MOCa 2021: Materia Oscura en Colombia

Tuesday, 8 June 2021 - Thursday, 10 June 2021

Book of Abstracts

Contents

MOCa / 1

Scalar Multiplet Dark Matter in a Fast Expanding Universe: resurrection of the *desert* region

Authors: Basabendu Barman[None]; purusottam ghosh[None]; FARINALDO queiroz[1]; Abhijit Kumar Saha[2]

[1] *International Institute of Physics -Natal*

[2] *IIT Guwahati*

Corresponding Authors: pghoshiitg@gmail.com, abhijitsaha118@gmail.com, fisicojunior3@gmail.com, basabendu88barman@gmail.com

We examine the impact of a faster expanding Universe on the phenomenology of scalar dark matter (DM) associated with $SU(2)_L$ multiplets. Earlier works with radiation dominated Universe have reported the presence of *desert* region for both inert $SU(2)_L$ doublet and triplet DM candidates where the DM is under abundant. We find that the existence of a faster expanding component before BBN can revive a major part of the *desert* parameter space consistent with relic density requirements and other direct and indirect search bounds. We also review the possible collider search prospects of the newly obtained parameter space and show that such region can be probed at the future colliders with improved sensitivity via a stable charged track.

MOCa / 2

A dark clue to seesaw and leptogenesis in a pseudo-Dirac singlet doublet scenario with (non)standard cosmology

Author: Abhijit Kumar Saha[1]

Co-authors: Ananya Mukherjee [2]; Partha Konar [3]; Sudipta Show [2]

[1] *Indian Association for the Cultivation of Science*

[2] *Physical Research Laboratory*

[3] *Physical research Laboratory*

Corresponding Authors: konar@prl.res.in, sudipta@prl.res.in, ananya@prl.res.in, abhijitsaha118@gmail.com

We propose an appealing alternative scenario of leptogenesis assisted by dark sector which leads to the baryon asymmetry of the Universe satisfying all theoretical and experimental constraints. The dark sector carries a non minimal set up of singlet doublet fermionic dark matter extended with copies of a real singlet scalar field. A small Majorana mass term for the singlet dark fermion, in addition to the typical Dirac term, provides the more favourable dark matter of pseudo-Dirac type, capable of escaping the direct search. Such a construction also offers a formidable scope to radiative generation of active neutrino masses. In the presence of a (non)standard thermal history of the Universe, we perform the detailed dark matter phenomenology adopting the suitable benchmark scenarios, consistent with direct detection and neutrino oscillations data. Besides, we have demonstrated that the singlet scalars can go through CP-violating out of equilibrium decay, producing an ample amount of lepton asymmetry. Such an asymmetry then gets converted into the observed baryon asymmetry of the Universe through the non-perturbative sphaleron processes owing to the presence of the alternative cosmological background considered here. Unconventional thermal history of the Universe can thus aspire to lend a critical role both in the context of dark matter as well as in realizing baryogenesis.

MOCa / 3

Connecting neutrino physics with dark matter

Author: Eduardo Peinado[1]

[1] *Universidad Nacional Autonoma de Mexico*

Corresponding Author: epeinado@fisica.unam.mx

TBA

MOCa / 4

Dark sector searches at Belle II

Authors: James Libby[1]; Michel Bertemes[2]

[1] *Indian Institute of Technology Madras (IN)*

[2] *Austrian Academy of Sciences (AT)*

Corresponding Authors: michel.bertemes@oeaw.ac.at, james.libby@cern.ch

The Belle II experiment at the asymmetric e^+e^- collider, SuperKEKB, is a substantial upgrade of the Belle/KEKB experiment. Belle II aims to record 50 ab^{-1} of data over the course of the project. During the first physics runs in 2018-2020, around 100 fb^{-1} of data were collected. These early data include specifically-designed low-multiplicity triggers which allow a variety of searches for light dark matter and dark-sector mediators in the GeV mass range.

This talk will present the very first world-leading physics results from Belle II: searches for the invisible decays of a new vector Z', and visible decays of an axion-like particle; as well as the near-term prospects for other dark-sector searches. Many of these searches are competitive with the data already collected or the data expected in the next few years of operation.

MOCa / 5

Improved methods for the search of inverse Compton scattering and synchrotron radiation in dwarf galaxies. The case of annihilating or decaying Dark Matter

Author: Martin Vollmann[1]

[1] *Technische Universität München*

Corresponding Author: martin.vollmann@gmail.com

In the context of cosmic-ray physics, we introduce a novel strategy for the computation of the inverse-Compton scattering (ICS) and synchrotron-radiation (SR) signals in dwarf galaxies. In particular, we identify various regimes where, in analogy to prompt gamma rays, the diffuse ICS and SR signals from dark matter annihilation/decay can be expressed as the multiplication of a halo times a spectral function. These functions are computed here for the first time for a number of benchmark cases. Our theoretical setup differs from previous work in that, instead of employing a method-of-images strategy, we consider a Fourier-mode expansion of the relevant Green's functions. With this strategy, exact results can be obtained with very low computational cost and for generic dark matter models. In particular, O(10 –100) Fourier modes can be easily incorporated into the computations in order to probe the smallest scales of the problem.

