DISCRETE 2022

Report of Contributions

Contribution ID: **1** Type: **Talk**

Axion and FIMP Dark Matter in a $U(1)$ extension of the Standard Model

Tuesday, November 8, 2022 2:00 PM (15 minutes)

In the Standard Model a Dark Matter candidate is missing, but it is relatively simple to enlarge the model including one or more suitable particles.
We consider in this paper one such extension, inspired by simplicity and by the goal to solve more than just the Dark Matter issue.
Indeed we consider a local $U(1)$ extension of the SM providing an axion particle to solve the strong CP problem and including RH neutrinos with appropriate mass terms. One of the latter is decoupled from the SM leptons and can constitute stable sterile neutrino DM.
In this setting, the PQ symmetry arises only as an accidental symmetry but its breaking by higher order operators is sufficiently suppressed to avoid introducing a large θ contribution.
The axion decay constant and the RH neutrino masses are related to the same v.e.v.s and the PQ scale and both DM densities are determined by the parameters of the axion and scalar sector.
The model predicts in general a mixed Dark Matter scenario with both axion and sterile neutrino DM and is characterised by a reduced density and observational signals from each single component.

Authors: KHAN, Sarif (University of Goettingen); Prof. COVI, Laura (University of Goettingen)

Presenter: KHAN, Sarif (University of Goettingen)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **2** Type: **Talk**

CP symmetry test at J-PET

Wednesday, November 9, 2022 2:00 PM (15 minutes)

The Jagiellonian Positron Emission Tomograph (J-PET) is a detector for tests of discrete symmetries as well as for medical imaging. The novelty of the system is based on usage of plastic scintillators for active detection material and trigger-less data acquisition system. The apparatus consists of 192 plastic scintillators read out from both ends with vacuum tube photomultipliers. Positronium being an eigenstate of both the C and P operators is an unique probe to test the CP symmetry. This test is based on determination of polarization of photons from positronium annihilation. This allows exploration of a new class of discrete symmetry odd operators that were not investigated before. The novelty of the experimental setup is based on usage of plastic scintillators as active detection material and trigger-less data acquisition system. In the talk we describe a preliminary result of CP symmetry test at the precision level of 10^{-4} in a whole available phase-space and experimental techniques developed by the J-PET collaboration.

Author: CZERWIŃSKI, Eryk (Jagiellonian University, Poland)

Presenter: CZERWIŃSKI, Eryk (Jagiellonian University, Poland)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **3** Type: **Talk**

Precision measurements with Kaons at CERN

Wednesday, November 9, 2022 4:15 PM (15 minutes)

The NA62 experiment at CERN collected the world's largest dataset of charged kaon decays in 2016-2018, leading to the first measurement of the branching ratio of the ultra-rare K+ –> pi+ nu nu decay, based on 20 candidates.
The radiative kaon decay K+ → pi0e+vg (Ke3g) was studied with a data sample of O(100k) Ke3g candidates with sub-percent background contaminations recorded in 2017-2018. The most precise measurements of the branching ratio and of T-asymmetry are achieved.
An analysis of the flavour-changing neutral current K+ -> pi+ mu+ mu- decay, based on about 27k signal events with negligible background contamination collected in 2017 and 2018 with a dedicated pre-scaled di-muon trigger, leads to the most precise determination of the branching ratio and of the form factor.
New preliminary results are obtained from an analysis of the K+ -> pi+ gamma gamma decay using data collected in 2016—2018 with a minimum-bias trigger. The sample, about 15 times larger than the previous largest one, leads to an unprecedented sensitivity. This analysis can be naturally extended to search for the K+ -> pi+ a, a -> gamma gamma process, where a is a short-lived axion-like particle.
An overview of the latest NA62 results and the future prospect of the experiment are presented.
The first observation of the decay K± → π0 π0 μ± ν (K00μ4) by the NA48/2 experiment at the CERN and the preliminary measurement of the branching ratio are also presented. The result is converted into a first measurement of the R form factor in Kl4 decays and compared with the prediction from 1-loop Chiral Perturbation Theory.

Authors: CENCI, Patrizia (INFN Perugia (I)); OTHER SPEAKER

Presenter: PERUZZO, Letizia (CERN NA62)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **4** Type: **Talk**

Physics beyond the SM with the NA62 experiment at CERN

Wednesday, November 9, 2022 4:30 PM (15 minutes)

The NA62 experiment at CERN took data in 2016–2018 with the main goal of measuring the K+ -> pi+ nu nubar decay. The high-intensity setup and detector performance make NA62 particularly suited for searching new-physics effects from different scenarios involving feebly interacting particles in the MeV—GeV mass range.
Searches for K+⟶e+N, K+⟶μ +N and K+⟶μ+νX decays, where N and X are massive invisible particles, are performed by NA62. The N particle is assumed to be a heavy neutral lepton, and the results are expressed as upper limits of O(10−8)of the neutrino mixing parameter |Uμ4|2. The X particle is considered a scalar or vector hidden sector mediator decaying to an invisible final state. Upper limits of the decay branching fraction for X masses in the range 10–370 MeV/c2 are reported. An improved upper limit of 1.0 x 10−6 is established at 90% CL on the K+⟶μ+νν branching fraction.
Dedicated trigger lines were employed to collect dilepton final states, which allowed establishing stringent upper limits on the rates lepton flavor and lepton number violating kaon decays. Upper limits on the rates of several K+ decays violating lepton flavour and lepton number conservation, obtained by analysing this dataset, are presented.
The NA62 experiment can also be run as a beam-dump experiment, by removing the Kaon production target and moving the upstream collimators into a “closed”position. Analyses of the data taken in beam-dump mode were performed to search for visible decays of exotic mediators, with a particular emphasis on Dark Photon Models.

Authors: CENCI, Patrizia (INFN Perugia (I)); OTHER AUTHOR

Presenter: PERUZZO, Letizia (CERN NA62)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **5** Type: **Talk**

Recent Belle II results related to lepton universality and flavour violation

Tuesday, November 8, 2022 2:45 PM (15 minutes)

This talk presents recent Belle II results on lepton flavor universality and flavour violation tests using B meson and tau decay.
The low-background collision environment along with the possibility of partially or fully reconstructing one of the two B mesons in the event offer high precision measurements of B decays or rare decays with missing energy. Results from semileptonic and electroweak penguin decay will be discussed. Similar advantages exist for rare tau decay searches. A search for the lepton number violating decays tau -> l alpha is also presented.

Author: LIBBY, Jim (IIT Madras)

Presenter: HOHMANN , Marcel (U Melbourne)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **6** Type: **Talk**

Top quark physics with the ATLAS experiment at the LHC

Tuesday, November 8, 2022 2:00 PM (15 minutes)

The large top quark samples in top quark pair and single top production have yielded measurements of the production cross section of unprecedented precision and in new kinematic regimes. They have also enabled new measurements of top quark properties that were previously inaccessible, enabled the observation of many rare top quark production processes predicted by the Standard Model and boosted searches for flavour- changing-neutral-current interactions of the top quark, that are heavily suppressed in the SM. In this contribution the highlights of the ATLAS top quark physics program are presented. ATLAS presents in particular new measurements of the production cross section and production asymmetry of highly boosted top quark pairs and of the top quark polarization in t-channel single top production. The recent observation of associated production of a single top quark with a photon completes the list of processes and adds sensitivity to the EW couplings of the top quark. ATLAS furthermore reports strong evidence for the four-top-production process. Strict bounds are also presented of searches for flavour-changing-neutral-current processes involving top quarks.

Author: ROMANO, Marino (Bologna (ATLAS))

Presenter: ROMANO, Marino (Bologna (ATLAS))

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **7** Type: **Talk**

Searching for new symmetries in the Higgs sector at ATLAS

Wednesday, November 9, 2022 2:00 PM (15 minutes)

The discovery of the Higgs boson with the mass of 125 GeV confirmed the mass generation mechanism via spontaneous electroweak symmetry breaking and completed the particle content predicted by the Standard Model. Even though this model is well established and consistent with many experimental measurements, it is not capable of solely explaining some observations. Many extensions of the Standard Model introduce additional scalar fields to account for the electroweak symmetry breaking and thereby extra Higgs-like bosons, which can be either neutral or charged. This talk presents recent searches for additional low- and high-mass Higgs bosons, as well as decays of the 125 GeV Higgs boson to new light scalar particles, using LHC collision data at 13 TeV collected by the ATLAS experiment in Run 2.

Author: DUDA, Dominik (MPI Munich (ATLAS))

Presenter: DUDA, Dominik (MPI Munich (ATLAS))

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **8** Type: **Talk**

Recent searches for new phenomena with the ATLAS detector

Tuesday, November 8, 2022 2:15 PM (15 minutes)

Many theories beyond the Standard Model (BSM) have been proposed to address several of the Standard Model shortcomings, such as the origin of dark matter and neutrino masses, the fine-tuning of the Higgs boson mass, or the observed pattern of masses and mixing angles in the quark and lepton sectors. Many of these BSM extensions predict new particles or interactions directly accessible at the LHC. This talk will present some highlights on recent searches based on the the full Run 2 data collected by the ATLAS detector at the LHC with a centre-of-mass energy of 13 TeV. These include searches for leptoquarks and vector-like fermions, new high mass resonances and lepton flavour violating decays, dark sector searches, as well as searches for new phenomena giving unconventional and/or long-lived particle signatures.

Author: FRANCHINI, Matteo (University of Bologna (IT))

Presenter: FRANCHINI, Matteo (University of Bologna (IT))

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **9** Type: **Talk**

Photon-photon fusion and tau g-2 measurement

Wednesday, November 9, 2022 4:30 PM (15 minutes)

High statistics measurements of light-by-light scattering, made accessible using relativistic heavy-ion beams provide a precise and unique opportunity to investigate extensions of the Standard Model, such as the presence of axion-like particles. This talk presents a series of measurements of such processes performed by the ATLAS Collaboration. New measurements of exclusive dilepton production (electron, muon, and tau pairs) are discussed. Furthermore, the tau-pair production measurements can constrain the tau lepton's anomalous magnetic dipole moment. Presented measurements of muon pairs produced via two-photon scattering processes in hadronic Pb+Pb collisions provide a novel test of strong-field QED by exploiting correlations between the lepton pair and second-order event-plane, which can potentially be a sensitive electromagnetic probe of the quark-gluon plasma. Results are compared with recent theory calculations.

Author: SCHMIEDEN, Kristof (Johannes Gutenberg Universitaet Mainz (DE))

Presenter: SCHMIEDEN, Kristof (Johannes Gutenberg Universitaet Mainz (DE))

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **10** Type: **Talk**

Higgs boson property measurements at the ATLAS experiment

Wednesday, November 9, 2022 2:15 PM (15 minutes)

Very detailed measurements of Higgs boson properties can be performed with the Run 2 13 TeV pp collision dataset collected by the ATLAS experiment. This talk presents a review of the latest measurements of the Higgs boson properties, including its mass, CP, and differential cross-sections. Furthermore, couplings, including self-coupling measurement using Higgs pair production, combining measurement targeting various production modes and decay channels are reported. Specific results on production mode cross sections, Simplified Template Cross Sections, and their interpretations are presented. These measurements are used to test specific scenarios of physics beyond the Standard Model, as well as its extension in the framework of Effective Field Theories.

Author: KITSAKI, Chara (National Technical Univ. of Athens (GR))

Presenter: KITSAKI, Chara (National Technical Univ. of Athens (GR))

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **11** Type: **Talk**

The NA64-e experiment at CERN

Wednesday, November 9, 2022 4:45 PM (15 minutes)

One of the most compelling arguments motivating the search for physics beyond the Standard Model (SM) is the need to explain the nature of Dark Matter (DM). Despite an extensive experimental program that combined direct, indirect, and detection at colliders, to date, no conclusive results about DM particle nature have been determined. Among the DM theories, DM particles in the mass range 1 MeV - 1000 MeV (also called Light Dark Matter or LDM) represent a theoretically well-grounded option if a new DM-SM interaction mechanism is introduced. A simple hypothesis is based on the introduction of a new vector boson (Dark Photon or A') interacting with the SM photon (through a feeble kinetic mixing) and with the DM particles. In this scenario, the A' can be generated by the interactions of charged particles with ordinary matter and subsequently decays into LDM particle pair.

