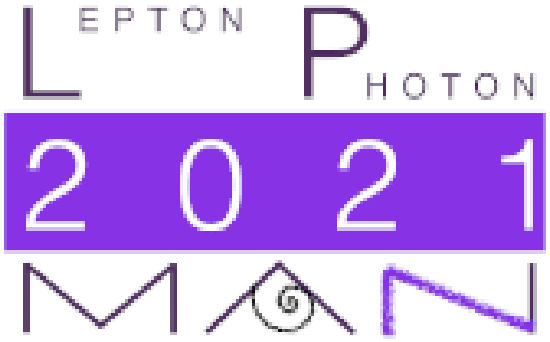
30th International Symposium on Lepton Photon Interactions at High Energies



Report of Contributions

Contribution ID: **1** Type: **Parallel session talk**

Precision top mass determination

Tuesday, January 11, 2022 2:20 PM (20 minutes)

The top mass has been measured to sub percent accuracy, however, using Monte Carlo (MC) event generators, that induce an additional O(1 GeV) ambiguity in the measurement due a lack of precise field theoretic definition of the Monte Carlo top mass scheme. I will describe how the groomed jet mass distribution for boosted, hadronically decaying, top jets at the LHC is a promising observable for precision top mass. We have first principles hadron level prediction and a field theory inspired treatment of the Underlying Event, which enables m_t determination via a direct comparison with the data, as well as calibration of the MC top mass. This is currently being pursued by ATLAS.

Primary author: Dr PATHAK, Aditya (University of Manchester)

Presenter: Dr PATHAK, Aditya (University of Manchester)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **2** Type: **Parallel session talk**

FASER Status and Physics Prospects

Wednesday, January 12, 2022 12:00 PM (20 minutes)

The FASER experiment is a new small and inexpensive experiment that is being placed 480 meters downstream of the ATLAS experiment at the CERN LHC. FASER is designed to discover dark photons and other light and very weakly-interacting particles that are produced in the far-forward region, outside of the ATLAS detector acceptance. The experiment has been successfully constructed and installed and will take data during Run-3 of the LHC. This talk will present the physics prospects, detector design, and commissioning status of FASER.

Primary author: FENG, Jonathan Lee (University of California Irvine (US))

Presenter: THEINER, Ondrej (Universite de Geneve (CH))

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **4** Type: **Parallel session talk**

New channels for light charged Higgs boson searches at the LHC

Tuesday, January 11, 2022 2:40 PM (20 minutes)

At the Large Hadron Collider (LHC), both the ATLAS and CMS Collaborations have been searching for light charged Higgs bosons via top (anti)quark production and decays channels, like $pp \to t\bar{t}$ with one top (anti)quark decaying into a charged Higgs boson and a b (anti)quark, when the decay is kinematically open. In this talk, we propose new searches at the LHC involving light charged Higgs bosons via their pair production channels like $pp \to H^{\pm}h/A$ and $pp \to H^{+}H^{-}$ in the 2-Higgs Doublet Model (2HDM) Type-I and -X scenarios. We demonstrate that for a light charged Higgs boson state, at the LHC, such di-Higgs production and their bosonic decays, such as $H^{\pm} \to W^{\pm}h$ and/or $H^{\pm} \to W^{\pm}A$, can give rise to signatures with event rates much larger than those emerging from $pp \to t\bar{t} \to t\bar{b}H^{-}$ + c.c.. We specifically study $h/A \to b\bar{b}$ and $\tau^{+}\tau^{-}$ decays. We, therefore, claim that the discussed combination of new production and decay modes can result in an alternative discovery channel for charged Higgs bosons lighter than the top (anti)quark at the LHC within the above two 2HDM Types. This talk is based on arXiv:2106.13656.

Primary author: KRAB, Mohamed (Sultan Moulay Slimane University, Morocco)

Presenter: KRAB, Mohamed (Sultan Moulay Slimane University, Morocco)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **5** Type: **Parallel session talk**

Within and beyond the SM via $b \to u$ decays

Tuesday, January 11, 2022 3:40 PM (20 minutes)

Armed with the Lattice and the most recent inputs from LCSR for the $B \to \pi$ form factors, we revisit the extraction of exclusive V_{ub} from the data on $B \to \pi l \nu$ branching ratios (BR's) from Belle and Babar. We analyze the complete set of available data and comment on the outliers, pointing out the differences between such an analysis and the one done by HFLAV previously using an "averaged" dataset. We carry out robust Frequentist and Bayesian fits and show that the tension between the exclusive and inclusive values for V_{ub} can be brought down to within 1σ. Furthermore, we define different fit scenarios using the available $B \to \pi, \rho l \nu$ experimental information along with the corresponding Lattice and the updated LCSR inputs and predict the values of a few observables within the SM for these scenarios. We also discuss the new physics (NP) sensitivities of these observables and obtain bounds on a few NP Wilson coefficients in $b \to u \tau \nu$ decays. We show that this sector allows for sizeable NP contributions and predict a few angular observables relevant to these modes.

Primary authors: Dr BISWAS, Aritra; Ms RAY, Ipsita; Prof. NANDI, Soumitra; Prof. PATRA, Sunando Kumar

Presenter: Dr BISWAS, Aritra

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **6** Type: **Parallel session talk**

Directionality for nuclear recoils in a liquid argon Time Projection Chamber

Tuesday, January 11, 2022 4:50 PM (20 minutes)

Liquid argon (LAr) is one of the most promising targets for the search of WIMP-like dark matter. LAr dual phase time projection chamber (LAr TPC) is a leading technology, able to detect both the scintillation and ionization signal. The correlation in the two signal channels provides a possible handle to measure the recoil direction of the nuclei: if confirmed, this would allow inferring the incident direction of potential dark matter candidates.

Previous work from SCENE resulted in a hint of the existence of a directional effect, which can potentially pave the way for a tonne scale directional WIMP search with LAr TPC. To validate this hypothesis, we conducted the Recoil Directionality (ReD) experiment to measure this correlation in 70 keV nuclear recoils to the highest precision.

The ReD TPC was carefully calibrated and then irradiated with a neutron beam at the INFN Laboratori Nazionali del Sud, Catania, Italy. A model based on directional modulation in charge recombination was developed to explain the correlation. In this contribution, we describe the experimental setup, the theoretical model, and the results from data analysis.

Primary author: Dr PANDOLA, Luciano (INFN-LNS)

Presenters: Dr PANDOLA, Luciano (INFN-LNS); PANDOLA, Luciano (INFN-LNS)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **9** Type: **Parallel session talk**

Development, construction, qualification and assembly of the Mu2e electromagnetic calorimeter mechanical structures and composite materials

Wednesday, January 12, 2022 9:40 AM (20 minutes)

The “muon-to-electron conversion” (Mu2e) experiment at Fermilab will search for the Charged Lepton Flavour Violating neutrino-less coherent conversion of a muon into an electron in the field of an aluminum nucleus. The observation of this process would be the unambiguous evidence of physics beyond the Standard Model. Mu2e detectors comprise a straw-tracker, an electromagnetic calorimeter and an external veto for cosmic rays. The calorimeter provides excellent electron identification, complementary information to aid pattern recognition and track reconstruction, and a fast calorimetric online trigger. The detector has been designed as a state-of-the-art crystal calorimeter and employs 1340 pure Cesium Iodide (CsI) crystals readout by UV-extended silicon photosensors and fast front-end and digitization electronics. A design consisting of two identical annular matrices (named “disks”) positioned at the relative distance of 70 cm downstream the aluminum target along the muon beamline satisfies the Mu2e physics requirements.
The hostile Mu2e operational conditions, in terms of radiation levels (total ionizing dose of 12 krad and a neutron fluence of 5x1010 n/cm2 @ 1 MeVeq (Si)/y), magnetic field intensity (1 T) and vacuum level (10^-4 Torr) have posed tight constraints on the design of the detector mechanical structures and materials choice. The support structure of the two 670 crystal matrices employs two aluminum hollow rings and parts made of open-cell vacuum-compatible carbon fiber. The photosensors and service front-end electronics for each crystal are assembled in a unique mechanical unit inserted in a machined copper holder. The 670 units are supported by a machined plate made of vacuum-compatible plastic material. The plate also integrates the cooling system made of a network of copper lines flowing a low temperature radiation-hard fluid and placed in thermal contact with the copper holders to constitute a low resistance thermal bridge. The data acquisition electronics is hosted in aluminum custom crates positioned on the external lateral surface of the two disks. The crates also integrate the electronics cooling system as lines running in parallel to the front-end system. In this talk we will review the constraints on the calorimeter mechanical structures design, the development from the conceptual design to the specifications of all the structural components, including the mechanical and thermal simulations that have determined the materials and technological choices and the specifications of the cooling station, the status of components production, the components quality assurance tests, the detector assembly procedures employed for building the detector at Fermilab, and the procedures for detector transportation and installation in the Mu2e experimental area.

Primary author: Dr PASCIUTO, Daniele (Istituto Nazionale di Fisica Nucleare - Pisa)

Co-author: DONATI, Simone (University of Pisa and Istituto Nazionale di Fisica Nucleare)

Presenter: Dr PASCIUTO, Daniele (Istituto Nazionale di Fisica Nucleare - Pisa)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **10** Type: **Parallel session talk**

Involving the New Generations in Fermi National Accelerator Laboratory Endeavours

Wednesday, January 12, 2022 10:40 AM (20 minutes)

Since 1984 the Italian groups of the Istituto Nazionale di Fisica Nucleare (INFN), collaborating with the DOE laboratory of Fermilab (US) have been running a two-month summer training program for Italian university students. While in the first year the program involved only four physics students of the University of Pisa, in the following years it was extended to engineering students. This extension was very successful and the engineering students have been since then extremely well accepted by the Fermilab Technical, Scientific Computing and Accelerator Division groups.
Since 2004 the program has been supported in part by DOE in the frame of an exchange agreement with INFN. An additional agreement for sharing support for engineers of the School of Advanced Studies of S. Anna (SSSA) of Pisa was established in 2007 between SSSA and Fermilab. In the frame of this program four SSSA students are supported each year. Over its almost 40 years of history, the program has grown in scope and size and has involved almost 550 Italian students from more than 20 Italian Universities, Since the program does not exclude appropriately selected non-Italian students, a handful of students of European and non-European Universities were also accepted in the years.
Each intern is supervised by a Fermilab Mentor responsible for performing the training program. Training programs spanned from Tevatron, CMS, SBN, Muon (g-2) experimental data analysis, development of particle detectors (silicon trackers, calorimeters, drift chambers, neutrino and dark matter detectors), design, construction and commissioning of the Muon (g-2) Mu2e, SBN and DUNE experiments, design of electronic and accelerator components, development of infrastructures and software for tera-data handling, research on superconductive elements and on accelerating cavities, theory of particle accelerators.
Since 2010, within an extended program supported by the Italian Space Agency and the Italian National Institute of Astrophysics, a total of 30 students in physics, astrophysics and engineering have been hosted for two months in summer at US space science Research Institutes and laboratories.
In 2015 the University of Pisa included these programs within its own educational programs through the Summer School “Summer Students at Fermilab and other US Laboratories”. Accordingly, Summer School students are enrolled at the University of Pisa for the duration of the internship and are identified and ensured as such. At the end of the internship the students are required to write summary reports on their achievements. After positive evaluation by a University Examining Board, interns are acknowledged 6 ECTS credits for their Diploma Supplement.
In 2021, to replace the Fermilab program cancelled due to the travelling restrictions, a 3-day Workshop was organized at INFN to keep the connection between the students and Fermilab and inform the students of the most recent developments of Fermilab future endeavours. A cohort of 25 selected students participated in the Workshop.
Information on student recruiting methods, on program organization and training programs of the recent years and on final student‘s evaluation process at Fermilab and at the University of Pisa will be presented.

Primary authors: Dr PASCIUTO, Daniele (Istituto Nazionale di Fisica Nucleare - Pisa); DONATI,

Simone (University of Pisa and Istituto Nazionale di Fisica Nucleare); Prof. BARZI, Emanuela (Fermilab); BELLETTINI, Giorgio (Dipartimento di Fisica)

Presenter: DONATI, Simone (University of Pisa and Istituto Nazionale di Fisica Nucleare)

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **11** Type: **Parallel session talk**

The Mu2e Experiment

Tuesday, January 11, 2022 4:50 PM (20 minutes)

The Mu2e experiment will search for the charged lepton flavor violating process of muon-to-electron conversion in the field of an aluminum nucleus. Muon-to-electron conversion is heavily suppressed in the standard model and so an observation of this signal would be a clear sign of new physics. Mu2e will search for the mono-energetic, 105 MeV electron signal with a discovery potential four orders of magnitude better than previous experiments. In this talk, I will give an overview of the Mu2e experiment as well as an update of its current status.