In addition, we propose a new strategy to search for dark matter using X-ray (ICS) or radio (SR) observations of dwarf galaxies that is (1) easy to implement and (2) free of the otherwise large degeneracies in the description of ICS or SR signals from dark matter.

MOCa / 6

Graviballs and Dark Matter

Author: Benjamin Guiot[1]

[1] *Universidad Tecnica Federico Santa Maria*

Corresponding Author: benjamin.guiot@usm.cl

In JHEP 11 (2020) 159, we have investigated the possible existence of graviballs, a system of bound gravitons, and show that two gravitons can be bound together by their gravitational interaction. This conclusion is consistent with older classical studies on gravitational geons. Our calculations rely on the formalism and techniques of quantum field theory, specifically on low-energy quantum gravity. By solving numerically the relativistic equations of motion, we access to the space-time dynamics of the graviball formation. The interest of our study is twofold:

1) Tree level calculations in quantum gravity are equivalent to general relativity. Consequently, the graviball is a prediction of general relativity and should exist (it shares similarities with black holes).
2) Graviballs offer a natural candidate for dark matter since they are massive and essentially invisible.

New results with more than 2 gravitons forming the graviball will be presented. We will discuss the stability of the graviball and phenomena similar to the black hole evaporation.

MOCa / 7

Distinguising dark matter from millisecond pulsars with the Cherenkov Telescope Array

Authors: Oscar Macias-Ramirez[None]; Oscar Macias[1]

[1] *University of Amsterdam*

Corresponding Authors: o.a.maciasramirez@uva.nl, oscar.maciasramirez@gmail.com

The leading explanation of the Fermi Galactic center gamma-ray excess is the extended emission from an unresolved population of millisecond pulsars (MSPs) in the Galactic bulge. Such a population would, along with the prompt gamma rays, also inject large quantities of electrons/positrons (e-e+) into the interstellar medium. These e-e+ could potentially inverse-Compton (IC) scatter ambient photons into gamma rays that fall within the sensitivity range of the upcoming Cherenkov Telescope Array (CTA). In this talk, I will highlight the unique capabilities of the Cherenkov Telescope Array to detect the expected IC signal from a putative population of 10 to 50 thousand MSPs in the center of our Galaxy. I will further show that, if an IC signal were detected, then CTA can successfully discriminate between a MSPs and a dark matter origin for the radiating e-e+.

MOCa / 8

DM EFT with Spin One Mediators

Authors: Fabiola Fortuna[1]; Pablo Roig Garcés[None]; José Wudka[None]

[1] *Cinvestav*

Corresponding Authors: ffortuna546@gmail.com, paroig@gmail.com

We analyze interactions between dark matter and standard model particles with spin one mediators in an effective field theory framework. In this paper, we are considering dark particles masses in the range from a few MeV to the mass of the Z boson. We use bounds from different experiments: Z invisible decay width, relic density, direct detection experiments, and indirect detection limits from the search of gamma ray emissions and positron fluxes. We obtain solutions corresponding to operators with antisymmetric tensor mediators that fulfill all those requirements within our approach.

MOCa / 9

Neutrino Portal to FIMP Dark Matter with an Early Matter Era

Authors: Catarina Cosme[1]; Maíra Dutra[2]; Yongcheng Wu[3]; Teng Ma[4]; Litao Yang[5]

[1] *IFIC, University of Valencia*

[2] *Carleton U.*

[3] *Oklahoma State University*

[4] *Technion - Israel Institute of Technology*

[5] *Tsinghua University*

Corresponding Author: cat.cosme.2@gmail.com

In this talk, I will discuss the freeze-in production of Feebly Interacting Massive Particle (FIMP) dark matter candidates through a neutrino portal, in the case where an early matter-dominated era took place for some period between inflation and Big Bang Nucleosynthesis. In this model, we consider a hidden sector comprised of a fermion and a complex scalar, with the lightest one regarded as a FIMP candidate, and three heavy neutrinos, responsible for mediating the interactions between the Standard Model and the dark matter sectors and for generating the masses of the Standard Model neutrinos. I will present the dynamics of the dark matter candidate throughout the modified cosmic history, evaluate the relevant constraints of the model, and discuss the consequences of the duration of the early matter-dominated era for dark matter production. Finally, I will show that, under some circumstances, this scenario becomes testable through indirect detection searches.