The NA64-e experiment at CERN exploits the 100 GeV SPS electron beam impinging on a thick active target (an electromagnetic calorimeter) to measure the energy deposited by each incoming particle. If an A' is produced in the target, the LDM daughter particles leave the detector without further interactions, resulting in a measurable "missing energy", defined as the difference between the beam and the measured "visible" energy. In this context, NA64 searches for large-missing-energy events in which a null activity in the downstream veto systems is detected. To date, NA64 has collected 2.84×10^{11} electrons on target. Zero events with missing energy > 50 GeV and no activity within the veto systems were observed. These results allowed the collaboration to set the most competitive limits in the LDM parameter space.

Recently, a missing energy measurement with a positron-beam has also been considered in NA64-e, connected to the POKER (POsitron resonant annihilation into darK mattER) ERC project. The use of a positron beam allows strongly enhancing LDM production by exploiting the electron-positron annihilation process. This also provides a clean signal signature associated with the underlying resonant reaction dynamics, translating into a peak the missing energy distribution whose position depends solely on the mass of the A'. The growing interest in this new approach motivated the NA64 collaboration to perform a preliminary feasibility study running the experiment with a 100 GeV positron beam in the current experimental setup.

This talk will present the latest NA64-e results, including an update regarding the positron beam run, and the plans for the future activities.

Author: BISIO, Pietro (INFN-Genova)

Presenter: BISIO, Pietro (INFN-Genova)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **12** Type: **Talk**

Probing the early universe with displaced new physics at colliders

Wednesday, November 9, 2022 4:15 PM (15 minutes)

Displaced events at colliders are a promising way, and in a large region of the parameter space the only way, to test feebly interacting particles, for instance produced through freeze-in. However, if one assumes freeze-in production happens in the standard cosmological history, these decays happen inside the detector only if the dark matter is very light because of the relic density constraint. Here, we argue how displaced events could very well point to freeze-in within a non-standard early universe history. Focusing on the cosmology of inflationary reheating, we explore the interplay between the reheating temperature and collider signatures for minimal freeze-in scenarios. Observing displaced events at the LHC would allow to set an upper bound on the reheating temperature and, in general, to gather indirect information on the early history of the universe.

Author: JUNIUS, Sam (ULB & VUB)

Presenter: JUNIUS, Sam (ULB & VUB)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **13** Type: **Talk**

Hybrid scoto/seesaw: flavour and dark matter

Wednesday, November 9, 2022 4:15 PM (15 minutes)

I will present our recent work (arXiv:2204.13605 [hep-ph]) based on a hybrid type-II seesaw/scotogenic model supplemented with a discrete flavour symmetry where CP is dynamically generated by the vacuum. Namely, we analyse compatibility with low-energy neutrino observables, review the charged lepton flavour violation implications and study the scalar and fermionic dark matter phenomenology of our framework.

Authors: Mrs BARREIROS, Debora (CFTP/IST, U. Lisboa); BRITO CÂMARA, Henrique (CFTP/IST, U. Lisboa); FELIPE, Ricardo (CFTP/IST, U. Lisboa and ISEL); Prof. JOAQUIM, Filipe (CFTP/IST, U. Lisboa)

Presenter: BRITO CÂMARA, Henrique (CFTP/IST, U. Lisboa)

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **14** Type: **Talk**

Exploring dark matter models with global fits

Tuesday, November 8, 2022 2:30 PM (15 minutes)

The nature of Dark Matter is one of the most fundamental questions of our day, and many new physics models have been developed to accommodate it. In spite of the considerable amount of experiments built to detect Dark Matter particles, none of them have yet provided significant evidence, and thus many of the models of dark matter are severely constrained. Understanding the status of these models in light of the experimental data then becomes a daunting task of exploring systematically and thoroughly their parameter spaces. Global fits are thus the ultimate strategy for this goal, as they provide efficient sampling of multidimensional parameter spaces and combine all constraints in a rigorous statistical manner. In this talk I will present the results of global studies on various models of dark matter: Higgs portal models, simplified models and an effective field theory of dark matter.

Author: GONZALO, Tomas (KIT)

Presenter: GONZALO, Tomas (KIT)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **15** Type: **Talk**

B-anomalies in a twin Pati-Salam theory of flavour

Tuesday, November 8, 2022 2:30 PM (15 minutes)

The vector leptoquark $U_1(3,1,2/3)$ is the only single mediator which can simultaneously address the anomalies in B-physics. Remarkably, such explanation of the B-anomalies requires a hierarchy in the U_1 couplings which may be connected with the well-known hierarchies in the masses of the SM fermions. In this direction, a twin Pati-Salam model was recently proposed, in which the U_1 couplings and the SM Yukawa couplings find a common origin via mixing of chiral quarks and leptons with vector-like fermions, providing a direct link between the B-anomalies and the fermion masses and mixing. I will present a simplified version of the model with three vector-like fermion families, in the massless first family approximation, and show that the second and third family charged fermion masses and mixings and the B-anomalies can be simultaneously explained and related. I will show that the model recovers the phenomenology of 4321 models at low-energies, being compatible with all known low-energy data, and I will highlight predictions in promising observables such as $\tau \to 3\mu$, $\tau \to \mu\gamma$ and $B \to K^{(*)}\nu\bar{\nu}$ at Belle II and LHCb. Finally, I will discuss high-p_T signals of the rich spectrum of new particles at the TeV scale, comprising the vector leptoquark U_1, a coloron g' and Z', as well as vector-like quarks and leptons with masses also around the TeV scale.

Author: FERNÁNDEZ NAVARRO, Mario (University of Southampton)

Co-author: Prof. KING, Stephen F. (University of Southampton)

Presenter: FERNÁNDEZ NAVARRO, Mario (University of Southampton)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **16** Type: **Talk**

Entangled neutral kaons as a tool for precision tests of CPT symmetry and Quantum Mechanics from KLOE-2

Wednesday, November 9, 2022 2:45 PM (15 minutes)

The process $\phi \to K_S K_L \to \pi^+\pi^-\pi^+\pi^-$ exhibits the characteristic Einstein–Podolsky–Rosen correlation that prevents both kaons to decay into pairs of charged pions at the same time. This constitutes a formidable tool to test with high precision the quantum coherence of the entangled kaon state, and to search for tiny deviations from the quantum mechanical prediction that may arise in a quantum gravity scenario. The fit to the observed difference of the kaon decay times with decoherence and CPT violation parameters of various phenomenological models will be discussed. The results, based on data sample of about 1.7 fb^{-1} (~ 1.7 $\times 10^9 \phi \to K_S K_L$ decays) collected with the KLOE detector at DAΦNE, are consistent with no deviation from quantum mechanics and CPT symmetry violation. The measurement technique together with specific data analysis chain will be presented.

Author: Prof. WIŚLICKI, Wojciech (NCBJ, Poland)

Presenter: Prof. WIŚLICKI, Wojciech (NCBJ, Poland)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **17** Type: **Talk**

First direct tests of T and CPT symmetries in transitions of neutral kaons from KLOE-2

Wednesday, November 9, 2022 2:30 PM (15 minutes)

The comparison of neutral K-meson transition rates between flavour and CP eigenstates is used to perform independent tests of time-reversal T, CP and CPT symmetries. The analysis of 1.7 fb^{-1} of KLOE data acquired at the DAΦNE e^+e^- collider, using ratios of rates of the two classes of processes, $K_S K_L \to \pi^\pm e^\mp \nu, 3\pi^0$ and $K_S K_L \to \pi^+\pi^-, \pi^\pm e^\mp \nu$, provides the first direct and model independent tests of T and CPT symmetries in transitions of neutral kaons.

Author: Dr SILARSKI, Michał (Jagiellonian University, Poland)

Presenter: Dr SILARSKI, Michał (Jagiellonian University, Poland)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **18** Type: **Talk**

Recent results about lepton flavor universality violation at LHCb

Tuesday, November 8, 2022 2:15 PM (15 minutes)

The study of lepton flavor universality violation (LFUV) plays an important role in search for new physics beyond standard model and has recently provided some anomalous results. Benefiting from the large datasets available at LHCb, many such measurements have been performed. Some of these measurements have very good precision and play a leading role in their respective world average values. In this talk, I will introduce recent LFUV results from LHCb, with more focus on processes with b->clv transition.

Author: FANG, Bo (IJCLab(FR))

Presenter: FANG, Bo (IJCLab(FR))

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **19** Type: **Talk**

Outer Automorphism Anomalies

Tuesday, November 8, 2022 4:45 PM (15 minutes)

We discuss anomalies associated with outer automorphisms in gauge theories based on classical groups, namely charge conjugations for SU(N) and parities for SO(2r). We emphasize the inequivalence between two versions of charge conjugation for SU(N) symmetries, and also two versions of parity for SO(2r) symmetries. The subgroups that commute with the outer automorphisms are identified. Some charge conjugations can lead to a paradox, which is resolved by the observation that they are anomalous and hence not symmetries. We then discuss anomaly matching conditions that involve the charge conjugations or parities. Interesting examples are given where the charge conjugation is spontaneously broken.

Author: MELIA, Tom (Kavli IPMU)

Presenter: MELIA, Tom (Kavli IPMU)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **20** Type: **Talk**

Cosmological constraints on decaying axion-like particles

Tuesday, November 8, 2022 2:15 PM (15 minutes)

Future cosmological probes promise significant progress in probing the dark universe and the related fundamental particles. Their impact is most powerful when we combine cosmological data with astrophysical observations and laboratory experiments. While computational tools are available for such studies, the large number of model parameters and ensuring consistency between data sets can present difficult challenges.
In this talk, I will show how the global-fitting framework GAMBIT can be used to constrain non-thermal axion-like particles (ALPs) with keV-to-MeV masses that decay into photons. For the first time we combine various cosmological and astrophysical constraints in a joint likelihood approach. This ensures the consistency of assumptions and allows us to investigate the entire multi-dimensional parameter space instead of fixing some parameters to benchmark values.
Leaving the ALP abundance and reheating temperature as free parameters, we identify and reopen still viable ALP parameter space – even slightly improving BBN observables compared to standard cosmology. In this context, I will comment on the additional constraining power from future spectral distortion missions. Our findings demonstrate the important complementarity of astrophysical and cosmological data and encourage the extension of our analysis to models with ALP-matter couplings.

Authors: BLOOR, Sanjay; BALÁZS, Csaba; GONZALO, Tomas (KIT); HANDLEY, Will; HOOF, Sebastian (Karlsruher Institut für Technologie); KAHLHOEFER, Felix (KIT); LECROQ, Marie; MARSH, David J. E.; RENK, Janina; SCOTT, Pat; STÖCKER, Patrick

Presenter: HOOF, Sebastian (Karlsruher Institut für Technologie)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **21** Type: **Talk**

Search for New Resonance in the photon and jet final state using CMS data

Tuesday, November 8, 2022 3:00 PM (15 minutes)

To address the incompleteness of the Standard Model (SM), many models, e.g compositeness, extra dimensions, have predicted the existence of new resonances at the LHC in the final state of a photon and a jet. If such a resonance exists, the signal would appear as a bump on top of the smooth invariant mass distribution of the SM background processes. A search is presented for new resonances decaying to a photon and a jet in proton-proton collisions at a center-of-mass energy of 13 TeV using the data collected by the CMS experiment between 2016 and 2018, corresponding to an integrated luminosity of 138 fb-1

Author: BABBAR, Jyoti

Presenter: BABBAR, Jyoti

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **22** Type: **Talk**

Improved test of CPT invariance in ortho-positronium decays at J-PET

Wednesday, November 9, 2022 2:15 PM (15 minutes)

Search for violation of the symmetry under combined transformation of charge, parity and time reversal in charged leptonic sector can be tested through the non-vanishing expectation value of certain angular correlation operators that are odd under CPT transformation. In this talk we will discuss the experimental approach for a CPT symmetry test by measuring angular correlations between the spin and momenta of photons originating from ortho-positronium (o-Ps$\rightarrow 3\gamma$) decays. This experiment is performed with the J-PET detector which measures a broad range of kinematical configurations of ortho-positronium annihilation into three photons and is the first experiment to determine the full range of the CPT-odd angular correlation. In the first part of the talk, we will present how a novel technique to estimate the spin of ortho-positronium and momenta of annihilation photons for single recorded ortho-positronium event allowed J-PET to measure the expectation value of CPT symmetry odd angular correlation operator at the precision level of 10^{-4}, a factor of three better than the best known previous experimental result. The second part of talk will focus on the new measures and perspectives for J-PET in improving the sensitivity to CPT violating effects beyond the level of 10^{-4} by increasing the efficiency for detection of photons from ortho-positronium decays by means of using a new 24 Modular J-PET detector and spherical annihilation chamber.

