorentz breaking theories involving HL-like theories and where the 'usual' Lorentz-breaking theories as particular cases.

We start with the action of HL $z = 3$ CPT-violating QED where a Lorentz and CPT violating term is included in the fermionic sector
$S = \int d^4x \left[\bar{\psi}(i\not{D}_0 + (i\not{D}_i)^3 - m^3 - \not{b}_0\gamma_5 + (\not{b}\not{D}\not{D})_i\gamma_5)\psi\right]$,
where $\not{D}_0 = D_0\gamma^0$, $\not{D}_i = D_i\gamma^i$, $\not{b}_0 = b_0\gamma^0$, and $(\not{b}\not{D}\not{D})_i = (bDD)_{ijk}\gamma^i\gamma^j\gamma^k$, with
$D_{0,i} = \partial_{0,i} + ieA_{0,i}$.

To calculate the generated CFJ term, first we use the simplest prescription for Dirac matrices, where we find that the CFJ term is finite and reproduces one of the values obtained in the usual Lorentz-breaking QED
$\mathcal{L}_{CFJ} = -\frac{e^2}{4\pi^2} b_\kappa \epsilon^{\kappa\lambda\mu\nu} A_\lambda \partial_\mu A_\nu$.
Using the 't Hoft and Veltman prescription, we find that the CFJ term is not generated.
$\mathcal{L}_{CFJ} = 0$

So, we can conclude that the generated CFJ term is finite, and gauge and Lorentz invariant, but indetermined because of its dependence on the calculation scheme. This result is natural, because the chiral anomaly is related with the ambiguity of the triangle graph, and since the chiral anomalies also exist in $z = 3$ HL-QED, the presence of ambiguity in the triangle graph in our theory seems to be a direct analogy of the situation taking place in the usual Lorentz-breaking QED.

Common Session / 35

Matriz de mezcla de neutrinos en el marco de la simetría $\mu\!-\!\tau$

Authors: David Cardona[None]; Diana Carolina Rivera Agudelo[1]

[1] *Universidad Santiago de Cali*

Corresponding Author: dc8a97@yahoo.com

Mientras que experimentos de oscilaciones de neutrinos han dado evidencia de que los neutrinos tienen masa y se mezclan, aún no se tiene una teoría que explique la estructura de estas mezclas, plasmada en la conocida matriz PMNS. Antes de la medida del ángulo de reactor (θ_{13}), la matriz PMNS presentaba una simetría de intercambio μ-τ consistente con un valor de cero para θ_{13} y para la fase de Dirac de violación CP . Después de la medida de gran precisión del ángulo θ_{13} se ha explorado la posibilidad de que la matriz PMNS surja de la perturbación de dicha simetría. Un caso especial de dicha simetría es el esquema TBM (Tri-Bi-Maximal), la cual establece $\sin^2\theta_{12} = 1/3$. En este trabajo se utilizan diferentes desviaciones del patrón de mezcla TBM, mediante rotaciones

unitarias y ortogonales, para estudiar la violación de CP, mostrando que es posible generar predicciones para las fases de Majorana y la fase de Dirac, estudiando sus relaciones con los parámetros de mezcla. Adicionalmente se estudian los efectos que tienen estas predicciones sobre el observable $|m_{ee}|$ relevante en el decaimiento doble beta sin neutrinos.

Heavy flavour / **36**

Production and properties of the Bc(2S)and B*c(2S)states

Author: Manuel Alejandro Rodriguez Giraldo[1]

Co-author: Jhovanny Andres Mejia Guisao [1]

[1] *Universidad de Antioquia (CO)*

Corresponding Authors: jmejiagu@cern.ch, manuel.alejandro.rodriguez.giraldo@cern.ch

We reported the production and properties studies of the Bc(2S)and B*c(2S)states,based on an event sample of pp collisions at a center-of-mass energy of 13 TeV, col-lected by CMS detecter and corresponding to an integrated luminosity of 143 fb−1.The excited states are reconstructed in theBcπ+π−decay. The production rate ofBc(2S)and B*c(2S)respect to the base state Bcas estimated within the acceptance ofthe detector. The relative rate of the two mesons respect to each other is also estimatedas well as the shape of the invariant mass of the pion-pion system.

Cosmology / Astroparticles / **38**

Anisotropic solid dark energy

Authors: Josue Motoa Manzano[1]; Cesar A. Valenzuela-Toledo[2]; JOHN BAYRON ORJUELA-QUINTANA[3]; Thiago Pereira[4]

[1] *Universidad del valle*

[2] *Universidad del Valle*

[3] *UNIVERSIDAD DEL VALLE*

[4] *Universidad estadual de Londrina*

Corresponding Authors: josue2014@hotmail.com, tspereira@uel.br, john.orjuela@correounivalle.edu.co, cesar.valenzuela@correou

In this work, we study a triplet of inhomogeneous scalar fields, known as "solid", as a source of anisotropic dark energy. By using a dynamical system approach, we find that anisotropic accelerated solutions can be realized as attractor points for suitable parameters of the model. We compliment the dynamical analysis with a numerical solution whose initial conditions are set in the deep radiation epoch. The model predicts a spatial shear within the observational bounds nowadays, even when it is set to zero as an initial condition The hairy attractors and an
ultra slowly varying equation of state of dark energy close to -1 are key features of this scenario. We also analyzed the isotropic limit of the model, finding that the solid can be described by a constant equation of state and thus being able to simulate the behaviour of a cosmological constant.