Primary author: EDMONDS, Andrew (Boston University)

Presenter: EDMONDS, Andrew (Boston University)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **13** Type: **Poster**

Studies of optical fibre and SiPM readout system for the Cylindrical Trigger Hodoscope in COMET Phase-I

Monday, January 10, 2022 4:28 PM (1 minute)

The COMET Phase-I experiment aims to search for charged lepton flavour violation in the coherent neutrino-less conversion of a muon to an electron with a 100 times better sensitivity than the current best limit. Muons required for the search are generated from the in-flight decay of low momentum pions produced inside a target by impinging a powerful proton beam extracted from the J-PARC Main Ring accelerator. As a result of the intense beam, our detector system must necessarily be situated in a high radiation high hit rate environment with neutron flux up to 10¹² MeV-equivalent neutrons per cm² and gamma dose up to 1 kGy. Standard photo-detectors cannot survive in such a harsh environment. So our design for a Cylindrical Trigger Hodoscope (CTH) consists of radially aligned plastic scintillator bars at the both ends of the tracking detector, with about 10m long optical fibre bundles that transmit the scintillation photon light. This enables us to use cost-effective silicon-photomultipliers (SiPM) remotely at the location where the radiation level is expected to be lower by an order. We demonstrated that our timing requirement of 1 ns is achievable with an optical fibre and SiPM readout scheme by using a small prototype, and further studies for photo-transmission efficiency and SiPM cooling are ongoing. In this presentation, results from several test measurements of the CTH will be presented, together with future prospects.

Primary authors: FUJII, Yuki (Monash University); AOKI, Masaharu (Osaka University); DEKKERS, Sam (Monash University); NASH, Jordan (Monash University); TOJO, Junji (Kyushu University (JP)); UENO, Kazuki (KEK); Mr WAKABAYASHI, Hiroyuki (Osaka University)

Presenter: FUJII, Yuki (Monash University)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **14** Type: **Parallel session talk**

Hyper-Kamiokande experiment: status and plans

Tuesday, January 11, 2022 2:40 PM (20 minutes)

The Hyper-Kamiokande experiment consists of a 260 kt underground water Cherenkov detector with a fiducial volume more than 8 times larger than that of Super-Kamiokande. It will serve both as a far detector of a long-baseline neutrino experiment and an observatory for astrophysical neutrinos and rare decays.
The long-baseline neutrino experiment will detect neutrinos originating from the upgraded 1.3 MW neutrino beam produced at the J-PARC accelerator 295 km away. A near detector suite, close to the accelerator, will help characterise the beam and minimise systematic errors.
The experiment will investigate neutrino oscillation phenomena (including CP-violation and mass ordering) by studying accelerator, solar and atmospheric neutrinos, neutrino astronomy (solar, supernova, supernova relic neutrinos) and nucleon decays.
In this talk, we will present an overview of the Hyper-Kamiokande experiment, its current status and physics sensitivity.

Primary author: Dr KHABIBULLIN, Marat (Russian Academy of Sciences (RU))

Presenter: MALEK, Matthew

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **15** Type: **Parallel session talk**

Dark matter studies with the PADME experiment

Wednesday, January 12, 2022 12:40 PM (20 minutes)

In recent years the physics of Feebly Interacting Particles (FIPs) saw a growing interest as a possible solution to the Dark Matter issue [1]. FIPs are exotic and relatively light particles, not charged under the SM gauge group, whose interactions with the SM bosons or fermions are extremely suppressed. They are assumed to be part of a possible secluded sector, called the dark sector, with the lightest stable dark particle(s) playing the role of DM.

In this scenario is inserted the Positron Annihilation into Dark Matter Experiment (PADME) ongoing at the Laboratori Nazionali di Frascati of INFN. PADME is searching primarily a Dark Photon signal [2] by studying the missing-mass spectrum of single photon final states resulting from positron annihilation events on the electrons of a fixed target. Actually, the PADME approach allows to look for any new particle produced in e+e− collisions through a virtual off-shell photon such as long lived Axion-Like-Particles (ALPs), proto-phobic X bosons, Dark Higgs …
After the detector commissioning and the beam-line optimization, PADME collaboration collected in 2020 about 5×10^{12} positrons on target at 430 MeV. These data are now under analysis and preliminary results are ready to be shown.
In the talk, it will be given an overview of the scientific program of the experiment and the performance of the detector will be presented showing Standard Model channels study (gamma-gamma events, Bremsstrahlung).

References

[1] P. Agrawal et al., "Feebly-Interacting Particles: FIPs 2020 Workshop Report", arXiv:2102.12143v1.
[2] M. Raggi and V. Kozhuharov, Adv. High Energy Phys. 509, (2014) 959802.

Primary author: Dr GIANOTTI, Paola (INFN Laboratori Nazionali di Frascati (IT))

Presenter: CHIODINI, Gabriele (INFN Lecce & Università del Salento (IT))

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **17** Type: **Parallel session talk**

Status of the Short-Baseline Near Detector at Fermilab

Tuesday, January 11, 2022 4:30 PM (20 minutes)

The Short-Baseline Near Detector (SBND) will be one of three liquid Argon Time Projection Chamber (LArTPC) neutrino detectors positioned along the axis of the Booster Neutrino Beam (BNB) at Fermilab, as part of the Short-Baseline Neutrino (SBN) Program. The detector is currently in the construction phase and is anticipated to begin operation the second half of 2022. SBND is characterised by superb imaging capabilities and will record over a million neutrino interactions per year. Thanks to its unique combination of measurement resolution and statistics, SBND will carry out a rich program of neutrino interaction measurements and novel searches for physics beyond the Standard Model (BSM). It will enable the potential of the overall SBN sterile neutrino program by performing a precise characterisation of the unoscillated event rate, and constraining BNB flux and neutrino-Argon cross-section systematic uncertainties. In this talk, the physics reach, current status, and future prospects of SBND are discussed.

Primary authors: ANDREOPOULOS, Costas (University of Liverpool & STFC Rutherford Appleton Laboratory); PANDEY, Vishvas (University of Florida)

Presenters: MCCONKEY, Nicola (University of Manchester (GB)); MCCONKEY, Nicola (University of Sheffield)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **18** Type: **Parallel session talk**

The SNO+ Experiment

Tuesday, January 11, 2022 4:50 PM (20 minutes)

SNO+ is a multi-purpose neutrino experiment located at SNOLAB. Following a commissioning phase with water as a detecting medium, SNO+ is now filled with liquid scintillator. We are studying backgrounds in the detector and embarking on a neutrino physics program including reactor, geo and solar neutrinos. Preparations are also underway to deploy roughly 4 tonnes of tellurium (0.5%) in the scintillator to conduct a neutrino-less double beta decay search. This talk will present the current status and prospects of SNO+.

Primary author: Dr WILSON, Jeanne (King's College London (KCL))

Presenter: Dr WILSON, Jeanne (King's College London (KCL))

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **20** Type: **Poster**

Vector meson photoproduction at the LHC with ALICE

Monday, January 10, 2022 4:19 PM (1 minute)

Photonuclear interactions dominate the interaction rate at large impact parameters of the colliding heavy ions via ultra-peripheral collisions (UPC). These processes allow us to study an evolution of the gluon content of protons and nuclei in new kinematic regime at the LHC.

The study of J/psi production allows for perturbative QCD considerations which address the gluon saturation and nuclear shadowing. Results on J/psi photoproduction cross sections both at forward and midrapidities are presented. The measurements are compared with available models for better understanding of QCD in this shadowing regime.

The light-meson photonuclear production in UPC at the LHC approaches the black-disk limit of QCD. The cross sections of the \rho^0 coherent photoproduction in Pb–Pb and Xe–Xe UPC were measured for different nuclear-breakup classes. The results are compared with model predictions.

Primary author: POZDNIAKOV, Valeri (Joint Institute for Nuclear Research (RU))

Presenter: POZDNIAKOV, Valeri (Joint Institute for Nuclear Research (RU))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **21** Type: **Poster**

Slow control and data acquisition interface in the Mu2e experiment

Monday, January 10, 2022 4:27 PM (1 minute)

The muon campus program at Fermilab includes the Mu2e experiment that will search for a charged-lepton flavor violating processes where a negative muon converts into an electron in the field of an aluminum nucleus, improving by four orders of magnitude the search sensitivity reached so far.
Mu2e's Trigger and Data Acquisition System (TDAQ) uses {\it otsdaq} solution. Developed at Fermilab, {\it otsdaq} uses the {\it artdaq} DAQ framework and {\it art} analysis framework, for event transfer, filtering, and processing.
{\it otsdaq} is an online DAQ software suite with a focus on flexibility and scalability, and provides a multi-user interface accessible through a web browser.
A Detector Control System (DCS) for monitoring, controlling, alarming, and archiving has been developed using the Experimental Physics and Industrial Control System (EPICS) open source Platform. The DCS System has also been integrated into {\it otsdaq}, providing a GUI multi-user, web-based control, and monitoring dashboard.

Primary authors: GIOIOSA, Antonio (Università & INFN Pisa); DONATI, Simone (University of Pisa and Istituto Nazionale di Fisica Nucleare)

Presenter: GIOIOSA, Antonio (Università & INFN Pisa)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **22** Type: **Parallel session talk**

The ESS based neutrino Super Beam Experiment (ESS□SB)

Wednesday, January 12, 2022 11:20 AM (20 minutes)

In the search for the CP-violation in the leptonic sector, crucial information has been obtained from neutrino experiments. The measurement of the third neutrino mixing angle, θ_13, opened the possibility of discovering the Dirac leptonic CP violating angle, δ_CP with intense "super" neutrino beam experiments. In the light of these new findings, an urgent need has arisen to improve the detection sensitivity of the current long-baseline detectors, considering proton driver at MW scale with MegaTon scale detector, with a key modification to place the far detectors at the second, rather than the first, oscillation maximum.
The European Spallation Source neutrino Super Beam (ESS□SB) aims to benefit from the high power of the European Spallation Source, ESS, LINAC in Lund-Sweden, to produce the world's most intense second-generation neutrino beam enabling measurement to be made at the second oscillation maximum. Assuming a ten-year exposure with two-years running time in neutrino mode and eight-years in antineutrino mode, CP-invariance violation could be established with a significance of 5σ over more than 70% of all values of δ_CP and with an error in the measurement of the δ_CP angle of less than 8° for all values of δ_CP. More details on the physics potential of the experiment will be given in the talk. The current design study programs running within the collaboration, especially those that that have direct impact on the precision measurements of δ_CP will be reviewed.

Primary author: TOLBA, Tamer (Universität Hamburg (UHH))

Presenter: TOLBA, Tamer (University of Hamburg)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **23** Type: **Parallel session talk**

Application of Quantum Artificial Intelligence / Machine Learning to High Energy Physics Analyses at LHC Using Quantum Computer Simulators and Quantum Computer Hardware

Wednesday, January 12, 2022 10:20 AM (20 minutes)

Machine learning enjoys widespread success in High Energy Physics (HEP) analyses at LHC. However the ambitious HL-LHC program will require much more computing resources in the next two decades. Quantum computing may offer speed-up for HEP physics analyses at HL-LHC, and can be a new computational paradigm for big data analyses in High Energy Physics.

We have successfully employed three methods (1) Variational Quantum Classifier (VQC) method, (2) Quantum Support Vector Machine Kernel (QSVM-kernel) method and (3) Quantum Neural Network (QNN) method for two LHC flagship analyses: ttH (Higgs production in association with two top quarks) and H->mumu (Higgs decay to two muons, the second generation fermions). We shall address the progressive improvements in performance from method (1) to method (3).

We will present our experiences and results of a study on LHC High Energy Physics data analyses with IBM Quantum Simulator and Quantum Hardware (using IBM Qiskit framework), Google Quantum Simulator (using Google Cirq framework), and Amazon Quantum Simulator (using Amazon Braket cloud service). The work is in the context of a Qubit platform (a gate-model quantum computer). Taking into account the present limitation of hardware access, different quantum machine learning methods are studied on simulators and the results are compared with classical machine learning methods (BDT, classical Support Vector Machine and classical Neural Network). Furthermore, we do apply quantum machine learning on IBM quantum hardware to compare performance between quantum simulator and quantum hardware.