MOCa / 11

Gravitational SIMPs

Authors: Nicolás Bernal[1]; Basabendu Barman[None]

[1] *Universidad Antonio Nariño*

Corresponding Authors: basabendu88barman@gmail.com, nicolas.bernal@uan.edu.co

We study the impact of thermalization and number-changing processes in the dark sector on the yield of gravitationally produced dark matter (DM). We take into account the DM production through the s-channel exchange of a massless graviton both from the scattering of inflatons during the reheating era, and from the Standard Model bath via the UV freeze-in mechanism. By considering the DM to be a scalar, a fermion, and a vector boson we show, in a model-independent way, that DM self-interaction gives rise to a larger viable parameter space by allowing lower reheating temperature to be compatible with Planck observed relic abundance. As an example, we also discuss our findings in the ontext of the $\mathbb{Z}_2$-symmetric scalar singlet DM model.

MOCa / 12

Maximally misaligned axions

Author: Mario Reig[1]

[1] *Instituto de Física Corpuscular (IFIC)*

Corresponding Author: mario.reig@ific.uv.es

In this talk I will discuss a simple model of maximal axion misalignment. Maximally-misaligned axions with masses larger than 10^{-22} eV constitute an attractive DM candidate with interesting phenomenology. On the other hand, maximally-misaligned axions with masses m=O(1-100)H_0 generically behave as dark energy with a decay constant that can take values well below the Planck scale, avoiding problems associated to super-Planckian scales.

MOCa / 13

Recent Results of Dark Sector Searches with the BaBar Experiment

Author: Bertrand Echenard[1]

[1] *California Institute of Technology*

Corresponding Author: echenard@caltech.edu

Many scenarios of physics beyond the Standard Model predict new particles with masses well below the electroweak scale. Low-energy, high luminosity colliders such as BABAR are ideally suited to discover these particles. We present several recent searches for low-mass dark sector particles at BABAR, including leptophilic scalars, self-interacting dark matter, and axion like particles produced in B decays. These examples demonstrate the importance of B-factories in fully exploring low-mass new physics.

MOCa / 14

Testing freeze-in with Z' bosons

Authors: Maíra Dutra[1]; Catarina Cosme[None]; Stephen Godfrey[1]; Taylor Gray[1]

[1] *Carleton University*

Corresponding Authors: cat.cosme.2@gmail.com, taylorgray@cmail.carleton.ca, mdutra@physics.carleton.ca, godfrey@physics.carleton.ca

If dark matter particles interact too feebly with ordinary matter, they have never been able to thermalize in the early universe. Such Feebly Interacting Massive Particles (FIMPs) would be therefore produced via the freeze-in mechanism. Testing FIMPs is a challenging task, given the smallness of their couplings. In this talk, after giving a brief overview on the phenomenology of FIMPs, I will discuss our recent proposal of a Z' portal where the freeze-in can be currently tested by many experiments. In our model, Z' bosons with mass in the MeV-PeV range have both vector and axial couplings to ordinary and dark fermions. We constraint our parameter space with bounds from direct detection, atomic parity violation, leptonic anomalous magnetic moments, neutrino-electron scattering, collider, and beam dump experiments.

MOCa / 15

Search for galactic dark matter and CEvNS in reactors with liquid argon

Author: Eric Vazquez-Jauregui[1]

[1] *IF-UNAM*

Corresponding Author: ericvj@fisica.unam.mx

DEAP-3600 is a WIMP dark matter direct-detection experiment located deep underground at SNOLAB near Sudbury in Canada, which uses liquid argon as target material. This experiment has set the most stringent limits in argon. A recent study was developed using a Non-Relativistic Effective Field Theory (NREFT) to consider other dark matter-nucleon interactions. The research includes some specific interactions and isospin-violating scenarios, where world-leading limits were achieved for some model parameters. This study also analyzed the modification of the exclusion limits due to potential substructures in the local dark matter halo, motivated by the observations of stellar distributions from the Gaia satellite and other astronomical surveys.

The Scintillating Bubble Chamber (SBC) is a new technology under development ideal for both GeV-mass WIMP searches and CEvNS detection at reactor sites. A 10-kg bubble chamber using liquid argon with the potential to reach and maintain sub-keV energy thresholds is currently under construction. This detector will combine the event-by-event energy resolution of a liquid noble scintillation detector with the world-leading electron-recoil discrimination capability of the bubble chamber.

Recent results from DEAP-3600 and the status of the SBC-10kg will be presented in this talk.