Author: CHUG, Neha

Presenter: CHUG, Neha

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **23** Type: **Talk**

Anatomy of scalar mediated proton decays in SO(10) models

Any grand unified model is plagued with particles capable of inducing proton decay. Identifying all potential scalar proton decay mediators stemming from different irreducible representations of SO(10), we will show their coupling with the Standard Model fermions, tree-level contributions of the effective strength of $B-L$ conserving($d=6$), and $B-L$ violating($d=7$) operators to proton decay width expression. Through the computed branching ratio of various decay modes of proton in a realistic SO(10) model based on 10_H and $\overline{126_H}$, we will enumerate distinct features of scalar mediated proton decay including bound on the mass of the proton decay mediators.

Authors: Dr PATEL, Ketan M. (Physical Research Laboratory); KUMAR SHUKLA, Saurabh (Physical Research Laboratory)

Presenter: KUMAR SHUKLA, Saurabh (Physical Research Laboratory)

Session Classification: Atoms, nuclei, molecules, and spectroscopy

Track Classification: All

Contribution ID: **24** Type: **Talk**

The cyclic symmetries in the representations of unitary discrete subgroups

Tuesday, November 8, 2022 4:45 PM (15 minutes)

Dark matter may be stable because of a conserved Z_p (cyclic) symmetry. Usually p is assumed to be 2, but it may also be larger than 2.

This Z_p is usually assumed to be in a direct product with some other symmetry group. The full symmetry group of the theory is then G = Z_p x G'. We suggest another possibility.

Many discrete subgroups of U(n), for any n > 2, have a non-trivial center Z_p, even if they are not the direct product of that Z_p with some other group. When that happens, the irreducible representations (irreps) of the group may either represent all the elements of that Z_p by the unit matrix, or else they may represent that Z_p faithfully. If ordinary matter is placed in a representation where Z_p is represented by 1, and dark matter is placed in irreps that represent Z_p faithfully, then dark matter is stabilized by that Z_p.

We have scanned all the discrete groups in the SmallGroups library with order <2000 that are not the direct product of a cyclic group with some other group. We have determined their centers and whether they are subgroups of one or more groups SU(n) or U(n). We have found that very many groups, especially subgroups of U(n) but not of SU(n), have non-trivial centers Z_p, mostly with p of the form 2^a times 3^b but also with other values of p.

Author: JURCIUKONIS, Darius (VU TFAI)

Co-author: Dr LAVOURA, Luis (CFTP, University of Lisbon)

Presenter: JURCIUKONIS, Darius (VU TFAI)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **25** Type: **Talk**

Influence of the Lorentz invariance violating interactions on discovery of CP violation and octant sensitivity at T2HK/T2HKK

We study the effect of Lorentz invariance violating(LIV) parameters on the discovery of the non-zero CP phase (δ_{13}) and the octant of 2-3 mixing angle (θ_{23}) in the neutrino sector in the context of the proposed T2HK/T2HKK experiments. We consider the CPT violating case and taking one LIV parameter at a time, investigate to what extent the CP discovery and octant determination potential are affected in presence of this new physics. TH2K has two detectors at 295 Km baseline which corresponds to the first oscillation maxima at a peak energy of 0.6 GeV while T2HKK has one at 295 Km and one at 1100 Km with the latter corresponding to the second oscillation maxima at peak energy. We study the synergies between the appearance and the disappearance channels as well as between the first and the second oscillation maxima and explore if these can result in enhanced sensitivity.

Authors: Mr PAN, Supriya (Physical Research Laboratory, Ahmedabad); Dr CHAKROBORTY, Kaustav; Prof. GOSWAMI, Srubabati (Physical Research Laboratory)

Presenter: Mr PAN, Supriya (Physical Research Laboratory, Ahmedabad)

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **26** Type: **Talk**

Higgs measurements from CMS

Wednesday, November 9, 2022 2:30 PM (15 minutes)

The data collected by CMS during the LHC Run 2 allow measuring many properties of the Higgs boson. We will review in this talk the recent results from CMS. They include fiducial and differential cross-section measurements, also in the STXS framework, and measurements of di-Higgs production. They can be interpreted in terms of coupling and charge-parity measurements, or in the effective field theory framework.

Author: TREVISANI, Nicolo (KIT - Karlsruhe Institute of Technology (DE))

Presenter: TREVISANI, Nicolo (KIT - Karlsruhe Institute of Technology (DE))

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **27** Type: **Talk**

Neutrino mass hierarchy from the discrete dark matter model

Wednesday, November 9, 2022 2:45 PM (15 minutes)

We explore a possible explanation for the hierarchy in scale between the atmospheric and solar neutrino mass differences ($|\Delta m^2_{31}|$ and Δm^2_{21})
through the presence of two distinct neutrino mass mechanisms from tree-level and one-loop-level contributions. We demonstrate
that the ingredients needed to explain this hierarchy are present in the minimal discrete dark matter mechanism. This scenario is characterized by adding new RH neutrinos and $SU(2)$ scalar doublets to the Standard Model as triplet representations of an A_4 flavour symmetry. The A_4 symmetry breaking, which occurs at the electroweak scale, leads to a residual $\mathbb{Z}_2$ symmetry responsible for the dark matter stability and dictates the neutrino phenomenology. We show that CP breaking in the scalar potential is needed to fit the neutrino mixing angles.

Authors: Dr BONILLA, Cesar (Departamento de Física, Universidad Católica del Norte); Dr PEINADO, Eduardo (Instituto de Física, UNAM); Dr HERMS, Johannes (Max-Planck-Institut für Kernphysik - Heidelberg); MEDINA, Omar (IFIC (CSIC-Universitat de Valéncia))

Presenter: MEDINA, Omar (IFIC (CSIC-Universitat de Valéncia))

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **28** Type: **Talk**

Welcome

Monday, November 7, 2022 9:20 AM (10 minutes)

Presenter: NIERSTE, Ulrich (KIT)

Session Classification: Plenary

Contribution ID: **63** Type: **Talk**

Exactly Stable Protons with a Muonic Force

Tuesday, November 8, 2022 4:30 PM (15 minutes)

Scalar leptoquarks are popular mediators in new physics explanations of the experimental anomalies in $b \to s\mu^+\mu^-$ decays and the muon $g-2$; however, the non-observation of charged lepton flavor violation and proton decay impose severe constraints on their interactions. We present a novel protection mechanism in the form of a gauged, lepton-flavored U(1) symmetry, which is broken by a scalar condensate to accommodate neutrino masses with a type-I seesaw. An exact remnant discrete Z_9 symmetry renders the proton exactly stable to all orders in the effective field theory expansion. This framework easily accommodates leptoquark explanations of the aforementioned anomalies without the dangerous interactions.

Author: THOMSEN, Anders Eller (University of Bern)

Presenter: THOMSEN, Anders Eller (University of Bern)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **64** Type: **Talk**

Measurements of CP violation at Belle II

Tuesday, November 8, 2022 2:00 PM (15 minutes)

The first results from the Belle II collaboration related to the determination of CP violation in B decays presented. Both time-dependent and direct CP violation measurements are possible at this next generation e^+e^- B factory. The first determinations of and constraints on all three CKM unitarity triangle angles are presented. Results using data sets equivalent to an integrated luminosity up to 189 fb$^-$1 are used.

Author: LIBBY, Jim (IIT Madras)

Presenter: Dr GOLDENZWEIG, Pablo (KIT, ETP)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **65** Type: **Talk**

Dark Matter in S3-Symmetric Three-Higgs Doublet Model With Spontaneous CP Violation

Tuesday, November 8, 2022 2:45 PM (15 minutes)

Models with an extended scalar electroweak sector can have vanishing vacuum expectation values. Such behaviour is a result of an underlying symmetry. If a symmetry prevents couplings between fermions and additional scalars, such scalars could become viable dark matter candidates. We catalogue S_3-symmetric three-Higgs-doublet models, based on whether a specific model could possibly accommodate a dark matter candidate. In our study we assume that the dark matter candidate is stabilised by the $\mathbb{Z}_2$ symmetry, which survived spontaneous symmetry breaking, and not superimposed over S_3. We explore two models; with an without CP violation. These models have a single dark and two active scalar sectors. The dark matter candidate masses, in two cases, are different from the known models with three scalar doublets. After investigating two models in detail, identifying parameters compatible with both theoretical and experimental constraints, we found that the dark matter candidate mass could be within the range of [52.5, 89] GeV or [6.5, 44.5] GeV for a model with CP violation.

Authors: KUNCINAS, Anton (CFTP/IST, U. Lisboa); OSLAND, Per (University of Bergen); REBELO, M. (Gui) Nesbitt (CFTP/IST, U. Lisboa); ØGREID, Odd Magne (Western Norway University of Applied Sciences)

Presenter: KUNCINAS, Anton (CFTP/IST, U. Lisboa)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **66** Type: **Talk**

On Discrete Goldstone Bosons

Wednesday, November 9, 2022 2:00 PM (15 minutes)

Exact discrete symmetries, if non-linearly realized, can protect a given theory against ultraviolet sensitivity. Quadratic divergences can cancel exactly, while the lightest scalars stemming from spontaneous symmetry breaking are massive without breaking the symmetry. This is at variance with non-linearly realized continuous symmetries, for which the masses of pseudo-Goldstone bosons require an explicit breaking mechanism and enjoy no such protection. The resulting symmetry-protected masses and potentials offer promising physics avenues, both theoretically and in view of the blooming experimental search for ALPs and other BSM particles. We develop this theoretical setup using invariant theory and focusing on the so-called natural minima of the potential. Typically, a subgroup of the ultraviolet discrete symmetry remains explicit in the spectrum, i.e. realized "à la Wigner". This suggests tell-tale experimental signals as a tool to disentangle that explicit low-energy symmetry: at least two degenerate scalars produced simultaneously, plus specific ratios of multi-scalar amplitudes which provide a hint of the full ultraviolet discrete symmetry. Theories displaying exact A4 and A5 symmetries are explored in detail, as illustrative examples.

Authors: ENGUITA-VILETA, Victor (Universidad Autónoma de Madrid); Prof. GAVELA, Belen (Universidad Autónoma de Madrid); HOUTZ, Rachel (IPPP Durham); Dr QUILEZ, Pablo (DESY)

Presenter: ENGUITA-VILETA, Victor (Universidad Autónoma de Madrid)

Session Classification: Light new particles

Track Classification: All

Contribution ID: **69** Type: **Talk**

Looking into the heart of darkness - two-phase xenon time projection chambers for direct dark matter searches

Friday, November 11, 2022 10:00 AM (30 minutes)

The fundamental nature of dark or invisible matter remains
one of the great mysteries of our time. A leading hypothesis is that dark matter is made of new elementary particles, with proposed masses and interaction cross sections spanning an enormous range. Amongst the technologies developed to search for dark matter particles, two-phase (liquid and gas) xenon time projection chambers are currently leading the field, providing unprecedented sensitivities and a large discovery potential. I will briefly present the development of these detectors from their earliest stages, then show first results from multi-tonne detectors currently taking data deep underground. I will also discuss the ongoing the RD; towards the next-generation DARWIN experiment.

Author: BAUDIS, Laura (University of Zurich)

Presenter: BAUDIS, Laura (University of Zurich)

Session Classification: Plenary

Track Classification: All

Contribution ID: **70** Type: **Talk**

Sterile neutrinos along the DUNE decay pipe

Wednesday, November 9, 2022 4:30 PM (15 minutes)

We analyse the sensitivity of the Deep Underground Neutrino Experiment (DUNE) to a sterile neutrino, combining information from both the Near Detector (ND) and the Far Detector (FD). DUNE's sterile exclusion reach is affected by taking into account the information on the neutrino production point, in contrast to assuming a point-like neutrino source. Visible differences remain after taking into account energy bin-to-bin uncorrelated systematics.

Author: PULIDO, Joao

Presenter: PULIDO, Joao

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **71** Type: **Talk**

Radiative Neutrino Mass with GeV Scale Majorana Dark Matter in Scotogenic Model

Wednesday, November 9, 2022 3:00 PM (15 minutes)

The experimental observations from the colliders
established the standard model (SM), is the most successful phenomenological framework to explain the non-gravitational interactions of fundamental particles at high energy. Non-zero neutrino mass and dark matter cast a shadow over its success. This necessitates the extension of the SM. The most straightforward and elegant extension of the SM to explain these two phenomena is the Scotogenic model, where the SM particle spectrum extends with three isospin singlet right-handed neutrinos and one doublet scalar while all of these being odd under Z2 symmetry. In this work, we have considered the lightest right-handed neutrino as the dark matter candidate and freeze-out mechanism for producing observed dark matter relic density. The charged lepton flavor violation decay processes constrain the upper side of Yukawa coupling while observed relic density limits the lower side. We have performed a unique parameterization to attain the highest possible Yukawa coupling while satisfying LFV and DM constraints. The reduced number of free parameters and large Yukawa coupling make the model predictability at lepton colliders very high. Collider phenomenology for possible signatures performed at lepton colliders and the required luminosities estimated for detection.