The work is performed by an international and interdisciplinary collaboration with the Department of Physics and Department of Computer Sciences of University of Wisconsin, CERN Quantum Technology Initiative, IBM Research Zurich, IBM T. J. Watson Research Center, Fermilab Quantum Institute, BNL Computational Science Initiative, State University of New York at Stony Brook, and Quantum Computing and AI Research of Amazon Web Services. This work pioneers a close collaboration of academic institutions with industrial corporations in the High Energy Physics analyses effort.

Though the size of event samples in future HL-LHC physics and the limited number of qubits pose some challenges to the Quantum Machine learning studies for High Energy Physics, more advanced quantum computers with larger number of qubits, reduced noise and improved running time (as envisioned by IBM and Google) may outperform classical machine learning in both classification power and in speed.

Although the era of efficient quantum computing may still be years away, we have made promising progress and obtained preliminary results in applying quantum machine learning to High Energy Physics. A PROOF OF PRINCIPLE.

In this talk, challenges and opportunities of applying quantum Artificial Intelligence /Machine learning to High Energy Physics analyses will also be addressed.

Primary author: WU, Sau Lan (University of Wisconsin Madison (US))

Presenter: WU, Sau Lan (University of Wisconsin Madison (US))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **24** Type: **Parallel session talk**

Studying electron-positron annihilation into $K_S K\pi$ and $K_S K\pi\pi^0$ with the CMD-3 detector

Tuesday, January 11, 2022 3:20 PM (20 minutes)

Studying electron-positron annihilation into $K_S K\pi$ and $K_S K\pi\pi^0$ with the CMD-3 detector

A. A. Uskov.
Budker Institute of Nuclear Physics, Siberian Branch of the Russian Academy of Sciences.

We studied the process $e^+e^-\to KK\pi$ with the CMD-3 detector at the electron-positron collider VEPP-2000. The statistics collected by the CMD-3 detector in the energy range of $1.2 - 2$ GeV during the 2011, 2012, 2017, 2019 runs, with a total luminosity integral of $\sim 120pb^{-1}$, was used for the analysis.

The measured cross-section is crucial for the physics of light hadrons from u, d, s quarks, clarifying the hadronic contribution to the anomalous magnetic moment of the muon $(g-2)_\mu$, and independently measuring the resonance parameters of both $\phi(1680)$, $\rho(1450)$. The intermediate dynamics of this process is also of interest, allowing us to check the isotopic relations and prove the dominance of the neutral $K^*(892)$ channel.

We developed a novel methodology for selecting signal events. Including multi-staged kinematic reconstruction. By adding the second stage, we reduced the background ~ 5 more times. This stage depends on a rigorous study of the background. Since we identified - the main physical background to be the process $e^+e^-\to 4\pi$.

The outline of the designed steps:

1. Kinematic reconstruction with 4 charged tracks.
2. Track combination, to distinguish the K_S meson by invariant mass and decay vertex.
3. Restriction on the energy of γ not bound to tracks.
4. Final selection of signal events based on analysis of 2D-distribution of four-track events by energy imbalance ΔE and momentum vector sum modulus of all four particles Δp.
5. Simulation to find efficiency ε and estimate systematic errors.

So, as a result of this work we not only designed a new selection algorithm, but also studied the theoretical aspect of the cross-section in the Vector Meson Dominance Framework. Therefore, we improved the world precision of $\phi(1680)$, $\rho(1450)$ and measured the cross-section of $e^+e^-\to KK\pi$ with the best accuracy.

Primary author: USKOV, Artem (Budker Institute of Nuclear Physics)

Presenter: USKOV, Artem (Budker Institute of Nuclear Physics)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **25** Type: **Poster**

The International Particle Physics Outreach Group - Engaging the world with science

Monday, January 10, 2022 4:21 PM (1 minute)

The International Particle Physics Outreach Group (IPPOG) is a global network of scientists, science educators and communication specialists developing and supporting science education and public engagement for particle physics. The primary methodology adopted by IPPOG promotes the direct involvement of scientists active in current research with education and communication specialists, in order to effectively develop and share best practices in outreach. IPPOG member activities include the International Particle Physics Masterclass programme, International Day of Women and Girls in Science, Worldwide Data Day, International Muon Week and International Cosmic Day organisation, and participation in activities ranging from public talks, festivals, exhibitions, teacher training, student competitions, and open days at local institutions. These independent activities, often carried out in a variety of languages to public with a variety of backgrounds, all serve to gain the public trust and to improve worldwide understanding and support of science. We present our vision of IPPOG as a strategic pillar of particle physics, fundamental research and evidence-based decision-making around the world.

Primary authors: ABREU, Pedro (LIP Laboratorio de Instrumentacao e Fisica Experimental de Part); GOLDFARB, Steven (University of Melbourne (AU))

Presenter: GOLDFARB, Steven (University of Melbourne (AU))

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **26** Type: **Poster**

A New Approach to Probe Non-Standard Interactions in Atmospheric Neutrino Experiments

Monday, January 10, 2022 4:20 PM (1 minute)

We propose a new approach to explore the neutral-current non-standard neutrino interactions (NSI) in atmospheric neutrino experiments using oscillation dips and valleys in reconstructed muon observables, at a detector like ICAL that can identify the muon charge. We focus on the flavor-changing NSI parameter $\varepsilon_{\mu\tau}$, which has the maximum impact on the muon survival probability in these experiments. We show that non-zero $\varepsilon_{\mu\tau}$ shifts the oscillation dip locations in L/E distributions of the up/down event ratios of reconstructed μ^- and μ^+ in opposite directions. We introduce a new variable Δd representing the difference of dip locations in μ^- and μ^+, which is sensitive to the magnitude as well as the sign of $\varepsilon_{\mu\tau}$, and is independent of the value of Δm^2_{32}. We further note that the oscillation valley in the $(E, \cos\theta)$ plane of the reconstructed muon observables bends in the presence of NSI, its curvature having opposite signs for μ^- and μ^+. We demonstrate the identification of NSI with this curvature, which is feasible for detectors like ICAL having excellent muon energy and direction resolutions. We illustrate how the measurement of contrast in the curvatures of valleys in μ^- and μ^+ can be used to estimate $\varepsilon_{\mu\tau}$. Using these proposed oscillation dip and valley measurements, the achievable precision on $|\varepsilon_{\mu\tau}|$ at 90% C.L. is about 2% with 500 kt·yr exposure. The effects of statistical fluctuations, systematic errors, and uncertainties in oscillation parameters have been incorporated using multiple sets of simulated data. Our method would provide a direct and robust measurement of $\varepsilon_{\mu\tau}$ in the multi-GeV energy range.

Primary authors: Mr KUMAR, Anil (Institute of Physics, Bhubaneswar, SINP, Kolkata, HBNI, Mumbai, India); Dr KHATUN, Amina (Comenius University, Bratislava, Slovakia,); Prof. AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar, HBNI, Mumbai, ICTP, Trieste,); Prof. DIGHE, Amol (TIFR, Mumbai)

Presenter: Mr KUMAR, Anil (Institute of Physics, Bhubaneswar, SINP, Kolkata, HBNI, Mumbai, India)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **29** Type: **Poster**

Measurements of the R value at BESIII

Monday, January 10, 2022 4:31 PM (1 minute)

The R value, defined as the ratio of the inclusive hadronic cross section and the muon cross section in e+e- collisions, is an important input for the calculation of the Standard Model predictions of the anomalous magnetic moment of the muon a_mu and the running of the QED coupling constant alpha_QED(m_Z) evaluated at Z pole. The BESIII collaboration has collected data with high statistics to measure the R value at more than 130 scan points between 2.0 and 4.6 GeV.
In this presentation, the measurement between 2.2324 and 3.6710 GeV is discussed. On average, a total uncertainty of less than 3% is achieved, which is dominated by the systematic uncertainty.

Primary author: LIU, Beijiang

Presenter: LIU, Dong

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **30** Type: **Parallel session talk**

Recent result of baryon time-like form factors at BESIII

Tuesday, January 11, 2022 3:00 PM (20 minutes)

Electromagnetic form factors allow to investigate fundamental properties of the baryons.
The BESIII collaboration has studied the time-like form factors of the proton and neutron with significantly improved precision. An intriguing periodic behavior of effective form factors lineshape is observed for both proton and neutron. Hyperons provide a unique avenue to study the strong interaction in baryon structure. Due to the unstable nature of hyperon, their form factors are usually studied in time-like via e+e- annihilations experiments. With the unique data sets obtained by the BESIII collaboration, the pair production cross sections for Lambda, Sigma, Xi, and Lambda_c are studied from threshold, where some abnormal threshold effects are observed. Using the self-analyzing weak decays of the Lambda and Lambda_c, the relative phase between the electric and magnetic form factors is measured. In this presentation the latest results on baryon form factors at BESIII are discussed.

Primary author: LIU, Beijiang

Presenter: SONG, Weimin (Jilin University College of Physics (CN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **31** Type: **Poster**

Cross sections measurement and search for exotic states at BESIII

Monday, January 10, 2022 4:30 PM (1 minute)

With the data samples collected above DDbar open charm threshold at BESIII, Born cross sections of electron positron annihilation into various final states have been measured, in order to search exotic charmonium-like states. Some recent results will be reported in this presentation including the following processes: e+ e- -> D*s+ DsJ-, e+ e- -> gamma chi_c0/1/2, e+ e- -> pi+ pi- psi(2S), observation of psi(3770) -> Lambda anti-Lambda.

Primary author: LIU, Beijiang

Presenter: BLOMS, Johannes

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **32** Type: **Poster**

Studies of charmonium decay from BESIII

Monday, January 10, 2022 4:29 PM (1 minute)

We shall report recent measurements of branching fractions of J/psi, chi_cJ or psi(2S) decays. It will contains the following studies: branching fraction of psi(2S)-> Sigma anti-Lambda +c.c., inclusive branching fraction of psi(2S) -> Ks + anything, observation of chi_cJ -> n Ks anti-Lambda, branching fraction of J/psi and psi(2S) -> Sigma+ anti-Sigma-.

Primary author: LIU, Beijiang

Presenter: BAKINA, Olga (Joint Institute for Nuclear Research)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **33** Type: **Parallel session talk**

(Semi-)Leptonic D decays at BESIII

Wednesday, January 12, 2022 12:20 PM (20 minutes)

BESIII has collected 2.93 fb-1 of data at 3.773 GeV, and 6.3 fb-1 of data between 4.18 and 4.23 GeV, respectively. We will report precison measurements of the decay constants fDs+ and the CKM matrix elements |Vcs| via D(s)+ -> l+v (l=mu, tau), which are important to test the LQCD calculations and the CKM matrix unitarity. We will also present observation of semileptonic decays of D0(+) -> K_1(1270) e+ nu, D0 -> rho- mu+ nu, and D+->omega mu+ nu. Tests of lepton flavor universality are also made via leptonic and semileptonic D decays. Also, precision measurements of form factors of Ds->K K e+ nu and pi pi e+ nu will be reported.

Primary author: LIU, Beijiang

Presenter: LI, Lanxing (University of Manchester (GB))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **34** Type: **Parallel session talk**

Hadronic charm decays at BESIII

Wednesday, January 12, 2022 11:20 AM (20 minutes)

BESIII has collected 2.93 fb-1 of data at 3.773 GeV, 6.3 fb-1 of data between 4.18 and 4.23 GeV, and 4.4 fb-1 of data between 4.6 and 4.7 GeV, respectively. The data set collected at 3.773 GeV contains quantum-correlated D0D0bar pairs that allow access to the phase differences between amplitudes. We will report the measurements of strong phase differences in D0(-bar) decays, such as K_S/L pi+ pi-, K_S/L K+ K-, K- pi+ pi0 and K- pi+ pi+ pi-, which are key to constraining the future gamma/phi3 measurements at LHCb and Belle II. In addition, we will present the measurements of the absolute branching fraction or amplitude analysis of hadronic decays of D+, D0, Ds+ and Lambda_c+.

Primary author: LIU, Beijiang

Presenter: ZHANG, Yu (University of Oxford (GB))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **35** Type: **Poster**

Light hyperon physics at BESIII

Monday, January 10, 2022 4:28 PM (1 minute)

The BESIII experiment at the electron positron collider BEPCII in Beijing is successfully operating since 2008 and has collected large data samples in the tau-mass region, including the world's largest data samples at the J/psi and psi(2S) resonances. The recent observations of hyperon polarizations at BESIII opens a new window for testing CP violation, as it allows for simultaneous production and detection of hyperon and anti-hyperon pair two body weak decays. The CP-symmetry tests can be performed in processes like e.g. J/psi —> Lambda Lambdabar, J/psi —> Sigma Sigmabar and J/psi —> Xi Xibar. For the Xi —> Lambda pi decay it is possible to perform three independent CP tests and determine the strong phase and weak phase difference. In this presentation an outline of the methods and recent results achieved at BESIII will be highlighted.