MOCa / 16

Inelastic dark matter in light of the g-2 anomaly

Author: Camilo Garcia Cely[1]

[1] *Deutsches Elektronen-Synchrotron DESY*

Corresponding Author: camilo.garcia.cely@desy.de

tbd

MOCa / 17

Radiative neutrino mass models

Author: Antonio Enrique Cárcamo Hernández[1]

[1] *Universidad Técnica Federico Santa María*

Corresponding Author: antonio.carcamo@usm.cl

I will discuss some models where the masses of the light active neutrinos are radiatively generated. Mechanisms for generating the SM charged fermion mass hierarchy will also be presented. Some phenomenological aspects, such as Dark matter, charged lepton flavor violation, electron and muon anomalous magnetic moments will be discussed as well.

MOCa / 18

A Renormalizable Model for Inflation and Dark Matter

Authors: Nicolás Bernal[1]; Manuel Drees[2]; Yong Xu[2]

[1] *Centro de Investigaciones, Universidad Antonio Nariño*

[2] *Bonn U.*

Corresponding Authors: drees@th.physik.uni-bonn.de, nicolas.bernal@uan.edu.co, yongxu@th.physik.uni-bonn.de

We present a renormalizable framework to embed inflation and dark matter (DM) by extending the standard model (SM) with one gauge singlet real scalar field ϕ and one gauge singlet fermonic field χ. In our setup, the real scalar field acts as inflaton, and its potential is the most general renormalizable polynomial up to quartic term, which becomes flat due to the existence of a (near) inflection-point. The inflationary predictions agree with the latest CMB experiments very well. We also analyze reheating by considering the Higgs production via inflaton decay. In our scenario DM χ particles can be produced via decay of inflaton, freeze-in mechanism or gravitational scattering of inflaton/SM plasma depending on the model parameter considered.

MOCa / 19

Searching for atmospheric Dark Matter

Author: Víctor Muñoz[1]

[1] *IFIC, UV*

Corresponding Author: vmmunoz2@uc.cl

An interesting possibility of producing relativistic dark matter is via cosmic-ray collisions. In this talk, I will discuss the production of dark matter in cosmic-ray air-showers, which are generated in the collision of cosmic-rays with the earth's atmosphere. I will also discuss the potential of neutrino detectors for constraining this atmospheric dark matter within the context of the vector portal.

MOCa / 20

Constraints on dark matter interactions using white dwarfs

Author: Maura Ramirez[None]

Corresponding Author: elizza.rmz91@gmail.com

Dark matter has been one of the greatest paradigms in the past few decades. In this talk we discuss the capture of dark matter in compact stellar objects as complementary to direct detection searches. We particularly work with white dwarfs (WD) since they are one of the best observed compact objects proposed as cosmic laboratories for studying physical processes happening at very extreme conditions. We used an Effective Field Theory approach to describe the interactions between fermionic DM and nuclei and calculated bounds on the cut-off scale of spin-independent operators.

MOCa / 21

Effects of a hidden photon-dark matter background in axion-photon interactions

Author: Paola Arias Reyes[None]

Corresponding Author: paola.arias.r@usach.cl

In this work we investigate a scenario where the dark matter of the universe is made of light hidden photons. Thanks to a Z_2 symmetry, the kinetic mixing with the photon is forbidden and the dark photon interacts with the Standard Model only via an axion-like particle, that acts as a messenger. Focusing on signatures involving the ordinary photon, our survey of the phenomenology includes limits from cosmological stability, CMB distortions, astrophysical energy loss, light-shining-through-walls experiments, helioscopes and solar X-ray observations.

MOCa / **22**

TeV Dark Matter in radiative seesaw/scotogenic models

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. Generation of Neutrino masses can be obtained via 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.

MOCa / **23**

Astrophysical solutions in the generalized SU(2) Proca theory

Authors: Jhan Nicolás Martínez Lobo[1]; Yeinzon Rodriguez Garcia[2]; Jose Fernando Rodriguez Ruiz[None]

[1] *Universidad Industrial de Santander*

[2] *UAN & UIS (Colombia)*

Corresponding Authors: yeinzon.rodriguez@uan.edu.co, jhanmartinez_15@hotmail.com

The scalar-tensor theory introduced by Horndeski has a sound and firm basis since it avoids the Ostograski's instability. The generalized SU(2) Proca Theory, which is a vector-tensor theory where the vector content enjoys a SU(2) global symmetry, has been built following Horndeski's spirit. Such a theory exhibits interesting properties that make it a candidate to describe the primordial inflationary period while satisfying the restriction on the gravitational waves speed. At astrophysical scales, the theory needs to be validated. Here we study the spherically-symmetric case using the 't Hooft-Polyakov magnetic monopole ansatz. We found equilibrium configurations constructed from only the metric tensor and the vector field mentioned above. These configurations constitute particle-like solutions which are regular at the origin and asymptotically flat. The objects we have found are boson stars which could eventually contribute to the dark matter content of the universe.