Common Session / **39**

K-matrix formalism in light-meson spectroscopy

Author: Sebastian Ordonez[1]

Co-author: Diego Milanés [2]

[1] *National University of Colombia*

[2] *Universidad Nacional de Colombia*

Corresponding Authors: damilanesc@unal.edu.co, jsordonezs@unal.edu.co

In this work we study the K-matrix formalism and show how this can be applied to Dalitz plot analyses of charm-meson decays, such as $D^0 \longrightarrow K_s^0\pi^+\pi^-$. The K-matrix, in contrast to the typical Isobar Model (IM), allows to properly include in the decay amplitude broad-overlapping resonances and non-resonant background, which are features of some of the known experimental results in light-meson spectroscopy. The $\pi\pi$ S-wave scattering presented in this work is a good example of this underlying dynamics. Moreover, the K-matrix formalism imposes by construction a unitarity constraint, which is not ensured by other approaches as IM.

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Correlación Energía-Energía en Electrodinámica Cuántica Supersimétrica

Authors: Alexander Gamboa[None]; Edilson Alfonso Reyes Rojas[1]

[1] *UNAL, DESY*

Corresponding Authors: eareyesro@unal.edu.co, alexgamboa8@gmail.com

Resumen:

La física moderna ha entrado en una nueva era de precisión donde los observables físicos, como las masas de las partículas o la correlación energía-energía de átomos hidrogenoides, deben ser medidos experimentalmente y calculados teóricamente con una mayor precisión. La búsqueda de nuevos grados de libertad físicos es también una prioridad en la agenda de los aceleradores de partículas modernos como el LHC, el ILC y el FCC. En particular, la supersimetría es el escenario de nueva física con mayor fenomenología en la actualidad y recibirá gran parte de la atención en los experimentos futuros. En nuestro proyecto vamos a estudiar las implicaciones de las correcciones provenientes de la supersimetría a la correlación energía-energía en el sistema de dos partículas electrón-positrón, con el fin de dar una descripción alternativa de la cuantización de la radiación electromagnética en la electrodinámica cuántica y establecer un esquema de renormalización que permita encontrar restricciones fenomenológicas al valor numérico de la escala de nueva física, donde se espera que los nuevos grados de libertad aparezcan.

Neutrinos / **43**

Theory of Fast Flavor Conversion for Supernova neutrinos

Author: Soumya Bhattacharyya[1]

[1] *TIFR*

Corresponding Author: soumyaastroparticle@gmail.com

We all know that in the dense anisotropic interior of the star, neutrino- neutrino forward-scattering can lead to fast collective neutrino oscillations, which has striking consequences on flavor dependent neutrino emission and can be crucial for the evolution of a supernova and its neutrino signal. Although the triggering and initial growth of fast oscillations are understood, owing to its complicated nonlinear evolution, the final impact is not yet known. Interestingly, stellar explosion and the neutrino signal are sensitive to the processed flavor-dependent fluxes, but the required neutrino theory

prediction is still lacking. In my talk I will address this crucial theoretical and phenomenological obstacle and present a theory of fast flavor conversions that will explain how, when and to what extent do the flavor differences change. Finally, I will give a method and a simple formula for computing the final fluxes that can be a crucial input for supernova theory and neutrino phenomenology.

Dark matter / 45

The Z5 model of two-component dark matter

Authors: Oscar Zapata[1]; Carlos E. Yaguna[None]

[1] *Universidad de Antioquia*

Corresponding Authors: cyaguna@gmail.com, oalberto.zapata@udea.edu.co

In this talk we present the phenomenology of the Z5 model for two-component dark matter. This model, which can be seen as an extension of the well-known singlet scalar model, features two complex scalar fields–the dark matter particles–that are Standard Model singlets but have different charges under a Z5 symmetry. The interactions allowed by the Z5 give rise to novel processes between the dark matter particles that affect their relic densities and their detection prospects.
Dark matter masses below the TeV are still compatible with present data, and current and future direct detection experiments may be sensitive to signals from both dark matter particles.

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Two component dark matter model in light of Beam Dump experiments.

Authors: Guillermo Palacio[1]; Amalia Betancur[1]; Andrés Fernando Castillo Ramirez[2]; Juan Guillermo Suarez[1]

[1] *Universidad EIA*

[2] *Universidad Sergio Arboleda*

Corresponding Authors: amaliab2@gmail.com, afcastillor@unal.edu.co, gapalacic@gmail.com

We study a scalar dark matter (DM) model with two DM species coupled to standard model (SM) particles via a sub-GeV dark photon. The two DM candidates can be produced at fixed-target experiment a la Beam-Dump. Predictions for signal and backgrounds are obtained with the help of MadDump and NuWro Montecarlo generators. We explore the potential reach on the sensitivity of DUNE near detector and SHiP experiment and analyze the constraints coming from current limits on DM observables such as relic density and DM conversion in the early universe.

Dark matter / 47

Multicomponent dark matter and the IDM

Authors: Andrés Felipe Rivera Romero[1]; Guillermo Palacio[None]; Amalia Betancur Rodríguez[None]

[1] *Universidad de Antioquia*

Corresponding Authors: amaliab2@gmail.com, afelipe.rivera@udea.edu.co, gapalacic@gmail.com

We present a multicomponent dark sector model, comprised of a fermionic and a scalar dark matter candidate. In the scalar sector, the dark matter candidate is the Inert Doublet Model, while the fermionic candidate is a mix of fields in different representations of the $SU(2)_L$ group. We present the results from imposing restrictions on relic density, direct detection and other observables.

Common Session / 48

Search for new physics in the final state of τ, b, ν

Authors: Tomas Atehortua Garces[1]; José David Ruiz Álvarez[2]

[1] *Universidad de Antioquia (CO)*

[2] *Universidad de Antioquia*

Corresponding Author: tomas.atehortua@udea.edu.co

The Standard model (SM) is one of the most successful physics theory, however it presents disagreements between some predictions and the observations. One of them has been studied in the last decade and it's related to the lepton universality. The R_{D^*} Anomaly appear to be enhanced respect to the standard model by roughly 30% with a global significance of $\approx 4\sigma$. This has been studied by BaBar, Belle and LHC-b experiments. As the measure it's close to the traditional 5σ deviations, it could be a sign of new physics. Nevertheless an approaching to the problem considering the b quark and the τ in the final state has never been measured. The aim of this project is discarding values from the mass parameter space for extensions to the SM as the W' model.