Primary author: LIU, Beijiang

Presenter: YAN, Liang (Universita e INFN Torino (IT))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **36** Type: **Poster**

Light meson spectroscopy at BESIII

Monday, January 10, 2022 4:27 PM (1 minute)

Due to the high production of light mesons J/ψ radiative and hadronic decays, the largest sample of J/psi events accumulated at the BESIII detector offers a
unique laboratory to study the light mesons spectroscopy and search for the light exotic states. In this talk, we shall report the recent progresses on the light meson spectroscopy achieved at BESIII.

Primary author: LIU, Beijiang

Presenter: WEIDNER, Frederik

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **37** Type: **Parallel session talk**

New results on semileptonic B decays at Belle

Wednesday, January 12, 2022 9:40 AM (20 minutes)

Though the Belle experiment has stopped data taking more than a decade ago, new results on semileptonic B meson decays are still being obtained. This is in part due to new experimental tools elaborated for Belle II applied to the Belle data set, such as the FEI (Full Event Interpretation) hadronic and semileptonic tag. We report new results on differential branching fractions of inclusive $B \to X_u \ell\nu$ and q2 moments in $B \to X_c \ell\nu$, which improve |Vub| and |Vcb| measurements. We also present measurements on exclusive decays $B \to \pi\pi\ell\nu$, $B \to \eta^{(\prime)}\ell\nu$ and $B \to D^{**}\ell\nu$, which are relevant to |Vub| and R(D*) measurements.

Primary author: NISHIDA, Shohei (KEK)

Presenter: BERNLOCHNER, Florian Urs (University of Bonn (DE))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **38** Type: **Parallel session talk**

Searches for lepton flavor violation and lepton flavor universality violation

Tuesday, January 11, 2022 3:00 PM (20 minutes)

The lepton flavor violation is a clear signature of the new physics and has been searched for by many experiments. Such decays can be searched using large amount of B and Υ mesons produced at Belle. We present our search for $B \to \ell\tau$, $\Upsilon(nS) \to \ell\ell'$, $\ell\tau$ decays (\ell = e, \mu). We also present the final results on $\tau \to \ell\gamma$ at Belle. In addition, we present our search for $B \to K^*\tau\tau$, which could potentially test the lepton flavor universality together with $B \to K^*\ell\ell$. All these results are based on data collected by the Belle experiment at the KEKB asymmetric-energy e^+e^- collider.

Primary author: NISHIDA, Shohei (KEK)

Presenter: SANDILYA, Saurabh (Indian Institute of Technology Hyderabad)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **40** Type: **Parallel session talk**

A polystyrene-based scintillator production process involving additive manufacturing

Wednesday, January 12, 2022 10:00 AM (20 minutes)

Plastic scintillator detectors are widely used in high-energy physics, often as an active neutrino target, both in long and short baseline neutrino oscillation experiments. They can provide 3D tracking with 4π coverage and calorimetry of the neutrino interaction final state combined with very good particle identification capabilities and sub-nanosecond time resolution. Moreover, the large hydrogen content makes plastic scintillator detectors ideal for detecting neutrons. However, new experimental challenges and the need for enhanced performance require the construction of detector geometries that are challenging using current production techniques. The solution can be found in additive manufacturing, able to quickly make plastic-based objects of any shape. In this talk, the applicability of 3D-printing techniques to the manufacture of polystyrene-based scintillator will be discussed. We will report the feasibility of 3D printing polystyrene-based scintillator with light output performances comparable with that of detectors manufactured using standard production techniques. The latest advances in R&D aim at combining the 3D printing of plastic scintillator with other materials, such as optical reflectors or absorbers. The status of the R&D and the latest performance results will be presented.

Primary authors: SGALABERNA, Davide (ETH Zurich (CH)); KOSE, Umut (CERN EP-NU)

Presenter: DOLAN, Stephen (CERN)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **41** Type: **Parallel session talk**

New physics in $b \to s\ell\ell$ decays with complex Wilson coefficients.

Tuesday, January 11, 2022 3:20 PM (20 minutes)

We perform a data-driven analysis of new physics (NP) effects in exclusive $b \to s\ell^+\ell^-$ decays in a
model-independent effective theory approach with dimension six operators considering scalar, pseudo-scalar,
vector and axial-vector operators with the corresponding Wilson coefficients (WC) taken to be complex. The
analysis has been done with the most recent data while comparing the outcome with that from the relatively
old dataset. We find that a left-handed quark current with vector muon coupling (O_9) is the only one-operator scenario that can explain the data in both the cases with real and complex WC with a non-zero
imaginary contribution. This is the case even if all the CP-asymmetric observables are dropped from
the fit. We have pointed out the corresponding CP-averaged and CP-asymmetric observables which could be the
probable source of such large imaginary contributions. We simultaneously apply model selection tools like cross-validation and information theoretic approach like Akaike Information Criterion (AIC_c) to find out the operator or sets of operators that
can best explain the available data in this channel. It is observed that O_9 with complex WC is the only
one-operator scenario which survives the test. However, there are a few two and three-operator scenarios
(with real or complex WCs) which survive the test, and the operator O_9 is common among them. For the selected scenarios, we have
provided predictions for various observables and compared them.

Primary author: RAY, IPSITA (IIT GUWAHATI, INDIA)

Co-authors: Dr BISWAS, Aritra (Indian Institute of Technology, Guwahati, India); Dr NANDI, Soumitra (Indian Institute of Technology, Guwahati, India); Dr PATRA, Sunando Kumar (Bangabasi Evening College, West Bengal, India)

Presenter: RAY, IPSITA (IIT GUWAHATI, INDIA)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **42** Type: **Parallel session talk**

LZ status and simulations

Tuesday, January 11, 2022 4:30 PM (20 minutes)

LUX-ZEPLIN (LZ) is a dark matter direct detection experiment currently being commissioned at the Sanford Underground Research Facility in Lead, South Dakota. At the heart of the detector is a dual-phase time projection chamber containing 7 tonnes of active liquid xenon. During its 1000-day science run, LZ aims to achieve unprecedented sensitivity to Weakly Interacting Massive Particles (WIMPs) down to a WIMP-nucleon spin-independent cross section of about $1.4 \times 10^{-48} cm^2$ for a $40 GeV/c^2$ mass WIMP. In this talk I will introduce the LZ detector and the status of the experiment. I will also give an overview of the LZ simulation framework and how it is used to predict LZ's sensitivity to additional well motivated dark matter models and physics beyond the Standard Model searches.

Primary authors: FRUTH, Theresa (UCL); FOR THE LZ COLLABORATION

Presenter: FRUTH, Theresa (UCL)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **43** Type: **Parallel session talk**

Dark-sector physics at Belle II

Wednesday, January 12, 2022 11:20 AM (20 minutes)

The Belle II experiment is in the unique position of probing a yet uncharted sector of particle physics, which includes hypothetical particles coupling very weekly with the standard model ones that might help explaining the nature of dark matter and other anomalies. Belle II analyzed 0.5 fb-1 of commissioning data to exclude part of the parameter space of models including low mass Z' bosons and axion-like particles. The results of a new search for Dark-Higgstrahlung processes, obtained on the 2019 data set, are presented and longer-term reach on a variety of Dark Sector signatures are also discussed.

Primary author: LIBBY, James (Indian Institute of Technology Madras (IN))

Presenter: HAIGH, Huw (Austrian Academy of Sciences (AT))

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **44** Type: **Parallel session talk**

Tau physics at Belle II

Tuesday, January 11, 2022 4:30 PM (20 minutes)

The low-background environment of electron-positron collisions along with the large expected sample size and an hermetic detector make Belle II the premier experiment for studying tau-lepton physics. A competitive measurement of the mass of the tau lepton is reported based on a a small data set, and studies for world-leading measurements of tau lifetimes, foreseen with significantly less data than collected at Belle and Babar, are discussed. Perspectives on tests of lepton (flavor) universality and other searches for non-SM physics in tau decays are also outlined.

Primary author: LIBBY, James (Indian Institute of Technology Madras (IN))

Presenter: GRUBEROVA, Zuzana (Charles University)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **45** Type: **Parallel session talk**

Hadronic B decays at Belle II

Wednesday, January 12, 2022 10:00 AM (20 minutes)

The analysis of B-meson decays to charmed and charmless hadronic final states is a keystone of the Belle II physics program. It allows for theoretically reliable and experimentally precise constraints on the CKM Unitarity Triangle fit, and is sensitive to effects from non-SM physics. Results on branching ratios, direct CP-violating asymmetries, and polarization of various channels, with particular emphasis on those for which Belle II will have unique sensitivity, are shown. Perspectives on the precision achievable on the CKM angles alpha/phi_2 and gamma/phi_3, and on the so called “Kpi puzzle” are also discussed.

Primary author: LIBBY, James (Indian Institute of Technology Madras (IN))

Presenter: REIF, Markus

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **46** Type: **Parallel session talk**

Electoweak and radiative penguin decays at Belle II

Tuesday, January 11, 2022 2:20 PM (20 minutes)

Decays of B mesons that proceed through electroweak and radiative penguin amplitudes currently attract significant attention due to a number of observed discrepancies between the standard model predictions and the experimental results.
Belle II is expected to perform measurements on channels closely related to those exhibiting anomalies and that are uniquely available to Belle II. These include b -> s(d) nu nubar and b -> s(d) tau+ tau- transitions. We present the first signals observed with early data on b -> s gamma, b -> s l+ l- transitions, and discuss the limits on B+ -> K+ nu nubar obtained with a novel inclusive technique.

Primary author: LIBBY, James (Indian Institute of Technology Madras (IN))

Presenter: STEFKOVA, Slavomira (DESY)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **48** Type: **Parallel session talk**

Charm and time-dependent CP violation in B decay at Belle II

Wednesday, January 12, 2022 12:00 PM (20 minutes)

Analyses of D and B meson yields as functions of decay time provide access to fundamental standard model parameters and probe natural non-SM scales at 10-100 TeV energies. Outstanding vertexing performances are key enablers of this program. We prove the capabilities of the Belle II detector by measuring the lifetimes of the D0 and D+ mesons. The results are the most precise to date, owing to a vertexing resolution 2x better than that of Belle and BaBar. Perspectives on the sensitivity to the main observables in charm physics and on the achievable precision in time dependent CP violation in B decays will be discussed. First results obtained on relevant channels with early data sets are shown.

Primary author: LIBBY, James (Indian Institute of Technology Madras (IN))

Presenters: ZLEBCIK, Radek (Deutsches Elektronen-Synchrotron (DE)); ZLEBCIK, Radek (Charles University)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **49** Type: **Parallel session talk**

The CYGNO Experiment

Wednesday, January 12, 2022 12:20 PM (20 minutes)

The detection of ultra-rare events as the interaction of galactic dark matter (DM) candidate particles or of neutrinos originated from the Sun requires the development of innovative detection techniques. In particular future experiments for direct DM detection requires to extend their sensitivity to masses well below 10 GeV.
The Cygno collaboration plans to build and operate at LNGS a cubic meter demonstrator of a gaseous time projection chamber (TPC), equipped with an optical readout and using a He:CF4 mixture kept at atmospheric pressure. The presence of low Z atoms allows to reach a competitive sensitivity to DM masses in the GeV range while the presence of fluorine can be used to set limits on a spin-dependent DM interaction cross-section.
The Cygno TPC is equipped with a Gas Electron Multipliers (GEM) amplification stage of the primary ionisation electrons. Light is produced from the GEM while scientific CMOS camers and fast photodetectors are combined to obtaining a three-dimensional reconstruction of the tracks either due to nuclear or to electron recoils.

The design and the sensitivity of the demonstrator based on advanced Monte Carlo simulations of the radioactivity of the materials and of the LNGS cavern are reported. Pattern recognition algorithms are used to evaluate the identification capability of nuclear recoils against electronic recoils and studied in data from small scale prototypes. Energy measurement and also sensitivity to the source directionality are also evaluated. Therefore, a Cygno TPC would also be able to detect electron recoils originated by solar neutrinos interactions.
The Cygno collaboration plans to demonstrated the scalability of such detector concept to reach a target mass large enough to significantly extend our knowledge about DM nature and solar neutrinos.