MOCa / **24**

Revisiting sneutrino dark matter in natural SUSY scenarios

Authors: Joel Jones-Perez[1]; Werner Rudolf Porod[2]; Yang Liu[3]

[1] *PUCP*

[2] *Julius Maximilians Universitaet Wuerzburg (DE)*

[3] *U. Würzburg*

Corresponding Authors: yang.liu@uni-wuerzburg.de, jones.j@pucp.edu.pe, porod@physik.uni-wuerzburg.de

We study natural supersymmetric scenarios with light right-handed neutrino superfields, and consider the possibility of having a sneutrino as a dark matter candidate. We consider thermal and nonthermal production, taking into account freeze-out, freeze-in, and super-WIMP mechanisms. For the nonthermal case, we find that the R-sneutrino can reproduce the observed relic density by adjusting their mass and Yukawa couplings. For the thermal case, we find the need to extend the model in order to enhance sneutrino annihilations, which we exemplify in a model with an extended gauge symmetry.

MOCa / 25

Particle Astrophysics of the Galactic Center

Author: Shunsaku Horiuchi[1]

[1] *Virginia Tech*

Corresponding Author: horiuchi@vt.edu

The centers of galaxies provide promising targets to search for the nature of dark matter, but only if astrophysical emissions can be well understood. I will discuss studies of the Milky Way galactic center in pursuit of dark matter signals. I will cover a tantalizing signal, the Fermi Galactic Center Excess, and highlight the importance of astrophysical modeling to establish its validity and implications for dark matter. I will finish with some promising directions for the future.

MOCa / 26

Multicomponent dark matter and the dark photon portal

Author: Amalia Betancur Rodríguez[None]

Co-authors: Guillermo Palacio ; Andrés Fernando Castillo Ramirez [1]; Juan Suarez Gonzalez [2]

[1] *Universidad Nacional de Colombia*

[2] *Byelorussian State University (BY)*

Corresponding Authors: afcastillor@unal.edu.co, juan.suarez.gonzalez@cern.ch, gapalacic@gmail.com, amaliab2@gmail.com

We present a multicomponent subGeV dark matter model where the new dark sector particles interact with each other and the Standard Model through a dark photon. The new massive gauge boson arises from a broken U(1) dark symmetry. We will show how the relic abundance depends on the dark sector parameter space and the very important dark matter conversion channel. Moreover, we will show that experiments such as DUNE(Deep Underground Neutrino Experiment) have the potential to produce and detect these particles through dark matter-electron interactions.

MOCa / 27

VBF DM searches within Simplified Models

Author: Jose Ruiz[1]

Co-authors: Daniel Ocampo Henao [1]; ANDRÉS SANTIAGO DUQUE ESCOBAR [2]

[1] *Universidad de Antioquia (CO)*

[2] *Univesty of Antioquia*

Corresponding Authors: daniel.ocampo.henao@cern.ch, asantiago.duque@udea.edu.co, jose.ruiz@cern.ch

We study the possible Vector Boson Fusion signatures that arise from Simplified models for DM production at the LHC. We develop a strategy for looking for these signals and compare it with monojet type of searches. We show how different DM searches in simplified models are complimentary and needed to establish a full picture of DM production at the LHC.

MOCa / 28

Dark matter in a variant of the Scotogenic model

Author: Avelino Vicente[1]

[1] *IFIC - CSIC / U. Valencia*

Corresponding Author: avelino.vicente@ific.uv.es

There are many possibilities to link dark matter and neutrino masses, Scotogenic models being among the most popular options. In this talk I will discuss a variant of the Scotogenic model that includes charged fermions and a doublet with hypercharge $3/2$. In constrast with the standard Scotogenic model, only the scalar dark matter candidate is viable in this version. After presenting the model and explaining some particularities about neutrino mass generation, I will concentrate on its dark matter phenomenology, highlighting some relevant results.

MOCa / 29

On the Tau flavor of the cosmic neutrino flux

Author: Yasaman Farzan[1]