The standard model is the ruling theory for the composition and interaction of the known universe so far. It's composed by different type of particles, the quarks and leptons, each one with 3 generations, then we have the gauge bosons, responsible for the electric, weak and strong interactions, and finally the Higgs boson, responsible of giving mass to the rest of the massive particles from the SM. However, it's far from being a definitive theory, with problems as the Strong CP problem, and the neutrino masses, it is still in tests in experiments as the Tevatron and the LHC. One of this problem is associated with particles from the third generation of quarks and leptons, punctually with the b quarks, and the τ leptons. \\

The R_{D^*} is the ratio between the branching fraction of B decaying semileptonicaly to a τ with respect to the decay to other charged leptons, i.e:

\begin{equation}
R_{D^*} = \frac{\Gamma(B \rightarrow D^{(\ast)}\tau \nu)}{\Gamma(B\rightarrow D^{(\ast)}l\nu)}
\end{equation}
With $l = e$ or μ\cite{greljo2019mono}.\\\\

This measure appears to be enhanced respect to the standard model by roughly 30% with a global significance of $\approx 4\sigma$ in experiments as BaBar, LHCb, and Belle \cite{PhysRevLett.120.171802,PhysRevD.92.072014,PhysRevLett.109.

This is a problem because the standard model predicts for such process a characteristic known as the lepton Universality. Which states that in a process sufficiently energetic with a leptonic the 33.3% of the times the process will end with a τ in the final state, 33.3% of the the times we will find a μ in the final state and the other times will be a e. In that sense many models related to Beyond Standard Model physics as W', Z' model predict stronger interactions to the third generation of leptons and quarks compared to the other generations.\\

Many Studies had search new physics signs in process as $b \rightarrow \tau, \nu$, but in this sense the crossing symmetry can be used to study the phenomena by considering the three particles in the final state and the distribution of variables as the Transverse mass between the b, ν and τ, ν, and the total mass between the 3 particles.

Common Session / 49

SpaceMath version 1.0: A Mathematica package for beyond the standard model parameter space searches.

Authors: Marco Antonio Arroyo Ureña[None]; Ricardo Gaitán-Lozano[1]; Tomás Antonio Valencia-Pérez[2]

[1] *UNAM*

[2] *BUAP*

Corresponding Authors: antonio_2827@hotmial.com, marcofis@yahoo.com.mx, rgaitan@unam.mx

We present a `Mathematica` package, called `SpaceMath`, for Beyond the Standard Model (BSM) parameter space searches which be agree with the most up-to-date experimental measurements. The physical observables implemented in `SpaceMath` are classified in five categories, namely, LHC Higgs boson data (LHC-HBD), Flavor-Violating Processes (FVP), Oblique Parameters (OP), Unitarity and perturbativity (UP) and Meson Physics (MP). Nevertheless, `SpaceMath` version 1.0 (`SpaceMath v1.0`) works only with LHC-HBD and with extended scalar sector models. Future versions will implement the observables previously mentioned.

`SpaceMath v1.0` is able to find allowed regions for free parameters of extension models by using LHC-HBD within a friendly interface and an intuitive environment in which users enter the couplings, set parameters and execute \texttt{Mathematica} in the traditional way. We present examples, step by step, in order to start new users in a fast and efficient way. To validate `SpaceMath v1.0`, we reproduce results reported in the literature.

Neutrinos / 50

Front-end readout electronics for the PDS-SP of the DUNE Experiment

Author: Deywis Moreno Lopez[1]

[1] *Universidad Antonio Narino (CO)*

Corresponding Author: deywis.moreno.lopez@cern.ch

The Deep Underground Neutrino Experiment (DUNE) is one of the next generation of neutrino experiments in construction in the USA under an international scheme. Colombian institutions are involved in the development of the DUNE experiment as an example of how Latin American countries can help design one mega-science experiment. This talk summarizes the Colombian activities in the design of the front-end readout electronics (DAPHNE) for the photon detection system of DUNE and presents the perspectives for the future regional working around the project.

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Heavy Sterile Neutrino Decay at Short-Baseline Experiments

Authors: Gabriela Vitti Stenico[1]; Andre De Gouvea[2]; Suprabh Prakash[3]; Orlando L. G. Peres[4]

[1] *State University of Campinas (UNICAMP)*

[2] *Northwestern University*

[3] *Sun Yat-Sen University, Guangzhou*

[4] *UNICAMP*

Corresponding Authors: orlando@ifi.unicamp.br, degouvea@northwestern.edu, gstenico@ifi.unicamp.br, suprabh-prakash@gmail.com

We studied a neutrino decay scenario as a potential solution to conciliate the tension between appearance and disappearance data at the short-baseline experiments. Particularly, we considered a heavy neutrino mass-eigenstate that decays into a usual light neutrino plus a massless scalar. Under this neutrino decay hypothesis, we fitted LSND and MiniBooNE electron neutrino appearance data assuming Dirac or Majorana neutrinos. We obtained reasonable results for both cases. Including muon neutrino disappearance searches, and also current bounds on the new decay coupling constant, we noticed that the heavy neutrino decay scenario is compatible as long as $1\ \mathrm{MeV} \leq m_4 \leq 10$ keV. Finally, we showed that the future SBN program at Fermilab has the potential to definitively test the considered decay hypothesis.