Primary author: DI MARCO, Emanuele (INFN, Roma 1 (IT))

Presenter: PINCI, Davide (Sapienza Universita e INFN, Roma I (IT))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **50** Type: **Poster**

Probing dark matter with ILC

Monday, January 10, 2022 4:37 PM (1 minute)

The International Linear Collider (ILC) offers a number of unique opportunities for searches for dark matter and dark sector particles. The collider program will offer important capabilities, including precision Higgs measurements, searches for new scalars or mono-photon studies. But the ILC will also enable new fixed-target experiments using the high-energy electron and positron beams, both beam dump experiments and dedicated experiments using single beams. This talk will describe the expectations for these programs, which address all of the possible dark sector portals.

Primary author: ZARNECKI, Aleksander Filip (University of Warsaw)

Presenter: ZARNECKI, Aleksander Filip (University of Warsaw)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **51** Type: **Poster**

The T2K experiment measures the neutrino oscillation parameters by observing ν_μ ($\bar{\nu}_\mu$) disappearance and ν_e ($\bar{\nu}_e$) appearance from a ν_μ($\bar{\nu}_\mu$) beam. The events are observed in the near detector ND280 and the far detector Super−Kamiokande (SK) situated at 280 m and 295 km respectively from the beam production target. In SK, the products of ν and $\bar{\nu}$ interactions produce Cherenkov rings. Charged current quasi−elastic (CCQE) interactions, the most dominant in the T2K energy region produce single ring CC events used for analyses. Resonant 1π production, the second dominant CC interaction in this energy region will have multi−ring topology and can be included to increase statistics. The addition of CC $\nu_\mu 1\pi^+$ ($\nu_e 1\pi^+$) samples are expected to improve the precision on $\sin^2\theta_{23}$ and $|\Delta m^2{}_{32}|$ (leptonic CP phase δ_{CP}). Studies on the selection of CC 1π like events accumulated from forward horn current (FHC) operation are performed for ν_μ and ν_e samples. Estimation of different systematic uncertainties are important for oscillation sensitivity studies. One main contribution is detector systematic uncertainities related to the selection variables of samples including multi−ring samples. These are estimated via a fit to atmospheric neutrinos events collected in Super-K. We present the selection of multi−ring samples as well as the process of estimation of detector systematic uncertainties.

Monday, January 10, 2022 4:19 PM (1 minute)

The T2K experiment measures the neutrino oscillation parameters by observing ν_μ ($\bar{\nu}_\mu$) disappearance and ν_e ($\bar{\nu}_e$) appearance from a ν_μ($\bar{\nu}_\mu$) beam. The events are observed in the near detector ND280 and the far detector Super−Kamiokande (SK) situated at 280 m and 295 km respectively from the beam production target. In SK, the products of ν and $\bar{\nu}$ interactions produce Cherenkov rings. Charged current quasi−elastic (CCQE) interactions, the most dominant in the T2K energy region produce single ring CC events used for analyses. Resonant 1π production, the second dominant CC interaction in this energy region will have multi−ring topology and can be included to increase statistics. The addition of CC $\nu_\mu 1\pi^+$ ($\nu_e 1\pi^+$) samples are expected to improve the precision on $\sin^2\theta_{23}$ and $|\Delta m^2{}_{32}|$ (leptonic CP phase δ_{CP}). Studies on the selection of CC 1π

like events accumulated from forward horn current (FHC) operation are performed for ν_μ and ν_e samples. Estimation of different systematic uncertainties are important for oscillation sensitivity studies. One main contribution is detector systematic uncertainities related to the selection variables of samples including multi–ring samples. These are estimated via a fit to atmospheric neutrinos events collected in Super-K. We present the selection of multi–ring samples as well as the process of estimation of detector systematic uncertainties.

Primary authors: FERNANDES VILELA, Cristovao (CERN); REH, Michael (University of Colorado Boulder (US)); Dr LAKSHMI, S Mohan (National Centre for Nuclear Research, Warsaw); TOWSTEGO, Trevor (University of Toronto (CA))

Presenter: Dr LAKSHMI, S Mohan (National Centre for Nuclear Research, Warsaw)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **52** Type: **Poster**

Sensitivity of future e+e- colliders to processes of dark matter production with light mediator exchange

Monday, January 10, 2022 4:36 PM (1 minute)

High energy ⊠+⊠– colliders offer unique possibility for the most general search for dark matter (DM) based on the mono-photon signature. As any ⊠+⊠– collision processmay include hard initial-state photon radiation, analysis of the energy spectrum and angular distributions of observed photons can be used to search for hard processes with an invisible final state.
We consider production of DM particles at the International Linear Collider (ILC) and Compact Linear Collider (CLIC) experiments via a mediator exchange. Dedicated procedure of merging the matrix element calculations with the lepton ISR structure function was developed to model the Standard Model background processes contributing to mono-photon signature with WHIZARD.
Detector effects are taken into account within the DELPHES fast simulation framework. Limits on the light DM production cross section in a simplified model are set as a function of the mediator mass and width based on the expected two-dimensional distributions of the reconstructed mono-photon events.
Limits on the mediator couplings are then presented for a wide range of mediator masses and widths. For light mediators, for masses up to the centre-of-mass energy of the collider, coupling limits derived from the mono-photon analysis are more stringent than those expected from direct resonance searches in decay channels to SM particles.

Primary author: KALINOWSKI, Jan Henryk (University of Warsaw)

Co-authors: ZARNECKI, Aleksander Filip (University of Warsaw); MEKALA, Krzysztof (University of Warsaw); KOTLARSKI, Wojciech (TU - Dresden); SOPICKI, Pawel (University of Warsaw (PL))

Presenter: KALINOWSKI, Jan Henryk (University of Warsaw)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **54** Type: **Parallel session talk**

Un-binned Angular Analysis of $B \to D^* \ell \nu$ and the Right-handed Current

Wednesday, January 12, 2022 9:00 AM (20 minutes)

In this talk, I will present the results of a sensitivity study of un-binned angular analysis of $B \to D^* \ell \nu$ decay, including the contributions from the right-handed vector current. I will show that the angular observables can constrain very strongly the right-handed current without the intervention of the yet unsolved Vcb puzzle.

Primary authors: LU, Caidian; KOU, Emi; HUANG, Zhuoran (APCTP); TANG, Ruying

Presenter: HUANG, Zhuoran (APCTP)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **55** Type: **Poster**

The full electroweak $\mathcal{O}(\alpha)$ corrections to charged Higgs pair production via photon-photon collisions

Monday, January 10, 2022 4:23 PM (1 minute)

We provide high-precision predictions for the charged Higgs pair production via photon-photon collisions in the framework of two Higgs doublet model (2HDM), taking into account a full set of one-loop-level scattering amplitudes. We include the full electroweak (EW) corrections together with soft and hard QED radiation in the calculations. The production rates in different polarization collision modes of initial beams are also discussed. It can be enhanced up to two-times by oppositely polarized photons at high energies and right-handed polarized photons at low energies. Our results show that the full EW corrections must be included to improve a percent level accuracy.

Primary author: Dr DEMIRCI, Mehmet (Karadeniz Technical University)

Presenter: Dr DEMIRCI, Mehmet (Karadeniz Technical University)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **56** Type: **Parallel session talk**

Latest Three Flavor Neutrino Oscillation Results from NOvA

Tuesday, January 11, 2022 3:00 PM (20 minutes)

NOvA is a long-baseline, accelerator neutrino experiment measuring oscillation and interaction physics. The NuMI beam at Fermilab is used to generate muon neutrinos that pass in their un-oscillated state through the Near Detector, located at Fermilab, and the Far Detector 810 km away in Ash River, Minnesota. NOvA studies the muon neutrino deficit and electron neutrino excess with both neutrino and antineutrino beams at the Far Detector, to measure the neutrino oscillation parameters θ_{23} and Δm^2_{32}, as well having sensitivity to the neutrino mass ordering and the CP-violation phase, δ_{CP}. In this talk we present the latest neutrino oscillation results from NOvA using both neutrino and antineutrino data, with 13.6×10^{20} and 12.5×10^{20} proton-on-target respectively.

Primary author: SZTUC, Artur (UCL (University College London))

Presenter: SZTUC, Artur (UCL (University College London))

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **57** Type: **Parallel session talk**

Cryogenic characterisation of Silicon Photomultipliers for future Dark Matter experiments

Wednesday, January 12, 2022 9:20 AM (20 minutes)

The Silicon photomultipliers are extensively studied at room temperatures whereas only a limited research has been done on them at cryogenic temperatures. The recent R&D for underground low energy particle physics experiments involve SiPMs extensively as the prime photo-detectors due to their ability to enhance the sensitivity of the rare particle events. For cryogenic applications, the SiPMs by LFoundry are being characterised at LNGS, Italy have Dark Count rate of 0.1 cps/□□2-0.3 cps/□□2 over the range of 5-8V over-voltage with afterpulse probability upto 10%. The internal CrossTalk (iCT) on the other hand, increases significantly with over-voltage introducing an excess of noise that can spoil the resolution of the measurement. Specific electronics was designed to test 1cm^2 SiPMs to calculate the iCT. A dedicated Poissonian laser model was constructed to satisfy the observed data also in comparison with other existing models. The PDE is another vital parameter that was modelled for cryogenic temperatures down to 87-77K through the direct measurements of triggering probability. For this purpose, a separate setup with two 1 mm^2 SiPMs were mounted and cooled down to 77K and then equally illuminated by different wavelengths' lasers. With the careful modelling of depletion region and absorption length in the SiPM lattice structure, SiPMs can be customised for cryogenic applications with PDE close to 60%. Additionally, external CrossTalk (eCT) phenomena was also explored, where a photon generated can escape the silicon bulk, reflected and reaches other SiPMs in the setup. This effect could be significant for TPCs in Dark Matter detectors where photo-detectors the top and bottom array face each other. Through frequentist approach of likelihood analysis, the parameters to extract the eCT probability in the setup of 4 SiPMs are obtained for different reflector materials. In this talk, SiPM noise contributions will be elaborated. The results of studies done for such noises and SiPM performance at cryogenic temperatures will be highlighted.

Primary authors: Dr RAZETO, Alessandro (Laboratori Nazionali del Gran Sasso); KACHRU, Priyanka (Gran Sasso Science Institute (IT))

Presenter: KACHRU, Priyanka (Gran Sasso Science Institute (IT))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **58** Type: **Parallel session talk**

Towards gender equality in High Energy Physics

Wednesday, January 12, 2022 9:00 AM (20 minutes)

Despite great strides in gender inclusivity in the sciences in the last millennium, the equal participation of women in sciences remains a distant dream. Dominant conceptions and practices of scientific knowledge attribution, dissemination and acquisition systematically continue to disadvantage women. This is particularly true in Physics. Gender diversity is a basic requirement of a democratic society and it is also imperative to the survival and advancement of science as a multitude of styles and approaches are needed to solve important physical problems. While participation of women at the undergraduate level is steadily increasing, there is a "Glass Ceiling Effect". In India , it has been noted that while faculty enrollment of women in medicine is about 44%, that in physical sciences is only 16%. With reference to women in High Energy Physics in India the situation is worse, and less than 10% (looking at the the Universities, IITs, IISERs, NITs, National Labs etc.). Gendered under-representation and lack of leadership go hand in hand. To have the opportunity and vision to be a leader, one must have a supportive environment, high self - esteem and good interpersonal skills. A realistic goal we hope to reach is a representation of 20% of women in High Energy Physics in next 10-15 years. The Indian high energy Community has recognized this fact and has initiated several proactive measures towards achieving this goal. To mention a few, the Indian Physics Association (IPA) formalized a working group on Gender in Physics with the mandate of coordinating national efforts towards gender parity in Indian physics profession. It organized a national level conference Pressing for Progress at University of Hyderabad in September 2019, the outcome of which is known as The Hyderabad Charter for Gender Equity in Physics. In the national level High Energy Physics symposium 2020, a special session was dedicated to deliberate the issues related to Gender-gap in Physics. This has set the precedent for gender diversity discussions at future meetings. Female role models have had a profound impact on young women's achievement and aspirations, in part because they represent the possibility of overcoming gender barriers to achieve success. In this context , A special article in Physics News has been published remembering Dr. Bibha Chowdhuri, the first Woman Particle Physicist in India. In this talk these and other efforts at achieving a gender parity in high energy physics will be discussed.