Author: AVNISH (Institute of Physics, Bhubaneswar, India.)

Presenter: AVNISH (Institute of Physics, Bhubaneswar, India.)

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **72** Type: **Talk**

Axion-like particles as mediators for dark matter: beyond freeze-out

Tuesday, November 8, 2022 4:00 PM (15 minutes)

Recent experimental advances now severely constrain electroweak-scale WIMPs produced via thermal freeze-out, leading to a shift away from this standard paradigm. Here we consider an axion-like particle (ALP), the pseudo-Goldstone boson of an approximate U(1) global symmetry spontaneously broken at a high scale fa, as a mediator between the Standard model (SM) particles and the dark matter (DM) particles. We explore the case where the couplings are too small to allow for DM generation via freeze-out and the mediator particle and the DM constitute a hidden sector which is thermally decoupled from the SM particles. However, alternative generation mechanisms such as freeze-in and freeze-out from a decoupled dark sector are now appropriate. Having determined the region of parameter space where the correct relic density is obtained, we then revisit experimental constraints on ALPs from electron beam dump experiments, astrophysics and rare B and K decays.

Author: BHARUCHA, Aoife (CPT Marseille)

Presenter: BHARUCHA, Aoife (CPT Marseille)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **73** Type: **Talk**

Electroweak Phase Transition in a Dark Sector with CP Violation

Tuesday, November 8, 2022 4:15 PM (15 minutes)

We investigate the potential of the model 'CP in the Dark'
for providing a strong first-order electroweak phase transition (SFOEWPT) by taking into account all relevant theoretical and experimental constraints. For the derivation of the strength of the phase transition we use the one-loop corrected, daisy-resummed effective potential at finite temperature, implemented in the C++ code BSMPT, to determine the global minimum at the critical temperature. The model 'CP in the Dark' provides a Dark Matter (DM) candidate as well as explicit CP violation in the dark sector. We find a broad range of viable parameter points providing an SFOEWPT. They are within the reach of XENON1T and future invisible Higgs decay searches for DM. 'CP in the Dark' also offers SFOEWPT points that display spontaneous CP violation at finite temperature. Having not only an SFOEWPT that provides the necessary departure from thermal equilibrium, but also a source of additional non-standard CP violation, opens a promising gate towards enabling the generation of the baryon asymmetry of the universe (BAU) through electroweak baryogenesis.

Author: BIERMANN, Lisa (Institute for Theoretical Physics, Karlsruhe Institute of Technology)

Presenter: BIERMANN, Lisa (Institute for Theoretical Physics, Karlsruhe Institute of Technology)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **74** Type: **Talk**

Two-component vector WIMP –fermion FIMP dark matter model with an extended seesaw mechanism

Tuesday, November 8, 2022 2:45 PM (15 minutes)

We consider a $U(1)_D$ extension of the Standard Model
that accounts for the neutrino masses and study in detail dark matter phenomenology. The model under consideration includes a vector WIMP and a fermion FIMP dark matter candidates and thus gives rise to two-component dark matter scenarios. We discuss different regimes and mechanisms of production and the interplay between neutrino masses and dark matter relic density. We show that the WIMP and FIMP together compose the observed relic density today with comparable contributions. Finally, we study the connection between the dark matter and the gravitational waves originating from the strong first-order phase transition in the scalar sector.

Author: COSTA, Francesco (University of Göttingen, ITP)

Presenter: COSTA, Francesco (University of Göttingen, ITP)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **75** Type: **Talk**

Search for CP violation in neutrino oscillations in standard and non-standard physics scenarios

Friday, November 11, 2022 11:40 AM (30 minutes)

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Author: GEHRLEIN, Julia (Brookhaven National Laboratory)

Presenter: GEHRLEIN, Julia (Brookhaven National Laboratory)

Session Classification: Plenary

Track Classification: All

Contribution ID: **76** Type: **Talk**

Modified Dirac equation in schwarzschild metric

Tuesday, November 8, 2022 4:30 PM (15 minutes)

Heisenberg's uncertainty principle at the Planck scale leads
to extensions of Dirac equations. In this paper, the generalized uncertainty problem (GUP) theory is used as an extension of the Dirac equation with the mass term m_1+iγ^5 m_2 (tachyonic) in the Schwarzschild metric. Its eigenvalue problem for a particle in a gravitational field created by a central mass is also solved. The fundamental spinor solution for the tachyonic Dirac equation is found on a helicity basis. This study shows that it is impossible with current theories to formulate a covariant equation that could be repulsed by gravity in the framework of space-like particles.

Author: Ms HASSANZADEH, Tara (Amirkabir University of Technology)

Presenter: Ms HASSANZADEH, Tara (Amirkabir University of Technology)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **78** Type: **Talk**

Discrete Goldstone Bosons

Monday, November 7, 2022 10:00 AM (30 minutes)

In this talk, I will discuss discrete Goldstone bosons (dGB's), light particles arising from spontaneously broken exact discrete symmetries. These dGB's are guaranteed to have nonzero masses, while the associated discrete symmetry protects them from quadratically divergent mass contributions. The nonzero masses of dGB's arise directly from the discrete symmetry, without requiring an explicit symmetry breaking mechanism, setting dGB's apart from other pseudo-Goldstone bosons. After explaining the mass protection mechanism, I will discuss the generic experimental signals of dGB's. Below the spontaneous symmetry breaking scale, typically a preserved subset of the discrete symmetry remains, leading to a telltale signal of degenerate dGB's being produced simultaneously. Moreover, ratios of multi-scalar production amplitudes give a probe of the full UV discrete symmetry.

Author: Dr HOUTZ, Rachel (Durham IPPP)

Presenter: Dr HOUTZ, Rachel (Durham IPPP)

Session Classification: Plenary

Track Classification: All

Contribution ID: **79** Type: **Talk**

Sterile Neutrino Search with the KATRIN Experiment

Wednesday, November 9, 2022 4:00 PM (15 minutes)

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Author: KÖLLENBERGER, Leonard (IAP, KIT)

Presenter: KÖLLENBERGER, Leonard (IAP, KIT)

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **81** Type: **Talk**

Charged Dark Matter in Supersymmetric Twin Higgs models

Wednesday, November 9, 2022 3:15 PM (15 minutes)

Supersymmetric Twin Higgs models allow for naturally low electroweak scale without much fine-tuning. If the lightest supersymmetric particle resides in the twin sector, it could be charged under the unbroken twin electromagnetism. I will consider the twin stau as candidate for dark matter in these class of models. All experimental constraints, including self-interaction bounds, are satisfied for wide range of the parameters. However, future direct detection experiments such as LUX-ZEPELIN will probe most of the parameter space. The collider signature of this scenario is a light stau which could be observed at the LHC as a long-lived particle.

Author: ŁUKAWSKI, Michał (University of Warsaw)

Presenter: ŁUKAWSKI, Michał (University of Warsaw)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **82** Type: **Talk**

CPT and unitarity constraints for higher-order CP asymmetries at finite temperature

Tuesday, November 8, 2022 5:00 PM (15 minutes)

We use an unconventional diagrammatic approach to formulate CPT and unitarity constraints for higher-order CP asymmetries entering the source term in the Boltzmann equation. Usually, the reaction rate asymmetries in these constraints are computed within the classical kinetic theory, using zero-temperature quantum field theory to describe particles' interactions. We approximate the rates, otherwise obtained within the closed-time-path formalism, in terms of diagrams drawn on a cylindrical surface and their holomorphic cuts. The resulting equilibrium asymmetry constraints incorporate thermal-mass effects and allow tracking the cancelations of reaction rate asymmetries computed with quantum statistics. We use the top Yukawa corrections to the asymmetries in the seesaw type-I leptogenesis as an example. The contribution is primarily based on arXiv:2209.03829.

Authors: MATÁK, Peter (Comenius University in Bratislava); BLAŽEK, Tomáš (Comenius University in Bratislava); ZAUJEC, Viktor (Comenius University in Bratislava)

Presenter: MATÁK, Peter (Comenius University in Bratislava)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **83** Type: **Talk**

The importance of quantum loops for astrophysical ALPs

Wednesday, November 9, 2022 2:30 PM (15 minutes)

We investigate the effect of quantum loops on the theory of axionlike particles (ALPs) coupled to electrons. Contrary to some statements in the recent literature, the effective ALP-photon coupling induced by an electron loop can be sizeable in the plasma of a supernova. We define a general effective coupling that depends on the kinematics of the specific process in which an ALP scatters, decays, or is produced. Using this effective coupling, it can be shown that production of ALPs by loop processes is in fact slightly more efficient than the respective tree-level processes in a numerical model of SN1987A. We update the bound on g_{ae} imposed by the observed duration of the neutrino burst of SN1987A. Moreover, we derive a new bound, which does not exist at tree-level for ALPs only coupled to electrons, from the non-observation of gamma-rays from ALP decays directly after the initial neutrino burst was observed in 1987. These are the leading constraints on g_{ae} in the ALP-mass range of roughly 30 keV to 240 MeV. Using the effective coupling, we furthermore point out that ALP dark matter coupled to electrons is not stable in the keV mass range due to loop-induced decays into photons. Large parts of the parameter space that direct detection experiments are sensitive to are therefore either (i) incompatible with the assumption of ALPs being dark matter as their lifetime is shorter than the age of the universe, or are (ii) already excluded by indirect detection searches for x-rays and gamma-rays as products of ALP decays.

Author: MÜLLER, Eike (Stockholm University)

Presenter: MÜLLER, Eike (Stockholm University)

Session Classification: Light new particles

Track Classification: All

Contribution ID: **84** Type: **Talk**

Status of the KOTO experiment to search for kaon rare decays

Monday, November 7, 2022 9:30 AM (30 minutes)

We report the status of the KOTO experiment at J-PARC to search for the decay $K_L \to \pi^0 \nu \overline{\nu u}$. The decay is sensitive to new physics beyond the standard model because the standard model process is highly suppressed in the decay. The branching ratio is 3×10^{-11} with small theoretical uncertainty in the standard model. We set an upper limit of the branching ratio at 3×10^{-9} with the data collected in 2015. We achieved the single event sensitivity of 7.2×10^{-10} with 3 events observed for the 2016-2018 data analysis. The number of observed events is consistent to the background estimations, and we introduced new measures against them, and collected more data in 2019-2021. We will report the status, and the future prospects including the KOTO step-2 aiming at the discovery of the decay.

Author: NANJO, Hajime (Osaka University)

Presenter: NANJO, Hajime (Osaka University)

Session Classification: Plenary

Track Classification: All

Contribution ID: **85** Type: **Talk**

Testing the Pauli Exclusion Principle and Collapse models in underground experiments

Tuesday, November 8, 2022 4:45 PM (15 minutes)

The Pauli Exclusion Principle (PEP) is one of the main cornerstones of the Quantum Theory. Violation of the PEP, albeit small, could be motivated by physics beyond the Standard Model which entail extra space dimensions, violation of the Lorentz invariance, non-commutative space-time. These scenarios can be experimentally constrained with stat-of-the-art X-ray spectroscopy, searching for forbidden transition in atomic systems. I shall present the results of the VIP-2 experiment at LNGS searching for PEP violations; the impact of this research in relation to quantum gravity models is also discussed. Finally, the experimental testes of quantum wave-function collapse models done at LNGS will also be outlined.

Author: Dr NAPOLITANO, Fabrizio (Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali di Frascati)

Presenter: Dr NAPOLITANO, Fabrizio (Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali di Frascati)

Session Classification: Atoms, nuclei, molecules, and spectroscopy

Track Classification: All

Contribution ID: **86** Type: **Talk**

Features of the Weinberg 3HDM potential

Tuesday, November 8, 2022 2:30 PM (15 minutes)

The Weinberg model is a Z_2\times Z_2-symmetric
three-Higgs-doublet model (3HDM)} designed to accommodate CP violation in the scalar sector within a gauge theory, while at the same time allowing for natural flavour conservation. In this model the coefficients of the potential are taken to be complex and therefore CP is explicitly violated. With coefficients chosen to be real, CP can be spontaneously violated via complex vacuum expectation values (vevs). In the absence of the terms leading to the possibility of CP-violation either explicit or induced by complex vevs, the potential has two U(1) symmetries. In this case, spontaneous symmetry breaking would in general give rise to massless states. In a realistic implementation, those terms must be included, thus preventing the existence of Goldstone bosons. A scan over parameters, imposing the existence of a neutral state at 125 GeV that is nearly CP-even, typically results in the existence of one or two states with masses below 125 GeV that have a significant CP-odd component. These light states would have a low production rate via the Bjorken process and could thus have escaped detection at LEP.