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Description and constraints of the back-end trigger of the Photon Detection System in DUNE

Author: Manuel AM[1]

[1] *EIA*

Corresponding Author: matheos.mc2@gmail.com

The photon detection system has been of great importance at DUNE (Deep Underground Neutrino Experiment). It can improve the sensitivity of the instrument by adding photon traces of the events, it's possible to increase data on CC interactions, and get information of the less common NC scattering on Ar. Supernova events are the high-level constraint DUNE must achieve in terms of bandwidth because it is impossible to know the rate of neutrinos in such events. For this reason, we present a description of the triggering scheme on each of the channels of the photon detection system, the region of zero-delay digitization, and the bandwidth of the readout system, for further trigger schemes descriptions of higher level.

Cosmology / Astroparticles / **53**

Systematically building the generalized Proca and SU(2) Proca theories of gravity and beyond

Author: ALEXANDER GALLEGO CADAVID[None]

Corresponding Author: alexander.gallego@udea.edu.co

To date, different alternative theories of gravity involving Proca and SU(2) Proca fields have been proposed. Unfortunately, the procedure to obtain the relevant terms has not been systematic enough or exhaustive, thus resulting in some missing terms or ambiguity in the process carried out. In this talk, we will show a systematic procedure to build the generalized Proca and SU(2) Proca field theories and beyond in four dimensions. In our approach, we employ all the possible Lorentz-invariant Lagrangian pieces made out of the Proca and SU(2) Proca fields and their first-order derivatives, and find the relevant combinations that propagate only three degrees of freedom and have healthy dynamics for the longitudinal mode. The key step in our procedure is to retain the flat space-time divergences of the currents in the theory during the covariantization process. In the curved space-time theory, some of the retained terms are no longer current divergences so that they induce the new terms that identify the beyond generalized Proca and SU(2) Proca field theories.

Dark matter / 54

Vector Boson Fusion Topology and Simplified Models for Dark Matter searches at colliders

Author: Daniel Ocampo Henao[1]

Co-authors: José D Ruiz-Álvarez [2]; Santiago Duque-Escobar [2]

[1] *Universidad de Antioquia (CO)*

[2] *Universidad de Antioquia*

Corresponding Author: daniel.ocampo.henao@cern.ch

A possibility to attempt at observing Dark Matter is to produce it at high energy colliders such as the Large Hadron Collider (LHC). LHC proton-proton collisions might result in the production of WIMPS in association with one or more QCD jets, photons as well as other detectable SM debris. Since WIMPs are electrically neutral and cosmologically stable massive particles, they manifest at colliders as missing transverse energy E_T. We explore prospects for dark matter at the LHC via the VBF topology. Particularly, we focus on scalar and vector-like mediators to look for better constraints on the masses and couplings regarding those previously found via the mono-jet strategy.

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Five texture zeros for Dirac neutrino mass matrices

Authors: Richard Beanvides[None]; Yitsbhey Giraldo[None]; Luis Muñoz[None]; William Ponce[None]; Eduardo Rojas[None]

Corresponding Author: ribebenavides@gmail.com

In this work, we propose new five texture zeros for the mass matrices in the lepton sector in order to predict neutrino masses. In our approach, we extend beyond the standard model (SM) by assuming Dirac masses for the neutrinos, a feature which allows us to make a theoretical prediction for the lightest neutrino mass in the normal ordering. The textures that were analyzed have enough free parameters to adjust the VPMNS mixing matrix including the CP-violating phase, the neutrino mass squared differences, and the three charged lepton masses. we used two different procedures, the first method was based on a least-squares analysis and the second approach was algebraic.

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WIMP Dark Matter in a Type-II Scotogenic model

Author: Roberto Lineros[1]

[1] *Universidad Católica del Norte*

Corresponding Author: roberto.lineros@ucn.cl

Dark Matter and neutrinos are one of the most puzzling components of the Universe. Neutrino masses can be explained by radiative processes where Dark Matter particles are involved. Such models are known as Scotogenic DM models. The Dark Matter candidate in these models are stable thanks to the same symmetry that protect the radiative process. We present a realization of the scotogenic model using as inspiration model the Type-II seesaw. We show the model has a good DM candidate at the TeV scale and its phenomenology can be tested by CTA and Darwin.

Common Session / 58

Large extra dimension at JUNO

Author: Victor Basto-Gonzalez[1]

[1] *Universidad del Valle/ Universidad de Pamplona*

Corresponding Author: vsbasto@gmail.com

We use the JUNO experiment which is a reactor neutrino experiment to constrain the parameters of the Large Extra Dimension (LED) model. The parameters of this model are the radius of extra dimension R_{LED} and the lightest neutrino mass m_0. We select the JUNO experiment because its aims is to determine the hierarchy of the neutrino masses and for this it will simultaneously measure the oscillations due to the parameters Δm^2_{21} and $|\Delta m^2_{32}|$ and also the mixing angles θ_{12} and θ_{13} using a resolution on the visible energy of the positrons of 1% at 1 MeV. The LED model used in this work considers that neutrinos are Dirac neutrinos, the space-time structure of our universe is 4 + 1 that is: four flat spatial dimensions where the extra spatial dimension is compactified in a circle of radius R_{LED} and the 1 indicates a time dimension. We expect the results obtained in the parameters R_{LED} and m_0 from this analysis will be slightly more restrictive than previous work already done due to the energy resolution of the JUNO experiment.