Primary authors: Prof. SRIVASTAVA, Ajit M (Institute of Physics, Bhybaneswar, India); Prof. BAMBAH, Bindu Anubha (University of Hyderabad); MOHANTA, Rukmani (University of Hyderabad); Prof. DAHIYA, Harleen (Dr. B.R. Ambedkar National Institute of Technology, Jalandhar – 144011, India); Prof. GOSWAMI, Srubabati (Physical Research Laboratory, Ahmedabad – 380009, India)

Presenter: MOHANTA, Rukmani (University of Hyderabad)

Session Classification: Science in Society

Track Classification: Equality, Diversity, and Inclusion

Contribution ID: **62** Type: **Poster**

Very forward calorimeters for future electron-positron colliders

Monday, January 10, 2022 4:26 PM (1 minute)

Detectors at future e+e- colliders need special calorimeters in the very forward region for a fast estimate and precise measurement of the luminosity, to improve the hermeticity and mask the central tracking detectors from backscattered particles. In our concept, two compact calorimeters are foreseen, LumiCal and BeamCal. Both are designed as sandwich calorimeters with very thin sensor planes to keep the Molière radius small, facilitating such the measurement of electron showers in the presence of background. Silicon sensor prototypes and dedicated FE ASICs have been developed and produced. The ASICs match the timing and dynamic range requirements. In the recent beam tests, a multi-plane compact prototype was equipped with thin sensor planes fully assembled with the new readout electronics and installed in 1 mm gaps between tungsten plates of one radiation length thickness. The latest status of the calorimeter prototype development will be presented, including selected performance results, obtained in a 5 GeV electron beam at DESY, as well as the expected performance obtained from simulation.

Co-author: Dr GHENESCU, Veta (Institute of Space Science (RO))

Presenters: SMILJANIC, Ivan (Vinca Institute of Nuclear Sciences, University of Belgrade (RS)); SMILJANIC, Ivan (Vinca Institute of Nuclear Sciences)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **63** Type: **Parallel session talk**

Silicon pixel-detector R&D for future lepton colliders

Wednesday, January 12, 2022 9:00 AM (20 minutes)

The physics aims at future lepton colliders such as CLIC or FCC-ee pose challenging demands on the performance of the proposed all-silicon vertex and tracking-detector systems. A single-plane spatial resolution of a few micrometers is needed, combined with a low mass of ~0.2% X0 per layer for the vertex detectors and ~1% X0 per layer for the main trackers. Moreover, hit-time tagging with a few nanosecond resolution is required for CLIC, to reduce the impact of beam-induced background on the measurement accuracy to an acceptable level. An even better timing precision below 100 ps on pixel level would improve the background rejection further, and opens up the possibility of particle-identification by time of flight measurements within the tracking layers.

To address these detector requirements, a broad R&D program on new silicon detector technologies is being pursued within various collaborative frameworks, such as the CERN EP R&D programme, AIDAinnova and the CLICdp collaboration. Different small pitch (25 micron) hybrid technologies with innovative sensor concepts are explored as candidates for the inner vertex-detector layers. A dedicated 65 nm readout chip (CLICpix2) has been developed and interconnected via fine pitch bump-bonding to 50-150 micron thin planar active-edge sensors. Furthermore, alternative interconnects such as bonding using anisotropic conductive films (ACF) are explored. Fully monolithic CMOS technologies are considered both for the vertex and the tracking detectors. Based on 3D TCAD simulations and previous test results, innovative concepts for CMOS sensors with a small collection electrode have been developed, targeting various future projects. Several prototype chips have been produced using variants of a modified 180 nm CMOS process with different substrate materials. The CLICTD tracker demonstrator design includes an innovative sub-pixel segmentation scheme for a readout pitch of 300 micron x 30 micron. An extensive test-beam measurement campaign has been performed to compare the various CLICTD design and processing variants. Recent measurements with the ATTRACT FASTPIX timing demonstrator produced in the same 180 nm CMOS process have demonstrated the feasibility of performing time tagging on single-hit level with a precision of approximately 100 ps for a pixel pitch of 20 micron and below. Similar concepts are currently being explored in a 65 nm CMOS process offering further performance improvements. To predict and optimise the performance of the various prototype technologies, a fast and versatile Monte Carlo Simulation Tool (Allpix-Squared) has been developed.

This contribution introduces the requirements and gives an overview of the R&D program for silicon-based vertex and tracking detectors at future lepton colliders, highlighting new results from measurements and simulations of recent prototypes.

Primary author: DANNHEIM, Dominik (CERN)

Presenter: DORT, Katharina (CERN, Justus-Liebig-Universitaet Giessen (DE))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **65** Type: **Parallel session talk**

The Light Dark Matter eXperiment, LDMX

Wednesday, January 12, 2022 12:20 PM (20 minutes)

The constituents of dark matter are still unknown, and the viable possibilities span a very large mass range. Specific scenarios for the origin of dark matter sharpen the focus on a narrower range of masses: the natural scenario where dark matter originates from thermal contact with familiar matter in the early Universe requires the DM mass to lie within about an MeV to 100 TeV. Considerable experimental attention has been given to exploring Weakly Interacting Massive Particles in the upper end of this range (few GeV – ~TeV), while the region ~MeV to ~GeV is largely unexplored. Most of the stable constituents of known matter have masses in this lower range, tantalizing hints for physics beyond the Standard Model have been found here, and a thermal origin for dark matter works in a simple and predictive manner in this mass range as well. It is therefore a priority to explore. If there is an interaction between light DM and ordinary matter, as there must be in the case of a thermal origin, then there necessarily is a production mechanism in accelerator-based experiments. The most sensitive way, (if the interaction is not electron-phobic) to search for this production is to use a primary electron beam to produce DM in fixed-target collisions. The Light Dark Matter eXperiment (LDMX) is a planned electron-beam fixed-target missing-momentum experiment that has unique sensitivity to light DM in the sub-GeV range. This contribution will give an overview of the theoretical motivation, the main experimental challenges and how they are addressed, as well as projected sensitivities in comparison to other experiments.

Primary author: GROUP, Robert (University of Virginia)

Presenter: MIDDLETON, Sophie (Caltech)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **66** Type: **Poster**

Modification of Neutrino Floor: Case of $U(1)_{L_\mu - L_\tau}$ Model

Monday, January 10, 2022 4:15 PM (1 minute)

In this work, we investigate the beyond standard model (BSM) impact of leptophilic U(1) models, specifically $U(1)_{L_\mu - L_\tau}$ on coherent elastic neutrino-nucleus scattering (CEνNS) and hence its effect on dark matter (DM) direct detection experiments. Imposing the latest relevant experimental constraints on these models, we obtain $\mathcal{O}(50\%)$ enhancement for case of $U(1)_{L_\mu - L_\tau}$ in a region $m'_Z \approx 20$ MeV. Subsequently, we observe that the enhancement seen in CEνNS is roughly getting translated to enhancement by a factor of 2.7 (for Germanium based detectors) and 1.8 (for Xenon based detectors) in the neutrino scattering event rate which eventually enhances the neutrino floor by same amount.
This enhancement is more prominent in the region with DM masses less than 10 GeV. The model parameter space that leads to this enhancement, can simultaneously explain both anomalous magnetic moment of muon ($(g-2)_\mu$) and observed DM relic density, in a modified scenario.

Primary author: SADHUKHAN, Soumya (Ramakrishna Mission Residential College (Autonomous), Narendrapur)

Presenter: SADHUKHAN, Soumya (Ramakrishna Mission Residential College (Autonomous), Narendrapur)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **67** Type: **Parallel session talk**

T2K Status and plans

Tuesday, January 11, 2022 3:20 PM (20 minutes)

T2K is a long baseline experiment providing world-leading measurements of the parameters governing neutrino oscillation. T2K data enable the first 3 sigma exclusion for some intervals of the CP-violating phase \delta_{CP} and precision measurements of the atmospheric parameters \Delta_m^{2}{32}, sin^2(\theta{23}).
T2K exploits a beam of muon neutrinos and antineutrinos at the Japan Particle Accelerator Research Centre (JPARC) and it measures oscillations by comparing neutrino rates and spectra at a near detector complex, located at JPARC, and at the water-Cherenkov detector Super Kamiokande, located 295 Km away. The T2K beam will be upgraded with increased power in 2022 and an upgrade of the ND280 near detector, located 2.5 degrees off-axis, is being assembled to exploit the increased statistics. Moreover, the Super Kamiokande detector has been loaded with 0.02% of Gadolinium in 2020, enabling enhanced neutron tagging.
In preparation for the exploitation of such data, the T2K collaboration is working on an updated oscillation analysis to improve the control of systematic uncertainties A new beam tuning has been developed, based on an improved NA61/SHINE measurements on a copy of the T2K target and including a refined modelling of the beam line materials. New selections are being developed at ND280, with proton and photon tagging, and at Super Kamiokande, extending pion tagging to muon neutrino samples. After reviewing the latest measurements of oscillation parameters, the status of such new analysis developments and the plan to deploy the beam and ND280 upgrade will be presented.

Primary author: THE T2K COLLABORATION

Presenter: DOYLE, Tristan (Lancaster University)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **70** Type: **Poster**

On the significance of the flavour anomalies

Monday, January 10, 2022 4:21 PM (1 minute)

A coherent pattern of deviations from Standard Model predictions has been observed in b-hadron decays of the type $b \to s\ell^+\ell^-$. These deviations seem to indicate
the existence of a new fundamental interaction that breaks lepton flavour universality (LFU).
We discuss the Look Elsewhere Effect in estimating the significance
of this hypothesis and, more generally, any new physics of short-distance origin
in this system, by combining different observables.
We show that even using a very conservative approach towards theory uncertainties, and very general new-physics hypotheses, a significance of about 4 sigma is obtained.
In view of future experimental tests of LFU in these channels, we present a general expression that allows one to include in the fit of modified Wilson coefficients also observables such as R_{pK}, $R_{K\pi}$ and $R_{K\pi\pi}$, for which the form factors are unknown. We show that the inclusion of such observables can have a dramatic effect on the new physics significance.

Primary authors: MATHAD, Abhijit (Universitaet Zuerich (CH)); SERRA, Nicola (Universitaet Zuerich (CH)); ISIDORI, Gino (Universitaet Zuerich (CH)); OWEN, Patrick Haworth (Universitaet Zuerich (CH)); SILVA COUTINHO, Rafael (Universitaet Zuerich (CH))

Presenter: LANCIERINI, Davide (University of Zurich (CH))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **71** Type: **Poster**

Heavy Neutrinos at Future Linear e+e- Colliders

Monday, January 10, 2022 4:35 PM (1 minute)

Neutrinos are probably the most mysterious particles of the Standard Model. The mass hierarchy and oscillations, as well as the nature of their antiparticles, are currently being studied in experiments around the world. Moreover, in many models of the New Physics, baryon asymmetry or dark matter density in the universe are explained by introducing new species of neutrinos. Among others, heavy neutrinos of the Dirac or Majorana nature were proposed to solve problems persistent in the Standard Model. Such neutrinos with masses above the EW scale could be produced at future linear e+e- colliders, like the Compact LInear Collider (CLIC) or the International Linear Collider (ILC).

We studied the possibility of observing production and decays of heavy neutrinos in qql final state at the ILC running at 500 GeV and 1 TeV and the CLIC running at 3 TeV. The analysis is based on the WHIZARD event generation and fast simulation of the detector response with DELPHES. Dirac and Majorana neutrinos with masses from 200 GeV to 3.2 TeV are considered. Estimated limits on the production cross sections and on the neutrino-lepton coupling are compared with the current limits coming from the LHC running at 13 TeV, as well as the expected future limits from hadron colliders. Impact of the gamma-induced backgrounds on the experimental sensitivity is also discussed. Obtained results are stricter than other limit estimates published so far.

Primary authors: ZARNECKI, Aleksander Filip (University of Warsaw); Mr MEKALA, Krzysztof (University of Warsaw); REUTER, Jürgen (DESY Hamburg, Germany); BRASS, Simon (DESY)

Presenter: Mr MEKALA, Krzysztof (University of Warsaw)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **72** Type: **Parallel session talk**

ATLAS Upgrades

Tuesday, January 11, 2022 2:00 PM (20 minutes)

With the end of RUN-II, the LHC has delivered only 4% of the collision data expected to be available during its lifetime. The next data-taking campaign – RUN-III – will double the integrated luminosity the LHC accumulated in 10 years of operation. The Run-III will be the herald of the HL-LHC era, an era when 90% of total LHC integrated luminosity (4 ab–1) will be accumulated allowing ATLAS to perform several precision measurements to constrain the Standard Model Theory (SM) in yet unexplored phase-spaces, in particular in the Higgs sector, only accessible at LHC. Direct searches have so far provided no indication of new physics beyond the Standard Model, however, they can be complemented by indirect searches that allow extending the reach at higher scales. Indirect searches are based on the ability to perform very precise measurements, a highly complex task at a hadron collider that will require tight control of theoretical predictions, reconstruction techniques, and detector operation. Moreover, populating extreme regions of phase-space for multi-differential production cross-section analysis will require the development and validation of Monte Carlo phase-space biasing techniques and efficient integration methods to produce the billions of events needed to cope with higher luminosities.