[1] *IPM*

Corresponding Author: yasaman@theory.ipm.ac.ir

Observation of high energy cosmic neutrinos by ICECUBE has ushered in a new era in exploring both cosmos and new physics beyond the Standard Model (SM). In the standard picture, although mostly ν_μ and ν_e are produced in the source, oscillation will produce ν_τ {\it en route}. Certain beyond SM scenarios, like interaction with ultralight DM can alter this picture. Thus, the flavor composition of the cosmic neutrino flux can open up the possibility of exploring certain beyond the SM scenarios that are inaccessible otherwise. We show that the τ flavor holds a special place among the neutrino flavors in elucidating new physics. Interpreting the two anomalous events observed by ANITA as ν_τ events makes the tau flavor even more intriguing. We study how the detection of the two tau events by ICECUBE constrains the interaction of the neutrinos with ultralight dark matter and discuss the implications of this interaction for even higher energy cosmic neutrinos detectable by future radio telescopes such as ARA, ARIANNA and GRAND. We also revisit the $3+1$ neutrino

scheme as a solution to the two anomalous ANITA events and clarify a misconception that exists in the literature about the evolution of high energy neutrinos in matter within the $3+1$ scheme with a possibility of scattering off nuclei.
We show that the existing bounds on the flux of ν_τ with energy of EeV rules out this solution for the ANITA events. We show that the $3+1$ solution can be saved from both this bound and from the bound on the extra relativistic degrees of freedom in the early universe by turning on the interaction of neutrinos with ultralight dark matter.

MOCa / 30

Axion quality from flavour gauge symmetries

Author: Enrico Nardi[None]

Corresponding Author: enrico.nardi@lnf.infn.it

The strong CP problem is elegantly solved by the Peccei-Quinn (PQ) mechanism, that postulates the existence of a global Abelian symmetry endowed with a mixed □(1)□□-□□(3)□ anomaly, and broken spontaneously. Implementing the PQ mechanism in UV complete models poses some challenges: (i) being anomalous, the PQ symmetry cannot be fundamental, so which is its origin? (ii) being global, it is not respected by quantum gravity corrections, so how can it remain protected? I will argue that a class of local gauge groups can automatically produce PQ symmetries with the required level of protection. Within the standard model, these symmetries would play the role of flavour symmetries, providing interesting connections between the axion quality problem and the flavour puzzle.

MOCa / 31

Indirect Searches for Secluded Dark Matter

Authors: Clarissa Siqueira[1]; Aion Viana[2]; FARINALDO queiroz[3]; Guilherme Fortes[4]

[1] *Instituto de Física de São Carlos - Universidade de São Paulo (IFSC/USP))*

[2] *MAX-PLANCK-INSTITUT FÜR KERNPHYSIK*

[3] *International Institute of Physics -Natal*

[4] *Universidade de São Paulo*

Corresponding Authors: siqueira.cms@gmail.com, aion.viana@mpi-hd.mpg.de, fisicojunior3@gmail.com

Dark matter remains one of the most important open problems in particle physics and cosmology. Weakly interacting massive particles (WIMPs) appear as an appealing solution, providing the right relic density with a cross-section at the electroweak scale, however, no WIMP signals were observed until now. Secluded models are good alternatives to the standard ones. In this case, instead of a direct annihilation into the standard model (SM) particles, the dark matter annihilates into mediators which subsequently decay into SM particles. In this way, we can avoid the stringent limits from direct searches, and, at the same time, secluded models can be probed by indirect detection experiments. Motivated by the appearance of secluded dark matter in several model building endeavors, in this talk, we will present the sensitivity of several gamma-ray instruments (current and prospects), including Fermi-LAT, H.E.S.S., CTA, and SWGO, to secluded dark matter annihilations in the inner galactic halo, and in the dwarf spheroidal galaxies, covering a wide range of possible DM masses, from tens of GeV to hundreds of TeV.

MOCa / 33

Tree level Dirac seesaw

Author: Diego Restrepo[1]

[1] *Universidad de Antioquia*

Corresponding Author: restrepo@udea.edu.co

Three-level Dirac seesaw mechanisms with fermion dark matter candidates

MOCa / 34

Fourfold Search for Dark Matter

Author: FARINALDO queiroz[1]

[1] *International Institute of Physics -Natal*

Corresponding Author: fisicojunior3@gmail.com

Dark matter complementarity is commonly thought of in terms of direct, indirect and collider searches. Indeed most dark matter models can be probed that way. However, if dark matter is very light or too heavy, or possesses velocity suppressed interactions, these techniques become not as effective. We will show that using neutron stars to realize a fourfold dark matter complementarity study we can again effectively probe the nature of dark matter.

MOCa / 35

Spin 3/2 dark matter in the radiative seesaw

Author: David Suarez-Roldan[1]

Co-author: Diego Restrepo [1]

[1] *Universidad de Antioquia*

Corresponding Authors: restrepo@udea.edu.co, david.suarezr@udea.edu.co

We propose a model with spin 3/2 fermions and vector doublets. We compute neutrino masses via radiative seesaw mechanism. We investigate the consequences of the model in the dark matter relic abundance. Furthermore, we implement the Casas-Ibarra parametrization to constraint the parameter space considering theoretical constraints. We also analyze the parameter space for direct detection of dark matter.

MOCa / 36

Freezing-in into a thermalized hidden sector.