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Cosmological implications of electroweak vacuum instability: constraints on the Higgs curvature coupling from inflation

Author: Andreas Mantziris[1]

Co-authors: Tommi Markkanen ; Arttu Rajantie [2]

[1] *Imperial College London*

[2] *Imperial College (GB)*

Corresponding Authors: a.rajantie@imperial.ac.uk, tommi.t.markkanen@gmail.com, a.mantziris18@imperial.ac.uk

The current experimentally measured parameters of the Standard Model (SM) suggest that our universe lies in a metastable electroweak vacuum, where the Higgs field could decay to a lower vacuum state with catastrophic consequences. Our measurements dictate that such an event has not happened yet, despite the many different mechanisms that could have triggered it during our past light-cone. Via this observation, we can establish a promising link between cosmology and particle physics and thus constrain important parameters of our theories. The focus of our work has been to explore this possibility by calculating the probability of the false vacuum to decay during the period of inflation and using it to constrain the last unknown renormalisable SM parameter ξ, which couples the Higgs field with space-time curvature. In our latest study, we derived lower bounds for the Higgs-curvature coupling from vacuum stability in three inflationary models: quadratic and quartic chaotic inflation, and Starobinsky-like power-law inflation. In contrast to most previous studies we took the time-dependence of the Hubble rate into account both in the geometry of our past light-cone and in the Higgs effective potential, which is approximated with three-loop renormalisation group improvement supplemented with one-loop curvature corrections. We find that in all three models, the lower bound is ξ ⊠ 0.051 … 0.066 depending on the top quark mass. We also demonstrated that vacuum decay is most likely to happen a few e-foldings before the end of inflation.

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Estimation of the contribution of Muon Forward Scattering to the signal registered by the MuTe detector

Authors: Ricardo de León[1]; Mauricio Suárez[1]; Luis A. Núñez[2]

[1] *Universidad Industrial de Santander*

[2] *University of Los Andes*

Corresponding Authors: mauricio.suarez@correo.uis.edu.co, ricardo.deleon@correo.uis.edu.co, nunez@ula.ve

Muography is a technique that allows us to estimate the distribution of matter in the inner structure of geophysical formations like volcanoes. This technique is based on the measurement of the absorption of atmospheric muons that go through the structure, so that with a hodoscope instrument it is possible to build a map of density of matter, similar to a medical X-ray image. The MuTe (Muon-Telecope) collaboration, from *Universidad Industrial de Santander*, has designed and deployed a hybrid detector, with the same name. This detector consists of both a hodoscope and a water Cherenkov detector (WCD), and it has been conceived with two scientific aims in mind: applying Muography to study volcanic structures in Colombia, and working as a muon counting detector. In Muography, one source of noise is the Muon Forward Scattering (MFS) phenomenon, i.e. muons coming from the ground after a deflection caused by processes such as Coulomb interactions, that can be erroneously interpreted as muons that have crossed the structure of interest, when they actually have not. In this work, we quantify this effect using Monte Carlo simulations via the Geant4 toolkit, where we modeled the ground as standard rock. Thus, as a main result, we have estimated the MFS effect on the MuTe signal using an array of computer simulations: CORSIKA, to generate a realistic background of muons and other particles created in extensive air showers from cosmic rays; MAGNETOCOSMICS, to account for the effect that Earth's magnetic field has on the trajectories of primary cosmic rays; and a model of MuTe in Geant4, to estimate the superposition of the signal from MFS over the signal produced by the background of particles.

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Z' to ttbar in the single lepton-final state with Atlas Open Data

Authors: Nicolas Gomez Cruz[None]; Sebastian Ordonez[1]

Co-author: Carlos Sandoval Usme [2]

[1] *National University of Colombia*

[2] *Universidad Nacional de Colombia*

Corresponding Authors: carlos.sandoval@cern.ch, nigomezcr@unal.edu.co, jsordonezs@unal.edu.co

Different models of physics Beyond the Standard Model (BSM) predict different kinds of Z' bosons, motivating the search for these particles at the Large Hadron Collider (LHC). In this work, a $Z' \longrightarrow t\bar{t}$ analysis in the semileptonic top quark pair channel is presented, using the ATLAS Open Data Dataset at a centre-of-mass energy of 13TeV and corresponding to an integrated luminosity of 10fb^{-1}. An event selection criteria is implemented, where acceptable agreement between the data and Monte Carlo simulated predictions is observed.

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Simulation of a Water Cherenkov Detector Response tothe Background of Cosmic Rays at Pamplona Norte de Santander altitude (2300 m a.s.l.)for the LAGO Collaboration

Author: Heidar Marcel Parada Villamizar[None]

Co-author: Mauricio Suarez Duran

Corresponding Author: hmarcelparadav@gmail.com

KEYWORDS:
Cosmic Rays, Water Cherenkov Detector, Monte Carlo Simulations.

ABSTRACT:

The studies of cosmic rays (CR) is mainly performed by using detectors installed at theground; this detectors registered the secondary radiation produced by the interaction ofCR with Earth atmosphere. Since 2010 Colombia is an active member of the large scaleobservatory LAGO (Latin American Giant Observatory). This observatory operated anarray of Water Cherenkov Detectors (WCDs) spanned over Latin America in a wide rangeof latitudes. The installation of a new WCD requires the perform of a series of simulation,from the calculation of the flux of primaries that arrive to the Pamplona atmosphere untilthe WCD response to the secondary radiation. Here we show the signal expected atPamplona, Norte de Santander city. For this we have use the AGO's toolkit ARTI, aframework of computational techniques and codes (CORSIKA, GEANT4, C++, Python) toestimated the WCD signals produced by cosmic radiation at ground. As main results, thespectrum of secondaries here calculated fits with the expected and the WCD responseallows to us to separate the signal deposited by muons from the electrons/positron ones. Inparticular, our calculations shows the muon signal far away from the noise signal, so weexpected that a WCD installed at Pamplona can works as a muon counting. As a finalresults, we have checked the capability of the WCD simulated to measured the muon halflife time, this implies that a WCD deployed at the University of Pamplona can be used asLab equipment to teach particle physics.