To answer the quest for high precision measurements in a high luminosity environment, a comprehensive upgrade of the detector and associated systems was devised and planned to be carried out in two phases. The Phase-I upgrade program foresees new features for the muon detector, for the electromagnetic calorimeter trigger system, and for all trigger and data acquisition chain and will operate to accumulate about 350 fb–1 of integrated luminosity during the RUN-III. The RUN-III will mark the debut of a new trigger system designed to cope with more than 80 simultaneous collisions per bunch crossing. After this, ATLAS will proceed with the Phase-II upgrade to prepare for the high luminosity frontier where the ATLAS experiment will face more than 200 simultaneous collisions per bunch crossing and a high radiation level for many subsystems. The Phase-II upgrade comprises a completely new all-silicon tracker with extended rapidity coverage that will replace the current inner tracker detector; the calorimeters and muon systems will have their trigger and data acquisition systems fully redesigned, allowing the implementation of a free-running readout system. Finally, a new subsystem called High Granularity Timing Detector will aid the track-vertex association in the forward region by incorporating timing information into the reconstructed tracks. A final ingredient, relevant to almost all measurements, is a precise determination of the delivered luminosity with systematic uncertainties below the percent level. This challenging task will be achieved by collecting the information from several detector systems using different and complementary techniques.

The presentation will focus on the status of ongoing detector upgrades and on the physics goals that have motivated them.

Primary author: ATLAS COLLABORATION

Presenter: AFFOLDER, Tony (University of California,Santa Cruz (US))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **74** Type: **Poster**

A High-Granularity Timing Detector for the ATLAS Phase-II upgrade

Monday, January 10, 2022 4:29 PM (1 minute)

The increase of the particle flux (pile-up) at the HL-LHC with instantaneous luminosities up to L ~ 7.5 × 10^{34} $cm^{-2}s^{-1}$ will have a severe impact on the ATLAS detector reconstruction and trigger performance.
The end-cap and forward region where the liquid Argon calorimeter has coarser granularity and the inner tracker has poorer momentum resolution will be particularly affected. A High Granularity Timing Detector (HGTD) will be installed in front of the LAr end-cap calorimeters for pile-up mitigation and luminosity measurement.

The HGTD is a novel detector introduced to augment the new all-silicon Inner Tracker in the pseudo-rapidity range from 2.4 to 4.0, adding the capability to measure charged-particle trajectories in time as well as space. Two silicon-sensor double-sided layers will provide precision timing information for minimum-ionising particles with a resolution as good as 30 ps per track in order to assign each particle to the correct vertex. Readout cells have a size of 1.3 mm × 1.3 mm, leading to a highly granular detector with 3.7 million channels.
Low Gain Avalanche Detectors (LGAD) technology has been chosen as it provides enough gain to reach the large signal over noise ratio needed.

The requirements and overall specifications of the HGTD will be presented as well as the technical design and the project status. The on-going R&D effort carried out to study the sensors, the readout ASIC, and the other components, supported by laboratory and test beam results, will also be presented.

Primary author: ATLAS COLLABORATION

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

Session Classification: R&D

Track Classification: R&D

Contribution ID: **76** Type: **Poster**

Triggering in ATLAS in Run 2 and Run 3

Monday, January 10, 2022 4:32 PM (1 minute)

The ATLAS experiment at the LHC can record about 3 kHz of physics collisions, out of an LHC design bunch crossing rate of 40 MHz. A two-level trigger system is used to achieve a high selection efficiency for rare physics events while reducing the significant background rate. The event selection is based on physics signatures, such as the presence of energetic leptons, photons, jets or missing energy. The trigger system also exploits algorithms using topological information and multivariate methods to cover the broad physics program pursued by ATLAS.

We will give an overview of the Run-2 trigger menu and its performance as well as an outlook to the upcoming ATLAS data-taking period in Run, 3 from 2022 onwards. We will present the design principles of the new trigger software within the multithreaded framework AthenaMT together with a summary of the expected performance improvements due to the Phase-1 Level-1 system upgrades and more sophisticated reconstruction techniques.

Primary author: ATLAS COLLABORATION

Presenter: MORGENSTERN, Stefanie (University of Warwick (UK))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **77** Type: **Poster**

Surface commissioning of the New Small Wheel upgrade project of the ATLAS Experiment

Monday, January 10, 2022 4:31 PM (1 minute)

The ATLAS experiment is currently upgrading the first muon station in the high-rapidity region with the construction of new detector structures, named New Small Wheels (NSW), based on large-size multi-gap resistive strips Micromegas technology and small-strip Thin Gap Chambers (sTGC). The first of the two NSW (NSW-A) has been fully commissioned and installed in the ATLAS underground cavern where the first tests are being performed. The second wheel (NSW-C) will be fully commissioned by the end of September and installed later this year.
The installation and tests of both wheels will be concluded by the end of the LHC long shutdown 2 and will be fully operative for Run 3.
In this presentation the motivation of the NSW upgrade and the current status of the project will be reviewed and the latest progress on both wheels will be reported, with particular focus to the challenges faced during the surface commissioning and results from tests performed for the first time on full sectors directly on the wheel.

Primary author: ATLAS COLLABORATION

Presenter: KOURKOUMELI-CHARALAMPIDI, Athina (Pavia University and INFN (IT))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **82** Type: **Poster**

Electron and photon energy measurement calibration with the ATLAS detector

Monday, January 10, 2022 4:35 PM (1 minute)

An accurate calibration of the energy measurement of electron and photon is needed for many ATLAS physics analyses, such as the Higgs boson mass measurement. The calibration of the energy measurement is performed in-situ using a large statistics of Z->ee events. A prerequisite of this calibration is a good understanding of the material in front of the calorimeter and of the inter-calibration of the different calorimeter layers. The Z->ee sample is also used to measure the energy resolution. High-precision calibration of the whole Run 2 dataset corresponding to an integrated luminosity of 140 fb-1 of pp collisions at sqrt(s)=13 TeV is presented for the first time, including several methodological improvements.

Primary author: ATLAS COLLABORATION

Presenter: LUCIO ALVES, Fabio Lucio (Nanjing University (CN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **83** Type: **Parallel session talk**

Search for rare and lepton flavor violating decays of the Higgs boson with the ATLAS detector

Tuesday, January 11, 2022 5:54 PM (16 minutes)

The Standard Model predicts several rare Higgs boson decay channels, among which are decays to a Z boson and a photon, H to Zgamma, to a low-mass lepton pair and a photon H to llgamma, and to a meson and photon. The observation of some of these decays could open the possibility of studying the CP and coupling properties of the Higgs boson in a complementary way to other analyses. In addition, lepton-flavor-violating decays of the observed Higgs boson are searched for, where on observation would be a clear sign of physics effects beyond the Standard Model. Several results for decays based on pp collision data collected at 13 TeV will be presented.

Primary author: ATLAS COLLABORATION

Presenter: BORECKA-BIELSKA, Hanna Maria (Universite de Montreal (CA))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **84** Type: **Parallel session talk**

Higgs boson measurements in its decays into bosons with the ATLAS experiment

Tuesday, January 11, 2022 4:50 PM (16 minutes)

With the full Run 2 pp collision dataset collected at 13 TeV, very detailed measurements of Higgs boson properties can be performed using its decays into bosons. This talk presents measurements of Higgs boson properties using decays into bosons, including production mode cross sections and simplified template cross sections, as well as their interpretations.

Primary author: ATLAS COLLABORATION

Presenter: ENARI, Yuji (University of Tokyo (JP))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **86** Type: **Parallel session talk**

Combined Higgs boson measurements and their interpretations in Effective Field Theories and new physics models with the ATLAS experiment

Tuesday, January 11, 2022 5:22 PM (16 minutes)

Combining measurements of many production and decay channels of the observed Higgs boson allows for the highest possible measurement precision for the properties of the Higgs boson and its interactions. These combined measurements are interpreted in various ways; specific scenarios of physics beyond the Standard Model are tested, as well as a generic extension in the framework of the Standard Model Effective Field Theory. The latest highlight results of these measurements and their interpretations performed by the ATLAS Collaboration will be discussed.

Primary author: ATLAS COLLABORATION

Presenter: MILDNER, Hannes (University of Sheffield (GB))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **87** Type: **Poster**

Measurement of Z boson production in association with jets at ATLAS

Monday, January 10, 2022 4:16 PM (1 minute)

Measurements of W/Z-boson production in association with jets are an important test of perturbative QCD prediction and also yield information about the parton distribution functions of the proton. Cross sections for Z-boson production in association with jets of high transverse momentum are presented. We will also discuss results of Z-boson production in association with heavy-flavour jets. If available measurements of the Z boson kinematics with inclusive selections will be presented. The data are compared to theoretical predictions provided by various Monte Carlo event generators.

Primary author: ATLAS COLLABORATION

Presenter: LAURIER, Alexandre (Carleton University (CA))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **88** Type: **Parallel session talk**

Measurements of multi-boson production including vector-boson scattering at ATLAS

Wednesday, January 12, 2022 12:00 PM (20 minutes)

Measurements of multiboson production at the LHC probe the electroweak gauge structure of the Standard Model for contributions from anomalous couplings. In this talk we present recent ATLAS results on the measurement of electroweak production of a Zgamma pair in association with two jets and the first observation of three W boson production. We also present the differential cross-section measurement of WW production in association with jets and the measurement of differential cross-sections of four-lepton events, containing two same-flavour, opposite-charge electron or muon pairs. Moreover, precise boson and diboson differential cross-section measurements are interpreted in a combined Effective Field Theory analysis, allowing to systematically probe gauge boson self-interactions. New results is available will be also presented.

Primary author: ATLAS COLLABORATION

Presenter: ZHU, Junjie (University of Michigan (US))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **89** Type: **Parallel session talk**

Determination of proton parton distribution functions using ATLAS data

Wednesday, January 12, 2022 9:20 AM (20 minutes)

We present fits to determine parton distribution functions (PDFs) using inclusive W/Z-boson and W+jets measurements from the ATLAS experiment at the LHC. The ATLAS measurements are used in combination with deep-inelastic scattering data from HERA. We also present the results of PDF fits that use Z+jets measurements from ATLAS in addition to the measurements listed above. An improved determination of the sea-quark densities at high Bjorken, x, is seen, while confirming a strange-quark density similar in size to the up- and down-sea-quark densities in the range $x < 0.02$ found by previous ATLAS analyses. If available, PDF fits including inclusive W and Z boson production, ttbar production, W+jets and Z+jets production, inclusive jet production and direct photon production will also be presented.

Primary author: ATLAS COLLABORATION

Presenter: MEONI, Evelin (Universita della Calabria e INFN (IT))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **92** Type: **Poster**

Measurements of the Standard Model Higgs boson in pp collisions at 13 TeV with the ATLAS detector, in its associated production with a W or Z boson and decaying into a pair of b-quarks

Monday, January 10, 2022 4:17 PM (1 minute)

The search for the most dominant decay mode of the Higgs boson, $H \to b\bar{b}$, proved to be an elusive and challenging due to the low signal-to-background ratio, and a diverse range of backgrounds arising from multiple Standard Model processes. The use of the production in association with a W or Z boson, while reducing the overall rate of the process, allowed on the other hand to use topologies with better sensitivity, ultimately leading to the observation of the $H \to b\bar{b}$ process, and the measurement of its cross section in various bins of the transverse momentum of the accompanying vector boson. The poster presents measurements of the WH and ZH production, with the W or Z boson decaying into charged leptons (electrons or muons, including those produced from the leptonic decay of a tau lepton), in the $H \to b\bar{b}$ decay channel in pp collisions at 13 TeV, corresponding to an integrated luminosity of 139 fb^{-1}, with the ATLAS detector are presented.

Primary author: ATLAS COLLABORATION

Presenter: TEE, Amy (University of Wisconsin Madison)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **93** Type: **Poster**

Search for associated production of a Z boson with an invisibly decaying Higgs boson or dark matter candidates with the ATLAS detector using full Run-II Data at LHC

Monday, January 10, 2022 4:18 PM (1 minute)

In the Standard Model, the Higgs boson can decay invisibly only through two Z bosons further decaying to neutrinos. The branching ratio for this process is predicted to be very small. However, in some Beyond Standard Model (BSM) theories, the Higgs boson can also decay to weakly interacting particles, candidates for Dark Matter (DM), that can not be detected by the ATLAS detector and arise as missing transverse momentum (ETMiss) in the events. Studies are presented for a search for an excess in events with two electrons or muons and ETMiss sensitive to DM decays of the Higgs boson if the Higgs boson is produced in association with a Z boson. The analysis is performed using proton–proton collisions at a centre-of-mass energy of 13 TeV, delivered by the LHC, corresponding to an integrated luminosity of 139 fb−1 and recorded by the ATLAS experiment. Results are interpreted as an upper limit on the branching ratio of the Higgs boson to invisible particles and exclusion limits are also set for simplified Dark Matter models and 2HDM+a models.