Author: Prof. OSLAND, Per (University of Bergen)

Presenter: Prof. OSLAND, Per (University of Bergen)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **87** Type: **Talk**

Single charged Higgs boson production at the LHC

Wednesday, November 9, 2022 3:00 PM (15 minutes)

A search for charged Higgs may yield clear and direct sign
of new physics outside the realm of the Standard Model (SM). In the Two-Higgs
Doublet Model (2HDM), we investigate two of the main single charged Higgs
production channels at the Large Hadron Collider (LHC), assuming that either h or
H replicates the detected resonance at ~ 125 GeV; we ponder the practicality of
the associated charged Higgs production through the channel pp ⟶ H ± W ∓ and
pp ⟶ H ± bj that could have further substantial challenges at the LHC experiments.
Our study in this regard shows that the cross sections can have sizable rates, at
low tanβ so long the condition M H ± < m t − m b is satisfied, in the viable
parameter space. We propose a set of benchmark points with various unexplored
LHC signatures, arising from the aforementioned charged Higgs boson production
in both 2HDM type-I and type-X, to enhance the LHC search for such a particle.

Author: Mr OUCHEMHOU, Mohamed (Laboratoire de Physique Fondamentale et Applique Safi, Faculté Polydisciplinaire de Safi, Sidi Bouzid, B.P. 4162, Safi, Morocco.)

Presenter: Mr OUCHEMHOU, Mohamed (Laboratoire de Physique Fondamentale et Applique Safi, Faculté Polydisciplinaire de Safi, Sidi Bouzid, B.P. 4162, Safi, Morocco.)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **88** Type: **Talk**

Atomic responses for Dark matter scattering off electrons with Ge & Xe Detectors

Tuesday, November 8, 2022 3:15 PM (15 minutes)

Dark matter interaction with the atomic electron is a well-motivated problem in recent years. As the nature of DM and its non-gravitational interactions with normal matter are still unknown, instead of considering a specific, well-motivated method, we are using multi relativistic random-phase approximation (MCRRPA) and Frozen core approximation (FCA) in the present study. Recently, the relativistic random-phase approximation (RRPA) has been applied, with remarkable successes, to photoexcitation and photoionization of closed-shell atoms and ions of high nuclear charge, such as heavy noble gas atoms, where the ground state is well isolated from the excited states. Furthermore, it is desirable from the experimental point of view to determine which process and kinematic region would be best to constrain a certain type of DM interaction with electrons or nucleons. For this purpose, one has to rely on theoretical analysis. In this work, we try to address the above questions using the atom, Germanium, and Xenon—where most calculations can be carried out using nonrelativistic effective field theory. Calculation—and study its scattering with nonrelativistic LDM particles of a MeV to GeV mass range. Also, the energy transferred by the dark matter particle to the target depends on the reduced mass of the system. Therefore, the current sensitivity of direct detection experiments is limited to a few GeV masses of dark matter particles due to their high energy thresholds for detecting nuclear recoils. The sub-GeV dark matter is a less explored region and highly motivated for next-generation experiments. In this work, we are going to present the scattering of light dark matter (LDM) particles with atomic electrons in the context of nonrelativistic effective field theory. We consider both contact and long-range interaction between dark matter and atomic electron. A state-of-the-art many-body method is used to evaluate the SD and SI atomic ionization cross-sections of LDM-electron scattering. Our new atomic responses function to be numerically important in a variety of cases and can mold it with any dark matter velocity distribution, which we identify and investigate thoroughly using effective theory methods. We then use our atomic responses function to calculate differential cross sections within 5% error in RRPA and 20% in FCA. Detailed results will be presented at the meeting. This work was supported by the Ministry of Science and Technology (MOST) of Taiwan.

Author: Dr PANDEY, Mukesh Kumar (Department of Physics, National Dong Hwa University, Shoufeng, Hualien 97401, Taiwan)

Presenter: Dr PANDEY, Mukesh Kumar (Department of Physics, National Dong Hwa University, Shoufeng, Hualien 97401, Taiwan)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **90** Type: **Talk**

Probing ultralight dark matter with cold atoms

Wednesday, November 9, 2022 10:00 AM (30 minutes)

After broad introduction on ultralight DM, I will briefly
discussed issues associated on quality problem and the interplay between equivalence principle tests of ultralight DM and direct searches through the oscillation of energy levels, and then I'll demonstrate the potentially surprising result that oscillation of energy levels would provide us with possibly the best bound on QCD-axion models. It is basically going to be based on my three recent papers: Phys.Rev.Lett. 129 (2022) 3, 031301 2201.02042 Phys.Rev.Lett. 129 (2022) 3, 031302 2111.06883 and 2205.12988 and 2 new upcoming publications.

Author: PEREZ, Gilad (Weizmann Institute)

Presenter: PEREZ, Gilad (Weizmann Institute)

Session Classification: Plenary

Track Classification: All

Contribution ID: **91** Type: **Talk**

Lepton Flavour Violation

Tuesday, November 8, 2022 11:10 AM (30 minutes)

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Author: PERREVOORT, Ann-Kathrin

Presenter: PERREVOORT, Ann-Kathrin

Session Classification: Plenary

Track Classification: All

Contribution ID: **92** Type: **Talk**

Higher-Order Electroweak Contributions to Indirect CP Violation

Tuesday, November 8, 2022 4:15 PM (15 minutes)

The parameter ⍓ª is an important measure of the imbalance between matter and antimatter in the neutral kaon (ª0 and ª¯0) system. In particular, ⍓ª provides a highly sensitive probe of new physics and plays a critical role in the global fit of the Cabibbo-Kobayashi-Maskawa matrix. As one of the first discovered sources of ªᵾ violation, it has been extensively measured in experiment to per-mil precision. The theoretical calculation of ⍓ª, however, has historically been plagued by large perturbative errors arising from charm-quark corrections. These errors were larger than the expected magnitude of higher-order electroweak corrections in perturbation theory, rendering these contributions irrelevant. Recently, it was discovered that a simple re-parameterization of the effective Hamiltonian drastically reduces perturbative errors, making these higher-order electroweak calculations worth-while. We present the next-to-leading-logarithm electroweak contributions to ⍓ª.

Author: POLONSKY, Zachary (University of Zurich)

Presenter: POLONSKY, Zachary (University of Zurich)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **93** Type: **Talk**

New results on the neutron to hidden neutron oscillations hypothesis

Tuesday, November 8, 2022 4:30 PM (15 minutes)

Neutron to hidden neutron oscillation (n – n') experiments
are one of the several probes for testing the existence of hidden sector worlds [1, 2]. Although hidden states of matter were originally proposed to restore, on a general picture, the breaking of P and CP symmetries [4], currently they also correspond to candidates for dark matter [3]. In this work, we present a new experimental technique with ultra-cold neutrons (UCN) to test n – n' in the range of intermediate mass splitting. The experiment, which took place at the ILL's PF2 UCN source in 2020, used magnetic fields in the range [50 – 1130] μT to suppress the degeneracy-lifting energy difference. The preliminary analysis indicated no presence of n – n' signals, but lead to a new exclusion region of the parameter space, written as τ_nn 0 > 1 s for |δm| ∈ [2 – 69] × 10 −12 eV (95% C.L.). [1] C. Abel et al. "A search for neutron to mirror-neutron oscillations using the nEDM apparatus at PSI". In: Physics Letters B 812 (2021), p. 135993. doi: https://doi.org/10.1016/j. physletb.2020.135993. [2] H. Almazán et al. "Searching for Hidden Neutrons with a Reactor Neutrino Experiment: Constraints from the STEREO Experiment". In: Phys. Rev. Lett. 128 (6 Feb. 2022), p. 061801. doi: 10.1103/PhysRevLett.128.061801. [3] R. Foot. "Mirror dark matter: Cosmology, galaxy structure and direct detection". In: In-ternational Journal of Modern Physics A 29.11n12 (2014), p. 1430013. doi: 10 . 1142 / S0217751X14300130. [4] T. D. Lee and C. N. Yang. "Question of Parity Conservation in Weak Interactions". In: Phys. Rev. 104 (1 Oct. 1956), pp. 254–258. doi: 10.1103/PhysRev.104.254.

Author: SAENZ-AREVALO, William (LPC-Caen)

Presenter: SAENZ-AREVALO, William (LPC-Caen)

Session Classification: Atoms, nuclei, molecules, and spectroscopy

Track Classification: All

Contribution ID: **94** Type: **Talk**

Theory of CP violation in charm physics

Monday, November 7, 2022 11:10 AM (30 minutes)

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Author: Dr SCHACHT, Stefan (University of Manchester)

Presenter: Dr SCHACHT, Stefan (University of Manchester)

Session Classification: Plenary

Track Classification: All

Contribution ID: **95** Type: **Talk**

Estimating QCD-factorization amplitudes through the SU(3) symmetry

Tuesday, November 8, 2022 4:00 PM (15 minutes)

A well known technique to determine the decay amplitudes
of non-leptonic B meson processes is QCD factorization. One of the main issues faced by this procedure is the analytical determination of power suppressed terms, for instance of annihilation topologies. In this talk we describe the extraction of the annihilation contributions from data. Our method is based on establishing a set of rules which allow to transform the SU(3)-invariant description of B decay amplitudes into pairs of psudoscalar particles and the QCD factorization decomposition. Our approach provides not only the size of this contributions from phenomenological considerations but also a formal proof of the maximal number of degrees of freedom in the SU(3)-invariant, the topological and the QCD-factorization representations of B decay amplitudes into Pseudoscalar particles.

Author: Dr TETLALMATZI-XOLOCOTZI, Gilberto (University of Siegen)

Presenter: Dr TETLALMATZI-XOLOCOTZI, Gilberto (University of Siegen)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **96** Type: **Talk**

Near or Far Detectors? A Case Study for Long-Lived Particle Searches at Electron-Positron Colliders

Tuesday, November 8, 2022 3:15 PM (15 minutes)

We explore the discovery potential for long-lived particles at the 250-GeV ILC. The goal is to investigate possible gains of a dedicated far detector over the main detector ILD. For concreteness, we perform our study for sub-GeV axion-like particles a produced via $e^+e^- \to a\gamma$ or $e^+e^- \to Z\gamma \to (a\gamma)\gamma$ and decaying into pairs of charged leptons.
In the ideal case of zero background and perfect detection efficiency, we find that far detectors placed in the planned underground cavities or a large cuboid on the ground can enhance the sensitivity to long-lived pseudo-scalars at best moderately. On the other hand, the ILD itself is a perfect environment to search for long-lived particles, due to its excellent angular coverage and radial thickness. For long-lived particles produced with cross sections of a few picobarns, the ILD could probe lifetimes up to 300 ns or proper decay lengths up to 100 m in $250\,\text{fb}^{-1}$ of data. For axion-like particles produced through weak interactions, the ILC can reach an even higher sensitivity than searches for displaced vertices in meson decays at \belletwo. Our findings apply similarly to other proposed electron-positron experiments with a high angular coverage, such as the FCC-ee and CEPC.

Author: TILLINGER, Finn (Universität Heidelberg; Institut für Theoretische Physik)

Presenter: TILLINGER, Finn (Universität Heidelberg; Institut für Theoretische Physik)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **97** Type: **Talk**

Modular Flavor Symmetries and CP from the top down

Tuesday, November 8, 2022 9:30 AM (30 minutes)

The framework of compactified heterotic string theory offers consistent UV completions of the Standard Model of particle physics. In this approach, the existence of flavor symmetries beyond the Standard Model is imperative and the flavor symmetries can be derived from the top down. Such a derivation uncovers a unified origin of traditional discrete flavor symmetries, discrete modular flavor symmetries, discrete R symmetries of supersymmetry, as well as CP symmetry - altogether dubbed the eclectic flavor symmetry.
I will illustrate how the eclectic flavor symmetry is unambiguously computed from the top-down construction, discuss the different arising sources of spontaneous flavor symmetry breaking, and expose possible lessons for bottom-up flavor model building. Finally, I will focus on one explicit example model that provides a successful fit to all available experimental data while giving rise to concrete predictions for so-far undetermined parameters.