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Characterization of the signal produced by muons into one Water Cherenkov Detectors of the LAGO Observatory

Author: YORLAN PEREZ CUEVAS[1]

Co-author: MAURICIO SUAREZ DURAN [2]

[1] *Universidad de Pamplona*

[2] *Universidad de Pamplona*

Corresponding Author: perezyorlan2@gmail.com

The Latin American Giant Observatory (LAGO) is an observatory array of Water Cherenkov

Detectors (WCDs) expanded throughout Latin America, from Mexico to Antarctica, with scientific objectives to study the cosmic rays, space weather phenomena, and ground-level atmospheric radiation. The quality of the data recorded by LAGO is guaranteed based on a protocol that includes the installation process and periodic monitoring of the instrument's calibration. This calibration is based on the signal produced by muon-like particles that completely and vertically pass through the WCD, it is called VEM (Vertical Equivalent Muon); so, VEM identification is important to the trustworthiness and correct interpretation of the LAGO data. Currently, the LAGO's algorithm to process and analysis the data allows us to identify the VEM signal, but this algorithm fails occasionally for some data, mainly because the water into the WCD becomes more absorbing to Cherenkov photons, so this data is rejected. Here we show a statistical analysis of the signals produced by muons into one of the WCD of LAGO with the aim of recovery the rejected data. In this study, we have used a full month of accepted data to characterize the properties of the muon signal, i.e. peak and integral of the signal, the decay time of the pulse, among others, later we built a pulse model for muon signal and we have tested it throughout Monte Carlo simulations, using the simulation framework of LAGO based on Geant4. Finally, we have validated this model with another set of accepted data.

Keywords: Background Cosmic radiation, Muon signal, Water Cherenkov Detector

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Estimation of the effective dose from cosmic radiation received during a commercial flight passing through the South Atlantic anomaly

Author: Daniel Camilo Becerra Villamizar[1]

Co-author: Mauricio Suárez [2]

[1] *Universidad de Pamplona*

[2] *Universidad Industrial de Santander*

Corresponding Authors: mauricio.suarez@correo.uis.edu.co, camilobecerra823@gmail.com

Exposure to ionizing radiation during commercial flights has repercussions on human health, in particular for flights pass through the South Atlantic Geomagnetic Anomaly (SAA). This radiation is originated from the interaction of cosmic rays (CR) with Earth's atmosphere. Likewise, the flux of CR with energies around GeV is affected by the Geomagnetic field, this establishes a dependence between ionizing radiation and geographical position. Currently, tools such as CARI-7A estimates the effective dose for commercial flights. In general, this kind of code uses semi-empirical models to estimate the radiation at the flight altitude and ignore the contribution of particles like muons on the calculation of the dose; this because of the low probability of interaction with matter and the low dose of muons compare with neutron particles. Nonetheless, a better estimation of the radiation at flight altitude and the contribution of muons for the effective dose can improve this calculation due to the bigger flux of CR into the SAA. Here we show an improvement of the estimation of the effective dose during a commercial flight that crosses the AAS by calculating the secondary radiation produced by CR between 1 GeV and 10ˆ6 GeV, via CORSIKA and GATE codes. In this work, we have included a model (metallic cylinder) of the plane fuselage. In addition, we have evaluated the influence of the geomagnetic field on secondary radiation through a method that uses its local and instantaneous configuration. In this way, this work is a contribution to the understanding of how high-energy RC (<10ˆ6 GeV), the aircraft fuselage, and the geomagnetic field can improve the estimation of the effective dose estimated for commercial flights that cross the SAA.

Keywords: ionizing radiation, effective dose, commercial flights, Geomagnetic field.

Common Session / 65

Estimation of energy levels for cosmic rays affected during a Forbush decrease from data from the LAGO Observatory

Author: Karoll Michely Parada Jaime[None]

Co-author: Mauricio Suarez Duran

Corresponding Author: michelyparada17@gmail.com

Abstract

The space weather phenomena have an important impacts in science and current
technological structure. This work is focused on the interaction between solar transient events and cosmic rays, specifically on Forbush Decrease (FD) events. A FD consists in a decrease/affectation on the counts of radiation a ground level during an Interplanetary Coronal Mass Ejection (ICME) crossing the Geomagnetic field. Here we show a method to estimated the cosmic rays affected during the FD of March of 2012 in terms of the Geomagnetic rigidity cut-off. For this, we have used the data registered at San Carlos de Bariloche, Argentina, by one of the detectors of the LAGO observatory (an extended cosmic radiation observatory over Latin American, from México to the Antartic). This detector is a water Cherenkov detector that works as muon counting, i.e. we could followed the rate of muon at ground and because these muon coming from hadronic interactions, we built a Rigidity cut-off function to estimate which primaries, according with their magnetic rigidity,were deflected

out of their track to the atmosphere. To verify this approach, we validity this function through the LAGO's toolkit ARTI, a framework of computational techniques and codes (CORSIKA, GEANT4, C++, Python), i.e. we calculated the secondaries produced by this rate of cosmic rays and then, the signal produced by those secondaries into the Geant4 detector model.

Neutrinos / 66

Machine Learning Applications to Reactor Antineutrino Detection with PROSPECT

Authors: Diego Venegas Vargas[1]; Blaine Heffron[1]

[1] *The University of Tennessee Knoxville/Oak Ridge National Laboratory*

Corresponding Authors: bheffron@vols.utk.edu, dvenega1@vols.utk.edu

The Precision Reactor Oscillation and Spectrum Experiment (PROSPECT) is an above-ground antineutrino experiment at short baselines located at the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL). This experiment's physics goals include searching for the existence of sterile neutrinos and precisely measuring the antineutrino energy spectrum. At PROSPECT, antineutrinos are detected via the inverse beta decay (IBD) interaction. This process provides a near-unique space-time correlated signal pair consisting of a positron energy deposition and a delayed neutron capture in the liquid scintillator (LS). The correlation between prompt and delayed pulses/signals is an excellent handle for background suppression. The ORNL group is currently exploring several applications of machine learning techniques for the reconstruction and analysis of antineutrino events. In this presentation, I will focus on one of these efforts which attempts to improve the current positron identification capability by identifying a subset of positrons through orthopositronium formation.