Author: Nicolas Fernandez[1]

[1] *University of Illinois at Urbana–Champaign*

Corresponding Author: nicoelfisico@gmail.com

The standard freeze-in paradigm has a hidden UV sensitivity in that the initial DM population is assumed to be exactly zero. We explore how a pre-existing population of DM, either alone or as part of a thermalized dark sector, affects the dynamics of freeze-in. The UV sensitivity of this more general scenario, which we dub "glaciation", is manifested in the dependence of the late-time relic abundance on the size of the initial population. We dispense rather quickly with the case of a stand-alone initial DM abundance, which simply leads to an offset in the relic abundance compared to the standard scenario, but we find rich and interesting dynamics in the case of a pre-existing thermalized dark sector. Our results have important consequences for direct detection experiments searching for freeze-in dark matter.

MOCa / 37

Two-component scalar dark mater in Z_{2n} scenarios

Author: Oscar Zapata[1]

[1] *Universidad de Antioquia*

Corresponding Author: oalberto.zapata@udea.edu.co

In multi-component scalar dark matter scenarios, a single Z_N ($N \geq 4$) symmetry may account for the stability of different dark matter particles. Here we study the case where N is even ($N = 2n$) and two species, a complex scalar and a real scalar, contribute to the observed dark matter density. We show that, thanks to the new interactions allowed by the Z_{2n} symmetry, current experimental constraints can be satisfied over a wide range of dark matter masses, and that these scenarios may lead to observable signals in direct detection experiments.

MOCa / 38

Statistical approach to Clumpy dark matter detectability

Authors: Valentina Montoya Velásquez[None]; Jörg Jäckel[1]

[1] *Heidelberg University*

Corresponding Author: valentina.montoya@udea.edu.co

The inflationary production of dark matter (DM) can lead to several interesting scenarios in which DM may be homogeneously distributed or not. We are interested in studying clumpy DM and explore the characteristics of such clumps in a model independent way, orientating the analysis to the detectability of such inhomogeneities. To do so, we simulated a counting experiment and performed a statistical analysis on the resulting power spectrum, we monitored variables like time, number of total detection, clump counting event rate and got as a preliminary estimate that for clumps with overdensity rates of $\lambda_0 \geq 10$ a significance level of $\leq 5\sigma$ for the signal can be reached with $N \approx 200$ total events.

MOCa / 39

Similarities between visible and dark matter?

Author: Chee Sheng Fong[1]

[1] *UFABC*

Corresponding Author: sheng.fong@ufabc.edu.br

The similarity in the energy density between ordinary and dark matter is a curious observational fact. Perhaps they are more similar that we thought, related by a symmetry, which is slightly broken. We will explore such a possibility in the context of mirror world. In this context, we will discuss the Dirac and quasi-Dirac seesaw mechanism which explain the light neutrino mass and the simultaneous generation of visible and dark matter asymmetry. A interesting question is how these models can be verified experimentally.

MOCa / 40

Sterile neutrinos and self-interactions

Author: Walter Tangarife[1]

[1] *Loyola University Chicago*

Corresponding Author: wtangarife@luc.edu

In this talk, I will discuss the effects of self-interactions on the production of sterile-neutrino dark matter. For the case of self-interacting active neutrinos, the new interaction plays an important role in the resonant production of dark matter. We have analyzed such a scenario in the case of vector and scalar mediators. The case of self-interactions in the sterile sector provides an interesting model of self-interacting dark matter. These models serve as a well-motivated target for the upcoming experimental searches.

MOCa / 41

Fermion dark matter in scotogenic-like models

Author: Cesar Bonilla Díaz[None]

Corresponding Author: cesar.bonilla@ucn.cl

If neutrinos get their masses at the loop level, a dark sector might be involved in the mass generation mechanism as suggested by the scotogenic model. In this talk, I will review constraints and viable parameter space region for fermion dark matter candidates connected to the neutrino mass.

MOCa / 42

Production and signatures of multi-flavour dark matter scenarios

Author: Alejandro Ibarra[None]

Corresponding Author: ibarra@tum.de

We investigate the phenomenology of a dark matter scenario containing two generations of the dark matter particle, differing only by their mass and their couplings to the other particles, akin to the quark and lepton sectors of the Standard Model. For concreteness, we consider the case where the two dark matter generations are Majorana fermions that couple to a right-handed lepton and a scalar mediator through Yukawa couplings. We identify different production regimes in the multi-flavor dark matter scenario and we argue that in some parts of the parameter space the heavier generation can play a pivotal role in generating the correct dark matter abundance. In these regions, the strength

of the dark matter coupling to the Standard Model can be much larger than in the single-flavored dark matter scenario. Correspondingly the indirect and direct detection signals can be significantly boosted. We also comment on the signatures of the model from the decay of the heavier dark matter generation into the lighter.