Author: TRAUTNER, Andreas (Max-Planck-Institut für Kernphysik, Heidelberg)

Presenter: TRAUTNER, Andreas (Max-Planck-Institut für Kernphysik, Heidelberg)

Session Classification: Plenary

Track Classification: All

Contribution ID: **98** Type: **Talk**

Flavour anomalies

Monday, November 7, 2022 2:00 PM (30 minutes)

.Hints for the violation of lepton flavour universality (satisfied within the SM) have accumulated in recent years. In particular, deviations from the SM predictions were observed in semi-leptonic B decays (b->sll and b->ctau), in the anomalous magnetic moment of the muon (g-2), in leptonic tau decays and di-electron searches. Furthermore, also the deficit in first row CKM unitarity, known as the Cabibbo Angle Anomaly, can be interpreted as a sign of lepton flavour universality violation. In this talk I review the status of these anomalies and give an overview of the possible interpretations in terms of new physics models.

Author: CRIVELLIN, Andreas (PSI & UZH)

Presenter: CRIVELLIN, Andreas (PSI & UZH)

Session Classification: Plenary

Track Classification: All

Contribution ID: **99** Type: **Talk**

Recent Advancement in Laser Spectroscopy of Antihydrogen and the Progress towards the Measurement of its Gravitational Acceleration

Monday, November 7, 2022 4:00 PM (30 minutes)

The ALPHA experiment at CERN is designed to perform precision measurements of the properties of antihydrogen - the antimatter counterpart of the hydrogen atom. The so-called ALPHA-2 apparatus is dedicated to antihydrogen spectroscopy. Its goal is to test the CPT invariance, a fundamental symmetry of the Standard Model, which requires that the spectra of hydrogen and antihydrogen be identical. The measurement of the long-lived 1S-2S transition is a milestone in this line of research. Recently, the ALPHA collaboration has also reported on the first successful attempt to laser cool a sample of antihydrogen atoms, an important step towards high precision spectroscopy. The so-called ALPHA-g apparatus is currently making progress towards a measurement of the antihydrogen gravitational acceleration. From the experimental point of view, the gravitational interaction of antimatter is a completely unexplored field. Therefore the goal of ALPHA-g is put to test the prediction of the Weak Equivalence Principle in General Relativity, which states that the gravitational acceleration of matter and antimatter be identical. The technical aspects of ALPHA, such as antihydrogen trapping and detection, as well as its physics results, such as laser spectroscopy, are the focus of this talk.

Authors: CAPRA, Andrea (TRIUMF); ALPHA COLLABORATION

Presenter: CAPRA, Andrea (TRIUMF)

Session Classification: Plenary

Track Classification: All

Contribution ID: **100** Type: **Talk**

Global Fits of vector-mediated simplified models for dark matter

Tuesday, November 8, 2022 3:00 PM (15 minutes)

Dark matter candidates can arise from a wide range of
extensions to the Standard Model. Simplified models with a small number of new particles allow for the optimisation and interpretation of dark matter and collider experiments, without the need for a UV-complete theory. In this talk, I will discuss the results from a recent GAMBIT study of global constraints on vector-mediated simplified dark matter models. I will cover several models with differing spins of the dark matter candidate. Along with these constraints, I will provide new unitarity bounds from the self-scattering of vector dark matter and discuss their effect on collider constraints.

Author: CHANG, Christopher (The University of Queensland)

Presenter: CHANG, Christopher (The University of Queensland)

Session Classification: Astroparticle Physics and cosmology

Track Classification: All

Contribution ID: **101** Type: **Talk**

Searches for light dark sectors at Belle II, Belle, and BaBar

Monday, November 7, 2022 3:00 PM (30 minutes)

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Author: DE NUCCIO, Michael (University of British Columbia)

Presenter: DE NUCCIO, Michael (University of British Columbia)

Session Classification: Plenary

Track Classification: All

Contribution ID: **102** Type: **Talk**

Axions in the early universe

Thursday, November 10, 2022 11:40 AM (30 minutes)

Scattering and decay processes of thermal bath particles in the early universe can dump relativistic axions in the primordial plasma. If produced with a significant abundance, their presence can leave observable signatures in cosmological observables probing both the early and the late universe. In this talk, I will focus on the QCD axion and I will present recent and significant improvements for the calculation of the axion production rate across the different energy scales during the expansion of the universe. I will apply these rates to predict the abundance of produced axions, and I will present the latest cosmological bounds on the axion mass and couplings.

Author: D'ERAMO, Francesco (University of Padua & INFN Padua)

Presenter: D'ERAMO, Francesco (University of Padua & INFN Padua)

Session Classification: Plenary

Track Classification: All

Contribution ID: **103** Type: **Talk**

Consistent Kinetic Mixing

Wednesday, November 9, 2022 2:15 PM (15 minutes)

Extensions of the Standard Model (SM) with new Abelian gauge groups allow for kinetic mixing between the new gauge bosons and the hypercharge gauge boson, resulting in mixing with the photon. In many models the mixing with the hypercharge gauge boson captures only part of the kinetic mixing term with the photon, since the new gauge bosons can also mix with the neutral component of the $SU(2)_L$ gauge bosons. We take these contributions into account and present a consistent description of kinetic mixing for general Abelian gauge groups both in the electroweak symmetric and the broken phase. These contributions are relevant for *all* hidden photon models in which SM fermions are charged, like $U(1)_{B-L}, U(1)_{L_i-L_j}$, etc. Based on these results we derive a low-energy theorem for the couplings of novel Abelian gauge bosons with the Standard Model Higgs boson from the one-loop kinetic mixing amplitudes.

Author: FOLDENAUER, Patrick (IFT Madrid)

Presenter: FOLDENAUER, Patrick (IFT Madrid)

Session Classification: Light new particles

Track Classification: All

Contribution ID: **105** Type: **Talk**

Searching for Gravitational Waves from Cosmic Domain Walls

Wednesday, November 9, 2022 11:10 AM (30 minutes)

I will explore the possibility that theories with unstable
Domain Walls in the Early Universe could be responsible for the generation of a Gravitational Wave background signal, focusing in particular on the recent signal detected by Pulsar Timing Arrays experiments, NANOGrav 12.5 years dataset and International PTA Data Release 2 (IPTA DR2). As an example, a QCD Axion much heavier than usual might generate such a signal.

Author: NOTARI, Alessio

Presenter: NOTARI, Alessio

Session Classification: Plenary

Track Classification: All

Contribution ID: **107** Type: **Talk**

Spontaneous CP violation and the Strong CP problem

Wednesday, November 9, 2022 4:00 PM (15 minutes)

Models of spontaneous CP violation can solve the Strong
CP problem without the need of an anomalous Peccei-Quinn symmetry. In this talk we review the Nelson-Barr approach, quantifying a peculiar coincidence between unrelated mass scales that these models must satisfy in order to correctly reproduce the Standard Model quark masses and CP violation. We investigate the compatibility between this requirement and the induced radiative corrections to the neutron electric dipole moment, and with bounds coming from collider, electroweak and flavor observables.

Author: VALENTI, Alessandro (University of Padova)

Presenter: VALENTI, Alessandro (University of Padova)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **108** Type: **Talk**

The P2 Experiment

Wednesday, November 9, 2022 3:00 PM (15 minutes)

P2 is a precision experiment planned for the Mainz Energy recovering Superconducting Accelerator (MESA) currently under construction. The goal of P2 is to determine the electroweak mixing angle at a four-momentum transfer of Q^2 = 4.5e-3 GeV^2 with a precision of 0.14 %, comparable to existing measurements at the Z pole. The mixing angle is extracted by measuring the protons weak charge exploiting the parity-violating asymmetry in elastic electron-proton scattering. A high precision measurement of the electroweak mixing angle at low energies is sensitive for deviations from the SM's prediction of the running of the angle and, therefore, for new physics beyond the SM. Reaching the precision goal with the 155 MeV, 150 μA polarized electron beam provided by the MESA facility requires 11000 hours of measurement time using a 60 cm liquid hydrogen target. The detection of several GHz of scattered electrons poses interesting challenges for the experiment and its electronics.

This talk provides an overview of hey features of the P2 spectrometer and the physics motivation behind it.

Author: WEINSTOCK, Lars Steffen (Johannes Gutenberg University Mainz, Institute for Nuclear Physics)

Presenter: WEINSTOCK, Lars Steffen (Johannes Gutenberg University Mainz, Institute for Nuclear Physics)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **109** Type: **Talk**

Scalar FCNC and CP violating mixing matrices from the vacuum

Tuesday, November 8, 2022 3:00 PM (15 minutes)

In the context of a class of two Higgs doublet models where CP violation only arises spontaneously, a possible connection between CP violations in the quark and lepton sectors (described by the CKM and PMNS matrices) is analysed. The important role of scalar flavour changing couplings (SFCNC) in this type of scenario is also discussed in detail.

Author: NEBOT GOMEZ, Miguel (U. of Valencia - IFIC)

Presenter: NEBOT GOMEZ, Miguel (U. of Valencia - IFIC)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **110** Type: **Talk**

Status of the MUonE experiment

Wednesday, November 9, 2022 3:15 PM (15 minutes)

The MUonE experiment aims to measure with extremely high precision the leading-order hadronic contribution to the muon anomalous magnetic moment g-2. This currently represents the largest uncertainty in the theoretical prediction. A first test has been performed in 2021, with prototypes of the silicon sensors and related electronics, the fundamental components of the detector. The collected data are under analysis. The detector assembly and the tests will be carried on during 2022. In 2023 a test run is foreseen to validate the proposed methods and technologies, which will lead to the final proposal of the experiment. The current status and prospects of MUonE will be discussed.

Author: Ms SPEDICATO, Eugenia (University of Bologna)

Presenter: Ms SPEDICATO, Eugenia (University of Bologna)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **111** Type: **Talk**

Implications of the $(g-2)_\mu$ anomaly on the flavor structure of New Physics

Wednesday, November 9, 2022 4:00 PM (15 minutes)

The longstanding $(g-2)_\mu$ anomaly is one of the greatest puzzles in particle physics. If confirmed, it would be a clear indication for physics beyond the Standard Model. We discuss the implications of this anomaly on the flavor structure of its possible New Physics (NP) explanations. In particular, we investigate flavor alignment conditions that NP models need to satisfy in order to both satisfy the $(g-2)_\mu$ anomaly and, at the same time, be consistent with the tight bounds from $\mu \to e\gamma$. We analyze the problem in general terms within the Standard Model Effective Field Theory, considering the renormalization group evolution of all the operators involved. We show that semileptonic four-fermion operators, which are likely to generate a sizeable contribution to the $(g-2)_\mu$ anomaly, need to be tightly aligned to the lepton Yukawa couplings and the dipole operators in flavor space. While this tuning can be achieved in specific NP constructions, employing particular dynamical assumptions and/or flavor symmetry hypotheses, it is problematic in a wide class of models with broken flavor symmetries. We quantify this tension both in general terms, and in the context of explicit New Physics constructions.

Author: WILSCH, Felix (University of Zurich)

Presenter: WILSCH, Felix (University of Zurich)

Session Classification: High-intensity frontier

Track Classification: All

Contribution ID: **112** Type: **Talk**

B0 –¯B0 entanglement for an ideal experiment for the direct CP violation φ3=γ phase

Tuesday, November 8, 2022 3:15 PM (15 minutes)

B0¯B0 entanglement offers a conceptual alternative to the single charged B-decay asymmetry for the measurement of the direct CP-violating γ=φ3 phase. With f=J/ΨK_L ; J/ΨK_S and g=(ππ)0; (ρ_Lρ_L)0, the 16 time-ordered double-decay rate intensities to (f,g) depend on the relative phase between the f- and g-decay amplitudes given by γ at tree level. Several constraining consistencies appear. An intrinsic accuracy of the method at the level of 1° could be achievable at Belle-II with an improved determination of the penguin amplitude to g channels from existing facilities.

Author: Prof. BOTELLA, Francisco J. (IFIC (u. Valencia))

Presenter: Prof. BOTELLA, Francisco J. (IFIC (u. Valencia))

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **113** Type: **Talk**

Neutrino masses, flavor anomalies and muon

boldsymbolg-2$fromdarkloops$

Tuesday, November 8, 2022 5:00 PM (15 minutes)

The lepton sector of the Standard Model is at present haunted by several intriguing anomalies, including an emerging pattern of deviations in $b \to s\ell\ell$ processes, with hints of lepton flavor universality violation, and a discrepancy in the muon anomalous magnetic moment. More importantly, it cannot explain neutrino oscillation data, which necessarily imply the existence of non-zero neutrino masses and lepton mixings. We propose a model that accommodates all the aforecited anomalies, induces neutrino masses and provides a testable dark matter candidate. This is achieved by introducing a dark sector contributing to the observables of interest at the 1-loop level. Our setup provides a very economical explanation to all these open questions in particle physics and is compatible with the current experimental constraints.