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El Sistema Global de Asimilación de Datos GDAS, para la estimación del flujo de fondo de astropartículas a nivel del suelo en la colaboración LAGO

Author: Jennifer Grisales[None]

Co-authors: Luis A. Núñez [1]; Christian Sarmiento-Cano [2]

[1] *University of Los Andes*

[2] *Universidad Industrial de Santander*

Corresponding Authors: christian.sarmiento@correo.uis.edu.co, jegrica15@gmail.com, nunez@ula.ve

Presentamos una metodología que permite obtener perfiles atmosféricos mensuales para el estudio del flujo de astropartículas a nivel del suelo, usando el Sistema Global de Asimilación de Datos GDAS. Estos perfiles pueden ser creados para para cualquier ubicación geográfica, y su implementación permitió cuantificar los efectos de las variaciones de densidad, en el flujo de partículas.

Creamos 12 perfiles mensuales para la ciudad de Bucaramanga y observamos diferencias entre estos y el perfil predeterminado por la herramienta de simulación CORSIKA. Las diferencias fueron significativas para el flujo a nivel del suelo generado por núcleos primarios, con energías entre 10 GeV y 10^6 Gev, considerando el campo magnético terrestre. Encontramos que el flujo simulado con la atmósfera predeterminada, difiere hasta por un $\approx 10\%$ del flujo mes a mes. Además, también se observa una correlación entre las variaciones de flujo y los cambios de temperatura a lo largo del año, permitiendo determinar que la implementación de estos perfiles es necesaria para obtener estimaciones más realistas incluso en regiones tropicales.

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Neutrino oscillation probabilities due to possible non-standard interactions

Authors: Andrea Carolina Barros Sarmiento[1]; Mario A Acero[2]

[1] *Universidad del Atlántico*

[2] *Universidad del Atlantico*

Corresponding Authors: marioacero@mail.uniatlantico.edu.co, acbarros@mail.uniatlantico.edu.co

In this work, we studied the modifications of the neutrino oscillation probabilities due to possible non-standard interactions (NSI) with matter (taking into account a constant matter density profile), focused on the channels ν μ ⟶ ν μ and ν μ ⟶ ν e . First, the neutrino oscillation probability in matter without NSI was studied and then we proceeded with NSI. The most relevant NSI parameters that affect the oscillation phenomenon were also studied. To carry out this study, a code was written using the MathematicaTM software, in which the Hamiltonian was defined in terms of non-standard interaction, the evolution operator and the initial and final states of the neutrinos, then the parameters Δm 231 and θ 23 were changed at 1σ and 3σ of Confidence Level (C.L) for the particular configuration of the NOν A and DUNE experiments. As a result, the ν e appearance probability is affected by the parameters ee , eμ , eτ , τ τ and μτ , and their range of allowed values are found, taking into account the current experimental oscillation measurements and uncertainties. Unlike the channel of ν e appearance, in muon neutrino disappearance channel there is only one NSI parameter that affects this probability and this is μτ that takes the range −0.07 ≤ μτ ≤ 0.07 a 1σ and −0.176 ≤ μτ ≤ 0.132 a 3σ for thet NOνA experimen and for the DUNE experiment a range was found within the values −0.032 ≤ μτ ≤ 0.032 at 1σ and −0.083 ≤ μτ ≤ 0.090 3σ of C.L.

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LFV signals with Dirac neutrinos and axions

Author: OSCAR ANDRES RODRIGUEZ CIFUENTES[1]

[1] *Universidad de Antioquia*

Corresponding Author: oscara.rodriguez@udea.edu.co

In this work we present a phenomenological analysis of a WIMP/axion dark matter model with radiatively generated neutrino masses. In this model the PQ mechanism is responsible for Dirac neutrino masses through the realization of a five-dimension effective operator at one-loop level , as well as for the stability of all mediators in the loop by means of a remaining Z 2 symmetry originating from the spontaneous breaking of the PQ symmetry. As a result, mixed WIMP-axion dark matter scenarios are obtained. The model is implemented in high energy physics packages such as SARAH, SPheno and micrOMEGAS for its study, and constraints from LFV processes and direct detection searches are used to bound the valid parameter space of the model.

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3-3-1 model with right neutrinos, implemented in SARAH and SPheno

Authors: Alex Tapia[1]; Richard Beanvides[None]

[1] *University of Medellin*

Corresponding Authors: alex.tapia.casanova@gmail.com, ribebenavides@gmail.com

In this work, for the first time the implementation of the 3-3-1 model with right-handed neutrinos without exotic electric charges in SARAH package of MATHEMATICA is presented, and it shows how it correctly reproduces the analytical results of the model. As proof of this, we present the mass matrices for the quark sectors, where a Higgs sector with three scalar triplets has been used. Then, using the SPheno program, a numerical analysis of the analytical outputs obtained with SARAH is performed; this with the objective of determining if the model with three triplets generates the mass values of all quarks adequately when comparing them with those accepted in the literature. This implementation is presented in a didactic and accessible way to students who are interested in this field of physics.

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50 years of the GIM mechanism

Corresponding Author: luciano.maiani@cern.ch

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Black Holes in the Milky Way

Corresponding Author: jlu.astro@berkeley.edu

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Gauge Theories on Quantum Computers

Corresponding Author: dberens@physics.ucsb.edu

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Higgs Physics at the LHC: status and prospects

Corresponding Author: reina.camacho@cern.ch

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Challenges for the 3-3-1 models

Corresponding Author: vicente@ift.unesp.br

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EFTs: Bounding the systematic uncertainties of the Inverse Amplitude Method

Corresponding Author: fllanes@fis.ucm.es

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Scattering Amplitudes: QCD and gravity applications

Corresponding Author: william.torres@ific.uv.es

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Neutrinoless double beta decay searches

Corresponding Author: laura.cardani@roma1.infn.it

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Neutrino oscillations

Corresponding Author: ecatanomur@wm.edu

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SM measurements

Corresponding Author: joany.andreina.manjarres.ramos@cern.ch

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Searches for Higgs boson pairs with the ATLAS detector