MOCa / 43

Cosmological hydrodynamics simulations of the same spiral galaxies: connecting the dark matter distribution of the halo with the subgrid baryonic physics

Authors: Arturo nunez-Castineyra[1]; Emmanuel Nezri[2]; Pol Mollitor[3]

[1] *CEA, Saclay. Universite de Paris*

[2] *CNRS*

[3] *Laboratoire d'Astrophysique de Marseille*

Corresponding Authors: emmanuel.nezri@lam.fr, pol.mollitor@lam.fr, arturo.nunez@cea.fr

Baryonic physics i.e. star formation and stellar feedback are debated topics in galaxy formation and are of paramount importance for dark matter phenomenology. Particularly, the dark matter (DM) distribution features that play the main role in dark matter detection efforts.
In this work, we aim to illustrate the reach of baryonic-physics-related uncertainties on the dark matter distribution features in a Milky-Way (MW) sized halo. To this end, we study the halo morphology, geometry and profile, together with the phase space distribution on the same MW-sized dark matter halo simulated using different combinations of baryonic physics and one case including only DM. In these six high-resolution zoom-in cosmological simulations we found that the modifications of the gravitational potential induced by the central population of baryons induce different dark matter distributions, modifying the mass-density and velocity profiles. The variability and uncertainties on those features can have a direct impact on dark matter direct and indirect detection rates. As a consequence, we highlight the fact that most predictions using cosmological simulations have to be taken with caution as the dark matter distribution will change depending baryonic physics.

MOCa / 45

Neutrinos as a probe for new physics

Author: Diego Aristizabal[1]

[1] *Universidad Tecnica Federico Santa Maria (USM)*

Corresponding Author: daristi@gmail.com

Measurements of coherent elastic neutrino-nucleus scattering and neutrino-electron elastic scattering provide an useful tool to test neutrino properties at low thresholds. Stopped-pion neutrino sources as well as reactor and solar neutrinos can induce such signals. After a basic introduction to the subject, I will briefly mention various measurements and physics cases that could be studied at COHERENT and dark matter direct detection experiments. I will emphasize on prospects for measurements of neutrino magnetic moments.

MOCa / 46

Hunting for Dark Matter at LHC

Author: Niki Saoulidou[1]

[1] *National and Kapodistrian University of Athens (GR)*

Corresponding Author: niki.saoulidou@cern.ch

We will present ATLAS and CMS searches for dark matter particles, mediators, as well as dark sector extensions. We will cover analyses using several different final states, topologies, and kinematic variables utilizing partial but also full Run-II data-sets collected at the LHC. We will finish with an overview and an outlook towards Run III and beyond.

MOCa / 47

Modeling the Distribution of Galaxies in the Universe with N-body Simulations of Dark Matter

Author: Andreas Berlind[None]

Large astronomical surveys have allowed us to map the spatial distribution of galaxies on large scales. Measurements of galaxy clustering contain valuable information about cosmology and the physics of galaxy formation, but to extract this information we need accurate models that are based on computationally expensive N-body simulations of dark matter. I will describe our work to measure and model galaxy clustering using these simulations and I will discuss our ongoing efforts to potentially replace expensive simulations with AI techniques.

48

Closing remarks

MOCa / 49

Singlet fermion dark matter and Dirac neutrinos from Peccei-Quinn symmetry

Author: Óscar Rodríguez[1]

[1] *Universidad de Antioquia*

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

In this work we study the one-loop realizations of the d = 5 operator $\bar{L}\tilde{H}N_RS$ that leads to Dirac neutrino masses, where S is a singlet scalar field that hosts the QCD axion, N_R represents three right-handed neutrinos, L is the lepton doublet and H is the SM Higgs boson. As usual, the axion arises from the breaking of the Peccei-Quinn symmetry, which in our setup we use to not only solve the strong CP problem, but also to forbid the operator $\bar{L}\tilde{H}N_RS$ (which generates Dirac neutrino masses at tree level) and the tree-level realizations of $\bar{L}\tilde{H}N_RS$. Thus, the neutrino masses are directly correlated to the axion mass (via the PQ symmetry breaking scale v_S) and their smallness is due to the radiative character besides the mass suppression of the loop mediators. Furthermore, the PQ symmetry breaking leaves a residual Z_N symmetry that allow us to guarantee the stability of the lightest of the
mediators in the one-loop neutrino mass diagrams (as happens in the scotogenic models), thus leading naturally to multicomponent DM scenarios with axions and WIMPs. We illustrate our proposal

by considering a specific model, where simple numerical estimates allow us to show the effectiveness of the scheme regarding neutrino masses, DM and lepton flavor violating processes.