Authors: Dr CEPEDELLOA, Ricardo (Wurzburg U.); ESCRIBANO, Pablo (IFIC (CSIC - Univ. Valencia)); Dr VICENTE, Avelino (IFIC (CSIC - Univ. Valencia))

Presenter: ESCRIBANO, Pablo (IFIC (CSIC - Univ. Valencia))

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **114** Type: **Talk**

Theory of electric dipole moments

Wednesday, November 9, 2022 9:00 AM (30 minutes)

In this talk, I review recent theoretical progress of electric dipole moments (EDMs). After explaining a new standard model contribution to paramagnetic EDMs that is recently discovered, I discuss indirect constraints on muon and tau EDMs from paramagnetic EDM experiments such as ACME. I also briefly comment on indirect constraints on charm and bottom quark EDMs.

Author: EMA, Yohei

Presenter: EMA, Yohei

Session Classification: Plenary

Track Classification: All

Contribution ID: **115** Type: **Talk**

Flavor Probes of Axion Dark Matter

Thursday, November 10, 2022 11:10 AM (30 minutes)

Standard Model extensions with light axions are well-motivated by the observed Dark Matter abundance and the Peccei-Quinn solution to the Strong CP Problem. In general such axions can have large flavor-violating couplings to SM fermions, which naturally arise in scenarios where the Peccei-Quinn symmetry also explains the hierarchical pattern of fermion masses and mixings. I will discuss how these couplings allow for efficient axion production from the decays of SM particles, giving the opportunity to probe flavored axion Dark Matter with precision flavor experiments, astrophysics and cosmology.

Author: ZIEGLER, Robert

Presenter: ZIEGLER, Robert

Session Classification: Plenary

Track Classification: All

Contribution ID: **116** Type: **Talk**

Modular flavour symmetries from the bottom up

Tuesday, November 8, 2022 9:00 AM (30 minutes)

I discuss the application of modular invariance to the flavour problem from a (mostly) bottom-up perspective. In this framework, Yukawa couplings and mass matrices are obtained from modular forms, which are functions of a single complex number: the modulus VEV τ. This VEV can be the only source of symmetry breaking, so no flavons need to be introduced. When τ is close to special values (those preserving residual symmetries), a hierarchical fermion mass spectrum can arise for certain field representations. To illustrate this mechanism, a non-fine-tuned model with hierarchical charged-lepton masses is presented. Some of these apparently ad hoc values of τ turn out to be justified in simple UV-motivated CP-invariant potentials, for which novel CP-breaking minima are found.

Author: PENEDO, Joao (CFTP-IST, Lisbon)

Presenter: PENEDO, Joao (CFTP-IST, Lisbon)

Session Classification: Plenary

Track Classification: All

Contribution ID: **118** Type: **not specified**

Gravitational wave science with LISA

Wednesday, November 9, 2022 9:30 AM (30 minutes)

The space-borne interferometer LISA will be sensitive to a variety of mechanisms sourcing gravitational waves in the late and early universe. In this talk we present the status of the LISA mission and summarize the science that LISA will achieve. We discuss in some detail the measurements that will allow LISA to probe BSM physics and cosmology. Particular attention will be dedicated to the gravitational-wave signatures predicted in models with first-order phase transitions, and how well LISA will constrain such signatures.

Author: NARDINI, Germano (Stavanger)

Presenter: NARDINI, Germano (Stavanger)

Session Classification: Plenary

Track Classification: All

Contribution ID: **119** Type: **Talk**

Multi Higgs Doublet Models and symmetries

Monday, November 7, 2022 4:30 PM (30 minutes)

I discuss the usefulness of symmetries in the study of Multi Higgs Doublet Models.

Author: DE MEDEIROS VARZIELAS, Ivo

Presenter: DE MEDEIROS VARZIELAS, Ivo

Session Classification: Plenary

Track Classification: All

Contribution ID: **120** Type: **Talk**

Top physics results from CMS

Wednesday, November 9, 2022 2:45 PM (15 minutes)

Recent results on the top quark sector related to the test of various discrete symmetries of the standard model will be presented. These include the search for charge asymmetries and violation of charged lepton flavor and charge-parity symmetries, conducted using proton-proton collision data collected by the CMS experiment during 2015–2018. The obtained results are compared with predictions of the standard model towards constraining physics beyond it.

Author: KUMAR, Mintu (Ph.D student)

Presenter: KUMAR, Mintu (Ph.D student)

Session Classification: BSM collider physics

Track Classification: All

Contribution ID: **121** Type: **Talk**

ATLAS and CMS Dark Matter searches: results and future opportunities

Monday, November 7, 2022 2:30 PM (30 minutes)

There are many astrophysical observations and cosmological evidence for the existence of dark matter (DM), but little is known of its particle nature. The Standard Model (SM) does not predict its existence, however, numerous theories beyond the Standard Model (BSM) provide viable candidates for DM. Common candidates in many of these theoretical models are the weakly interacting massive particle (WIMP). If DM weakly interacts with the SM it could be produced at the Large Hadron Collider (LHC) experiments, escaping the detector and leaving a large missing transverse momentum as its signature. The ATLAS and CMS experiments have developed a broad search program for DM candidates and their interactions, including resonance searches for mediator particles which would couple DM to the SM, searches with large missing transverse momentum in the final states produced in association with other SM particles (light and heavy quarks, photons, Z and H bosons, as well as additional heavy scalar particles) called mono-X searches. There is a variety of models probed by those searches, including the Higgs portal model where the Higgs boson mediates the interactions between dark and SM sectors, the DM simplified model studying the energy scale of a mediator particle and dark matter particles, and the DM model with extended Higgs sectors (2HDM+a), which is a simplest gauge-invariant extension and provides a rich phenomenology. Many interesting results using the LHC full Run 2 pp collision data collected at 13 TeV have been achieved, in particular, the interpretations are made for various theoretical models and more complex final states. A review of the latest results of the DM searches at the ATLAS and CMS collaborations is presented, with emphasis on the future opportunities in run3 and beyond, including systematic limitations and new trigger schemes.

Author: EL JARRARI, Hassnae (Universite Mohammed V (MA))

Presenter: EL JARRARI, Hassnae (Universite Mohammed V (MA))

Session Classification: Plenary

Track Classification: All

Contribution ID: **122** Type: **Talk**

The quantum nature of the ”minimal” SO(10) GUT

Tuesday, November 8, 2022 4:15 PM (15 minutes)

In this talk I will present the latest developments on the minimal potentially realistic non-supersymmetric SO(10) GUT model with the scalar sector consisting of 45+126+10. This model is known to suffer from tachyonic instabilities in the spectrum at tree-level, but quantum corrections to the scalar potential may cure this problem - a route worth investigating, since this particular SO(10) GUT is expected to be inordinately predictive for proton decay. Recently, we completed an analysis of the one-loop corrections to the entire scalar spectrum in the 45+126 context relevant for GUT symmetry breaking, showing that there indeed exist viable non-tachyonic and perturbative regions in the parameter space. Lastly, I will discuss the ongoing analysis of the full model that includes the 10, and issues related to obtaining a suitable EW-scale Higgs doublet for the Yukawa sector.

Authors: Dr SUSIČ, Vasja (Charles University in Prague); JARKOVSKÁ, Kateřina (Charles University); MALINSKÝ, Michal (Charles University)

Presenter: Dr SUSIČ, Vasja (Charles University in Prague)

Session Classification: Atoms, nuclei, molecules, and spectroscopy

Track Classification: All

Contribution ID: **123** Type: **Talk**

New results on CPV in charm and bottom at LHCb

Monday, November 7, 2022 11:40 AM (30 minutes)

An overview of the recent CP violation measurements in charm and beauty decays is presented, and an updated determination of CKM angle gamma, charm mixing, and CP-violation parameters using the LHCb measurements.

Author: CARBONE, Angelo (INFN and University of Bologna)

Presenter: CARBONE, Angelo (INFN and University of Bologna)

Session Classification: Plenary

Track Classification: All

Contribution ID: **124** Type: **Talk**

Present status of neutrino physics from a theory perspective

Friday, November 11, 2022 11:10 AM (30 minutes)

One of the most important achievements in the field of particle physics was the discovery of neutrino oscillations. This implies the massive nature of neutrinos and in turn points to the existence of physics Beyond the Standard Model. In this talk I will chiefly focus on several strategies to probe new physics with neutrinos. First and foremost, I will discuss some classes of neutrino mass models and the respective detection prospects. I will also elaborate on the strategies to probe various new physics that is unrelated to neutrino mass, e.g. axion-like particles, at near-future neutrino experiments such as DUNE. Finally, I will discuss anomalies, in particular the excess of events at LSND and MiniBooNE experiments and respective BSM explanations.

Author: BRDAR, Vedran (CERN)

Presenter: BRDAR, Vedran (CERN)

Session Classification: Plenary

Track Classification: All

Contribution ID: **125** Type: **Talk**

Charged Lepton Flavour Violation (phenomenology)

Tuesday, November 8, 2022 11:40 AM (30 minutes)

The discovery of neutrino oscillations is the first laboratory evidence of New Physics beyond the Standard Model.
Oscillating neutrinos necessarily imply that neutrinos are massive and that (neutral) lepton flavour is violated.
A signal of charged lepton flavour violation (cLFV) however so far eludes experimental discovery.
In this talk I will review some phenomenological implications of current experimental bounds (and future sensitivities) on charged lepton flavour violating processes as well as potential future discoveries.
In connection to neutrino masses I will also highlight some phenomenological implications of leptonic CP violation on cLFV observables.

Author: KRIEWALD, Jonathan (IJS)

Presenter: KRIEWALD, Jonathan (IJS)

Session Classification: Plenary

Track Classification: All

Contribution ID: **126** Type: **Talk**

Exploiting quantum correlations - from particle physics to medicine

Quantum correlations are the cornerstone of quantum information theories. Profiting from the non-classical behaviour of a system opens new possibilities but also requires dedicated algorithms, simulations, and even infrastructures to be used. In this talk, the application of such quantum correlations (including the entanglement) for various systems, which can and are used in different fields, from fundamental particle physic studies to medical imaging techniques will be discussed.

Author: KRZEMIEN, Wojciech (National Centre for Nuclear Research)

Presenter: KRZEMIEN, Wojciech (National Centre for Nuclear Research)

Session Classification: Plenary

Track Classification: All

Contribution ID: **128** Type: **Talk**

Probes of Axion Dark Matter

Friday, November 11, 2022 2:00 PM (30 minutes)

This talk will give an overview over axions as dark matter and ways to detect them.

Author: Prof. JAECKEL, Joerg (Heidelberg Univ.)

Presenter: Prof. JAECKEL, Joerg (Heidelberg Univ.)

Session Classification: Plenary

Track Classification: All

Contribution ID: **129** Type: **Talk**

Latest results from the CUORE experiment

Wednesday, November 9, 2022 4:45 PM (15 minutes)

The Cryogenic Underground Observatory for Rare Events (CUORE) is the first bolometric experiment searching for 0νββ decay that has been able to reach the one-tonne mass scale. The detector, located at the LNGS in Italy, consists of an array of 988 TeO2 crystals arranged in a compact cylindrical structure of 19 towers. CUORE began its first physics data run in 2017 at a base temperature of about 10 mK and in April 2021 released its 3rd result of the search for 0νββ, corresponding to a tonne-year of TeO2 exposure. This is the largest amount of data ever acquired with a solid state detector and the most sensitive measurement of 0νββ decay in 130Te ever conducted, with a median exclusion sensitivity of 2.8×10^25 yr. We find no evidence of 0νββ decay and set a lower bound of 2.2 ×10^25 yr at a 90% credibility interval on the 130Te half-life for this process. In this talk, we present the current status of CUORE search for 0νββ with the updated statistics of one tonne-yr. We finally give an update of the CUORE background model and the measurement of the 130Te 2νββ decay half-life, study performed using an exposure of 300.7 kg·yr.

Co-author: CUORE COLL.

Presenter: Dr BERETTA, Mattia (UC Berkeley)

Session Classification: Neutrinos

Track Classification: All

Contribution ID: **130** Type: **Talk**

DISCRETE 2024

Friday, November 11, 2022 3:00 PM (15 minutes)

Presentation of DISCRETE 2024 in Ljubljana.