Corresponding Author: gabriel.palacino@cern.ch

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SUSY searches

Corresponding Author: pablo.martinez@cern.ch

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Exotica searches

Corresponding Author: begona.delacruz@ciemat.es

Dark matter / 84

Unraveling the origin of Black Holes from effective spin measurements

Corresponding Author: nicoelfisico@gmail.com

The remarkable discovery of gravitational waves from binary black hole mergers has given us a new way to study our universe. The origin of the black hole binaries remains unclear, I investigate whether information on the effective spin of binary black hole mergers from the LIGO-Virgo gravitational wave detections can be used to discriminate primordial versus astrophysical black holes. I will also present the posterior probability density for a possible mixture of astrophysical and primordial BHs as emerging from current data, and calculate the number of future mergers needed to discriminate different spin and alignment models at a given level of significance.

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Searching for dark matter emission with highly energetic cosmic messengers

Author: Óscar Macías[1]

[1] *Virginia Tech*

Corresponding Author: o.a.maciasramirez@uva.nl

Indirect dark matter detection is a powerful search method that allows to explore a very wide range of the dark matter mass spectrum. I will present our recent results in which we exploit multi-messenger astrophysical observations to explore the allowed parameter space for various archetypal dark matter candidates with masses in the range 10 GeV to 10ˆ16 GeV. Throughout my talk, I will explain our efforts to account for the systematic astrophysical uncertainties impacting our results.

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The KM3NeT Neutrino Observatory: opportunities for Latin American collaborators

Author: HAROLD YEPES RAMIREZ[1]

[1] *Yachay Tech / KM3NeT*

Corresponding Author: hyepes@yachaytech.edu.ec

The KM3NeT Neutrino Observatory is being built in two abyssal sites in the Mediterranean Sea: ARCA (IT), optimized for astrophysical neutrinos, and ORCA (FR), optimized for atmospheric neutrinos studies. The KM3NeT observatory will host the largest water Cherenkov detectors ever built

in the northern hemisphere, providing real-time and high-bandwidth connection to shore, also available for Earth and Life Sciences. ARCA will be ready to survey the sky with unprecedented angular resolution and sensitivity, providing an optimal view of the Southern sky including the Galactic Center. ORCA will provide a 3σ sensitivity on NMH after three years of exposure and competitive precision in Δm 2 32 and sin 2 θ 23 using atmospheric neutrinos. The P2O proposal to shoot a long baseline neutrino beam from the Protvino accelerator to ORCA could also open new perspectives that will be briefly addressed in this contribution, particularly, regarding δCP estimation. Dark Matter, Non-Standard Interactions, Multi-Messenger Astronomy, and Neutrino Tomography complete the KM3NeT scope. Regarding Earth and Sea Sciences programs, the abyss of the Mediterranean as site of prime interest, is used for research and long-term monitoring of geohazards, marine life and ocean dynamics.
Exciting times for Latin America scientific community are coming in Space, Earth and Sea Sciences, with the arrival of KM3NeT to the region. The construction, operation and scaling taking place nowadays are the main target of this contribution. Nonetheless, main technical aspects and calibrations of the observatory are presented, together expectations of its ambitious science programs, and some first physics results. Opportunities for Colombian collaborators are particularly motivated, looking for triggering a fore coming discussion next in time.

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The diffuse supernova neutrino background, a new window to the Universe

Author: Yuber Perez[None]

Corresponding Author: yfperezg@northwestern.edu

Since the first generation of stars, core-collapse supernovae have produced a steady flux of neutrinos, which could be detectable in the next-generation of experiments. Measuring this continuous flux, known as the diffuse supernova neutrino background (DSNB), could put novel bounds on possible beyond-the-Standard Model scenarios, such as lifetimes and oscillations expected if neutrinos are pseudo-Dirac particles. Moreover, the DNSB could teach us about cosmology and astrophysics since these neutrinos have been propagating in an expanding Universe. We will explore these possibilities in this talk.

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BSM physics program at DUNE

Corresponding Author: absousa@gmail.com

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Cosmic Rays Experiments in Latin America

Corresponding Author: asoreyh@cab.cnea.gov.ar

Cosmology / Astroparticles / 90

A guidance for building dark energy models

Corresponding Author: gabrielphysics@gmail.com

Heavy flavour / 91

Review on CPV and mixing in the charm system

Corresponding Author: alberto.correa.dos.reis@cern.ch

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Searching for flavored new physics at the LHC

Corresponding Author: jorge.martin.camalich@cern.ch

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QMexico - Latin America's role in the second quantum revolution

Authors: Andrea Delgado[1]; Andrea Delgado[None]

[1] *Texas A & M University (US)*

Corresponding Authors: delgado.andrea.21@gmail.com, andrea.delgado@cern.ch

QMexico is an organization that brings quantum computing researchers and enthusiasts from Colombia and Mexico together. Its main goal is to popularize quantum technologies and software. Also, through education and skill development opportunities, QMexico is training the next generation of quantum scientists. For this talk, we will focus on recent efforts to promote this emerging technology in Latin America through a hands-on workshop on the basics of quantum computing and the organization of QTalks, where Hispanic researchers talk about their work on the subject. We will also highlight the importance of bridging these innovative tools with high energy physics to solve some of the computational challenges facing the HEP community in the upcoming years.

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CONHEP status

Corresponding Author: carlos.sandoval@cern.ch

CONHEP / 102

LASF4RI status

Corresponding Author: restrepo@udea.edu.co

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Colaboración Arte y Ciencia

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LA-CoNGA Physics

Corresponding Author: nunez@ula.ve

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Las fronteras inexistentes entre el arte y la ciencia

Corresponding Author: danielabrillenbaer@gmail.com

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Proyectos Suratómica