Author: NEMEVŠEK , Miha

Presenter: NEMEVŠEK , Miha

Session Classification: Plenary

Track Classification: All

Contribution ID: **131** Type: **Talk**

Implications of a matter-antimatter mass asymmetry in Penning-trap experiments

Tuesday, November 8, 2022 5:00 PM (15 minutes)

Lorentz-invariance, and locality indicate a conservation of CPT in a causal, unitary and Hermitian quantum field theory, implying that fundamental properties of particles and antiparticles should be equal in magnitude. We compare experiments that could test the mass difference between a particle and its antiparticle and pay a special attention to the Penning trap experiments, which test CPT symmetry by comparing the charge-to-mass ratio measured from cyclotron frequencies of proton and antiproton. We point out how the bounds on CPT violation from the kaon oscillation experiment would be magnitudes above its sensitivity. This is shown by mass decomposition of hadrons using the energy-momentum tensor in QCD. Finally, including CPT tests from comparing neutrino and antineutrino oscillation into discussion, we review their hits towards Lorentz-invariance violation and/or non-locality, and how (micro-)causality is broken and possibly restored.

Author: CHENG, Ting

Presenter: CHENG, Ting

Session Classification: Atoms, nuclei, molecules, and spectroscopy

Track Classification: All

Contribution ID: **132** Type: **Talk**

(Anti-)hydrogen spectroscopy for tests of CPT and Lorentz invariance

Friday, November 11, 2022 2:30 PM (30 minutes)

Cold antihydrogen, the bound state of an antiproton and a positron, is an ideal laboratory to test the fundamental CPT symmetry, one of the cornerstones of the Standard Model (SM) of particle physics, by comparing its energy levels to ordinary hydrogen. Hydrogen is one of the best studied atoms experimentally, the two best-known transitions being the 1S-2S two-photon transition and the ground-state hyperfine transition. The ALPHA collaboration at CERN-AD has obtained first experimental results for both transitions in a Penning trap, and ASACUSA is preparing a measurement using a beam. As CPT is strictly conserved in the SM, its observation would immediately point to new physics, e.g., originating from string theory where the CPT theorem is not necessarily valid, or other reasons like decoherence. No theoretical framework exists that predicts CPT violation, but the Standard Model Extension (SME) is a phenomenological model useful to classify and compare measurements of different properties of matter and antimatter. As the SME is based on Lorentz invariance violation, it can be tested by experiments with matter only. E.g., using a beam of cold hydrogen atoms initially built to characterize the in-beam method, ASACUSA has performed experiments on the orientation dependence of an external static magnetic field for hydrogen hyperfine measurements, and preparations are under way to study the hyperfine structure of deuterium. An overview will be given on the current and planned experiments and their implications on the search for CPT violation.

Author: WIDMANN, Eberhard

Presenter: WIDMANN, Eberhard

Session Classification: Plenary

Track Classification: All

Contribution ID: **133** Type: **Talk**

Spontaneous parity violation

Wednesday, November 9, 2022 11:40 AM (30 minutes)

Parity as prime example of left-right symmetry, is at the core of discrete symmetries, the first one that a child sees. It has played a fundamental role in the development of weak interactions, first with the V-A effective theory and then in the construction of the Standard Model. I show first how the maximal breaking of parity in beta decay was crucial in Weinberg's classic 1967 paper that completed the SM. I then turn to the idea of spontaneous symmetry breaking of parity in the context of the Left-Right Symmetric Model (LRSM) which led originally to neutrino mass and the seesaw mechanism behind its smallness. I discuss finally how over the years, the LRSM turned into a self-contained, predictive theory of neutrino mass, in complete analogy with the SM as a theory of charged fermion masses.

Author: SENJANOVIC , Goran (LMU)

Presenter: SENJANOVIC , Goran (LMU)

Session Classification: Plenary

Track Classification: All

Contribution ID: **134** Type: **Talk**

Overview of KATRIN Results on the Neutrino Mass and New Physics Searches

Monday, November 7, 2022 5:00 PM (30 minutes)

The KATRIN experiment aims to measure the neutrino mass by precision spectroscopy of tritium β-decay. Recently, KATRIN has improved the upper bound on the effective electron-neutrino mass to 0.8 eV/c² at 90% confidence level [1] and is continuing to take data for a target sensitivity of 0.2 eV/c².
In addition to the search for the neutrino mass, the ultra-precise measurement of the β-spectrum can be used to probe physics beyond the Standard Model.
Some extensions of the Standard Model allow Lorentz invariance violations. Even though strong constraints in the neutrino sector have been set by oscillation experiments, certain Lorentz-invariance-violating parameters can only be accessed using interaction processes. The layout of the KATRIN experiment makes it possible to investigate those parameters which would manifest themselves as a sidereal oscillation of the spectral endpoint [2].
Motivated by a range of anomalies in neutrino physics experiments, the KATRIN data is investigated for an eV-scale sterile neutrino. For this search a model with three active and one sterile neutrino species is considered. A sterile neutrino shows up as a kink-like structure in the electron energy spectrum [3].
The KATRIN data also enables probing the local relic neutrino background by threshold-free neutrino capture on tritium. This process is characterised by an electron peak positioned two times the neutrino mass above the spectral endpoint [4].
Furthermore, general neutrino interactions (GNI) [5] can be investigated through a search for potential shape variations of the β-spectrum. For this purpose, all theoretically allowed interaction terms for neutrinos are combined in one effective field theory. This enables a model-independent description of novel interactions, which could provide small contributions to the weak interaction. Such potential modifications can then be identified in the KATRIN β-spectrum by means of energy-dependent contributions to the rate.

[1] The KATRIN Collaboration. Direct neutrino-mass measurement with sub-electronvolt sensitivity. Nature Physics 18, 160–166, 2022.
[2] The KATRIN Collaboration. Search for Lorentz-Invariance Violation with the first KATRIN data. Arxiv, 2022.
[3] The KATRIN Collaboration. Improved eV-scale sterile-neutrino constraints from the second KATRIN measurement campaign. Phys. Rev. D, 2022.
[4] The KATRIN Collaboration. New Constraint on the Local Relic Neutrino Background Overdensity with the First KATRIN Data Runs. Phys. Rev. Lett., 2022.
[5] Ingolf Bischer and Werner Rodejohann. General neutrino interactions from an effective field theory perspective. Nuclear Physics B, 947, 2019.

Author: Ms FENGLER, Caroline (KATRIN Collaboration)

Presenter: Ms FENGLER, Caroline (KATRIN Collaboration)

Session Classification: Plenary

Track Classification: All

Contribution ID: **135** Type: **Talk**

Study of New Physics in $B_q^0 - \bar{B}_q^0$ Mixing:Challenges, Prospects and Implications for Leptonic Decays

Wednesday, November 9, 2022 5:00 PM (15 minutes)

The phenomenon of $B_q^0 - \bar{B}_q^0$ mixing ($q = d, s$) provides a sensitive probe for physics beyond the Standard Model. We have a careful look at the analyses of the determination of the Unitarity Triangle apex, which is needed for the Standard Model predictions of the B_q mixing parameters, and we explore how much space for New Physics is left through the current data. We study the impact of tensions between inclusive and exclusive determinations of the CKM matrix elements $|V_{ub}|$ and $|V_{cb}|$ and we focus on the γ angle extraction. We present various future scenarios and we discuss the application of these results for leptonic rare B decays, which allows us to minimise the CKM parameters impact in the New Physics searches. Performing future projections, we explore and illustrate the impact of increased precision on the key input measurements. It will be exciting to see how more precise data in the future high-precision era of flavour physics can lead to a much sharper picture.

Author: MALAMI, Eleftheria (Siegen University)

Co-authors: DE BRUYN, Kristof (Nikhef & University of Groningen); FLEISCHER, Robert (Nikhef & Vrije Universiteit Amsterdam); VAN VLIET, Philine (DESY)

Presenter: MALAMI, Eleftheria (Siegen University)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **136** Type: **Talk**

B mesons lifetimes within the HQE

Wednesday, November 9, 2022 5:15 PM (15 minutes)

The heavy quark expansion (HQE) provides a well established framework to compute inclusive decay widths of heavy hadrons in terms of a systematic expansion in inverse powers of the constituent heavy quark mass. By including for the first time the contribution of the Darwin operator, SU(3)$_F$ breaking corrections to the matrix element of dimension-six four-quark operators and the so-called eye-contractions, we update the SM predictions, based on the HQE, of the total widths of the B^+, B_d, and B_s mesons, as well as of the lifetime ratios $\tau(B^+)/\tau(B_d)$ and $\tau(B_s)/\tau(B_d)$. Overall we find very good agreement with the corresponding experimental determinations, however, the prediction of $\tau(B_s)/\tau(B_d)$ is particularly sensitive to the value of the Darwin parameter and of the size of SU(3)$_F$ breaking in the non-perturbative input, which are so far still poorly constrained, leading to some tension in specific scenarios.

Author: PISCOPO, Maria Laura (University of Siegen)

Co-authors: LENZ, Alexander (Siegen University); RUSOV, Aleksey (University of Siegen)

Presenter: PISCOPO, Maria Laura (University of Siegen)

Session Classification: Quark Flavour

Track Classification: All

Contribution ID: **137** Type: **Talk**

Tests of discrete symmetries at low energies

Thursday, November 10, 2022 9:30 AM (30 minutes)

Permanent electric dipole moments probe the joint violation of parity and time-reversal symmetries, collecting many potential sources into a single low-energy observable. Although the Standard Model predicts finite values in many systems, these are too small for present-day experiments to detect.

Experimental results consistent with zero are thus interpreted, via the CPT theorem, as constraining the new sources of CP-violation required to generate the cosmological baryon asymmetry. Complementary results from many different experiments are needed to jointly constrain high-energy CP-violation, using global analysis to confront the multi-scale problem of interpreting low-energy experimental data.

I will discuss the experimental status today, focusing especially on precision measurements using neutrons and diamagnetic atoms. New technological developments, prospects for improved measurements, and connections to other observables will be mentioned.

Author: DEGENKOLB, Skyler (Universität Heidelberg)

Presenter: DEGENKOLB, Skyler (Universität Heidelberg)

Session Classification: Plenary

Track Classification: All

Contribution ID: **138** Type: **Talk**

New avenues in dark matter detection

Thursday, November 10, 2022 10:00 AM (30 minutes)

The exploration of dark matter beyond the WIMP is of vital importance towards resolving the identity of dark matter. I will present new proposals for the direct detection of light dark matter which hold much promise. These include the use of superconducting nanowires, two-dimensional targets such as graphene, and heavy fermion systems. Considering dark matter interactions with these targets, I will demonstrate the potential of the light dark matter direct detection program in upcoming years.

Author: HOCHBERG, Yonit

Presenter: HOCHBERG, Yonit

Session Classification: Plenary

Track Classification: All

Contribution ID: **139** Type: **Talk**

Dark Matter from Exponential Growth: Pandemic Dark Matter

Friday, November 11, 2022 9:30 AM (30 minutes)

We propose a novel mechanism for the production of dark matter (DM) from a thermal bath, based on the idea that DM particles χ can transform heat bath particles ψ: $\chi\psi \to \chi\chi$. For a small initial abundance of χ this leads to an exponential growth of the DM number density. We demonstrate that this mechanism complements freeze-in and freeze-out production in a generic way, enabling new possibilities to explain the observed DM abundance. After this general discussion we comment on connections to discrete symmetries and consider possible model realizations as well as observational prospects. In particular for sterile neutrinos we show that an exponential production regime naturally occurs for self-interacting sterile neutrinos, which opens up significant parameter space for sterile neutrino DM in a very simple model.

Author: DEPTA, Paul Frederik (Max-Planck-Institut für Kernphysik)

Presenter: DEPTA, Paul Frederik (Max-Planck-Institut für Kernphysik)

Session Classification: Plenary

Track Classification: All

Contribution ID: **140** Type: **Talk**

Status of the CKM matrix fits with a focus on Vub and Vcb

Tuesday, November 8, 2022 10:00 AM (30 minutes)

In this presentation, I will provide an overview on the current knowledge on the unitarity of the CKM matrix and its constraining power on new physics contributions. I will further review the current knowledge on the determination of V_{ub} and V_{cb}, whose values constrain together with the CKM angle γ/ϕ_3 constrain the apex of the unitary triangle. Several new measurements emerged recently that provide more insights on the tensions between different determination methods.

Author: Dr PRIM, Markus (University of Bonn)

Presenter: Dr PRIM, Markus (University of Bonn)

Session Classification: Plenary

Track Classification: All