Primary author: ATLAS COLLABORATION

Presenter: ARENA, Eloisa (University of Liverpool (GB))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **95** Type: **Parallel session talk**

Searches for leptoquarks with the ATLAS detector

Wednesday, January 12, 2022 10:28 AM (16 minutes)

Leptoquarks (LQ) are predicted by many new physics theories to describe the similarities between the lepton and quark sectors of the Standard Model and offer an attractive potential explanation for the lepton flavour anomalies observed at LHCb and flavour factories. The ATLAS experiment has a broad program of direct searches for leptoquarks, coupling to the first-, second- or third-generation particles. This talk will present the most recent 13 TeV results on the searches for leptoquarks and contact interactions with the ATLAS detector, covering flavour-diagonal and cross-generational final states.

Primary author: ATLAS COLLABORATION

Presenter: VAZQUEZ SCHROEDER, Tamara (CERN)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **96** Type: **Parallel session talk**

Searches for new physics with leptons using the ATLAS detector

Wednesday, January 12, 2022 9:56 AM (16 minutes)

Many theories beyond the Standard Model predict new phenomena, such as Z', W' bosons, or heavy leptons, in final states with isolated, high-pt leptons (e/mu/tau). Searches for new physics with such signatures, produced either resonantly or non-resonantly, are performed using the ATLAS experiment at the LHC. This includes a novel search that exploits the lepton-charge asymmetry in events with an electron and muon pair. Lepton flavor violation (LVF) is a striking signature of potential beyond the Standard Model physics. The search for LFV with the ATLAS detector focuses on the decay of the Z boson into different flavour leptons (e/mu/tau). The recent 13 TeV pp results will be reported.

Primary author: ATLAS COLLABORATION

Presenter: WIELERS, Monika (RAL (UK))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **97** Type: **Parallel session talk**

Searches for new phenomena in final states with 3rd generation quarks using the ATLAS detector

Wednesday, January 12, 2022 10:12 AM (16 minutes)

Many theories beyond the Standard Model predict new phenomena, such as heavy vectors or scalar, and vector-like quarks, in final states containing bottom or top quarks. Such final states offer great potential to reduce the Standard Model background, although with significant challenges in reconstructing and identifying the decay products and modelling the remaining background. The recent 13 TeV pp results, along with the associated improvements in identification techniques, will be reported.

Primary author: ATLAS COLLABORATION

Presenter: BURGER, Angela Maria (Oklahoma State University (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **98** Type: **Parallel session talk**

Searches for BSM physics using challenging and long-lived signatures with the ATLAS detector

Wednesday, January 12, 2022 10:44 AM (16 minutes)

Various theories beyond the Standard Model predict unique signatures that are difficult to reconstruct and for which estimating the background rate is also a challenge. Signatures from displaced decays anywhere from the inner detector to the muon spectrometer, as well as those of new particles with fractional or multiple values of the charge of the electron or high mass stable charged particles are all examples of experimentally demanding signatures. The talk will focus on the most recent results using 13 TeV pp collision data collected by the ATLAS detector. Prospects for HL-LHC will also be shown.

Primary author: ATLAS COLLABORATION

Presenter: GUSTAVINO, Giuliano (CERN)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **100** Type: **Parallel session talk**

Performance of boosted boson/top taggers, including applications in physics analyses in ATLAS

Wednesday, January 12, 2022 9:20 AM (16 minutes)

Many new-physics signatures at the LHC produce highly boosted particles, leading to close-by objects in the detector and necessitating jet substructure techniques to disentangle the hadronic decay products. This talk will focus on the tagging methods recently developed within the ATLAS collaboration to identify boosted top-quarks, vector- and Higgs-bosons. It will also illustrate the use of these tagging techniques in physics analyses, including recent diboson and top-antitop resonance searches, as well as searches for vector-like quarks or dark matter, using the full Run 2 dataset.

Primary author: ATLAS COLLABORATION

Presenter: LIU, Yanlin (University of Michigan (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **102** Type: **Parallel session talk**

Searches for Higgs boson pair production with the full LHC Run 2 dataset in ATLAS

Tuesday, January 11, 2022 2:00 PM (20 minutes)

The latest results on the production of Higgs boson pairs (HH) in the ATLAS experiment are reported, with emphasis on searches based on the full LHC Run 2 dataset at 13 TeV. In the case of non-resonant HH searches, results are interpreted both in terms of sensitivity to the Standard Model and as limits on the Higgs boson self-coupling. Search results on new resonances decaying into pairs of Higgs bosons are also reported. Prospects of testing the Higgs boson self-coupling at the High Luminosity LHC (HL-LHC) will also be presented.

Primary author: ATLAS COLLABORATION

Presenter: GUO, Linghua (Université Paris-Saclay (FR))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **103** Type: **Parallel session talk**

Searches for Supersymmetry with the ATLAS detector

Tuesday, January 11, 2022 3:20 PM (20 minutes)

Supersymmetry (SUSY) provides elegant solutions to several problems in the Standard Model, and searches for SUSY particles are an important component of the LHC physics program. This talk will present the latest results from SUSY searches conducted by the ATLAS experiment. The searches target multiple final states and different assumptions about the decay mode of the produced SUSY particles, including searches for both R-parity conserving models and R-parity violating models and their possible connections with the recent observation of the flavour and muon g-2 anomalies. The talk will also highlight the employment of novel analysis techniques, including advanced machine learning techniques and special object reconstruction, that are necessary for many of these analyses to extend the sensitivity reach to challenging regions of the phase space.

Primary author: ATLAS COLLABORATION

Presenter: STARK, Giordon Holtsberg (University of California,Santa Cruz (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **107** Type: **Parallel session talk**

Boosting the discovery potential for the LHC Run 3 – Improved Track Reconstruction for prompt and long-lived particles in ATLAS

Tuesday, January 11, 2022 3:00 PM (20 minutes)

Searches for long-lived particles are among the most promising search channels for physics beyond the Standard Model (BSM) at the LHC.
One strategy relies on reconstructing the decay products of potential neutral BSM particles decaying within the tracking detector volume. To maximise the sensitivity of such efforts, charged particle tracks need to be reconstructed even if their trajectories are not pointing back to the primary interaction point. This has so far been a limiting factor to these searches, as the default ATLAS event reconstruction applies strict pointing requirements in track reconstruction to stay within the bounds imposed by available computing resources. Non-pointing long-lived particle tracks were therefore reconstructed only i a small subset of the data, pre-selected by a range of filters not using tracking information and therefore severely reducing the signal acceptance.
In preparation for LHC Run-3, a major effort was performed to improve the computational performance of ATLAS track reconstruction and reduce the number of incorrectly reconstructed track candidates (”fakes”), also to accomodate a long-lived particle tracking step in the default reconstruction, removing the need for filtering.
This talk will describe the improvements made to ATLAS track reconstruction, and demonstrate how this goal was achieved while still retaining an overall reduction in processing time.

Primary author: ATLAS COLLABORATION

Presenter: WOLLRATH, Julian (University of California Irvine (US))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **108** Type: **Poster**

Search for light long-lived neutral particles that decay to collimated pairs of leptons or light hadrons with the ATLAS detector and the full Run-II Data at LHC

Monday, January 10, 2022 4:20 PM (1 minute)

Several possible extensions to the Standard Model (SM) predict the existence of a dark sector that is weakly coupled to the visible one. A widely studied case is one in which the two sectors couple via the vector portal, where a dark photon with a non-negligible lifetime and a mass in the MeV to GeV range mixes kinetically with the SM photon. If the dark photon is the lightest state in the dark sector, it will decay to SM particles, mainly to leptons and light quarks. At the LHC, dark photons would typically be produced with large boost, due to their small mass, resulting in collimated jet-like structures containing pairs of leptons and/or light hadrons (dark photon jets, DPJs). Studies are presented for dark photons from Higgs decays, where gluon-gluon Fusion (ggF) and Higgs production in association with a W boson (WH) are considered. Results obtained are interpreted in the context of complex models involving various number of dark particles as described by the Falkowski–Ruderman–Volansky–Zupan (FRVZ) model.

Primary author: ATLAS COLLABORATION

Presenter: BIONDINI, Alessandro (University of Liverpool (GB))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **109** Type: **Poster**

Search for di-jet resonances along with an isolated charged lepton at sqrt(s)=13 TeV pp collision with the ATLAS detector

Monday, January 10, 2022 4:22 PM (1 minute)

A search for dijet resonances in events with identified leptons has been performed using the full Run 2 data collected in pp collisions at sqrt(s)=13 TeV with the ATLAS detector, corresponding to an integrated luminosity of 139 fb^-1. The dijet invariant-mass (mjj) distribution from events with at least one isolated electron or muon was probed in the range of 0.22<mjj<6.3 TeV. The analysis probes much lower mjj than traditional inclusive dijet searches and is sensitive to a large range of new physics models in association with a final-state lepton. As no statistically significant deviation from the Standard Model background hypothesis was found, limits were set on contributions from generic gaussian signals and on various beyond-the-Standard Model (BSM) scenarios including the Sequential Standard Model, a charged Higgs boson model, a simplified Dark Matter model etc. It has also been studied that the multi-body invariant masses such as three- and four-body invariant mass distributions constructed from jets and leptons while following the same analysis strategy provide sensitivity to wide ranges of Physics, including many BSM scenarios.

Primary author: ATLAS COLLABORATION

Presenter: ISLAM, Wasikul (University of Wisconsin-Madison (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **115** Type: **Parallel session talk**

JUNO experiment: physics goals and current status

Tuesday, January 11, 2022 3:40 PM (20 minutes)

Jiangmen Underground Neutrino Observatory (JUNO) is a liquid scintillator based neutrino experiment, being built in the Guangdong province in southern China. Its construction is expected to be completed in 2022. The experimental hall is located underground, below a 700 meter rock over-burden, to reduce backgrounds from cosmic rays.
The JUNO primary scientific goal consists in the determination of the neutrino mass ordering (NMO). This can be inferred by measuring the oscillation pattern of electron anti-neutrinos emitted by two nuclear power plants, located at 53 km from the experimental site. In order to reach this ambitious goal, JUNO will benefit of a large 20 kton scintillator detection mass, and will target an unprecedented 3% energy resolution at 1 MeV scale. Sensitivity studies show that a 3σ-4σ statistical significance on NMO can be reached in six years of data-taking.
Thanks to its unique features, JUNO will also have rich astroparticle physics goals: the solar neutrino precision spectroscopy, the sub-percent determination of flavor oscillation parameters $\sin^2\theta_{12}$, Δm^2_{12} and Δm^2_{13}, the measurements of atmospheric neutrinos, geo-neutrinos, supernovae neutrinos and exotic searches.
In this talk, the JUNO physics goals, the detector design and the status of the experiment will be presented.

Primary author: Dr BASILICO, Davide (University of Milan)

Presenter: Dr BASILICO, Davide (University of Milan)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **116** Type: **Parallel session talk**

Constraining CPT violation with Hyper-Kamiokande and ESSnuSB

Tuesday, January 11, 2022 2:20 PM (20 minutes)

CPT invariance is one of the most fundamental symmetries in nature and it plays a major role in the formulation of Quantum Field Theory. Although no definitive signal of CPT violation has been observed so far, there are many reasons to carefully investigate various low-energy phenomena that can provide better probes to test CPT symmetry. In this context, neutrino experiments are expected to provide more stringent bounds on CPT invariance violation when compared to the existing bounds from the Kaon system. In this work, we investigate the sensitivity of the upcoming long-baseline experiments: Hyper Kamiokande (T2HK, T2HKK), ESSnuSB and DUNE to constrain the CPT violating parameters $\Delta(\delta_{CP})$, $\Delta(m^2_{31})$ and $\Delta(\sin^2\theta_{23})$, which characterize the difference between neutrino and antineutrino oscillation parameters. Further, we analyze neutrino and antineutrino data independently and constrain the oscillation parameters governing them by considering the combination of these experiments (DUNE+T2HKK and DUNE+ESSnuSB). In addition, assuming CPT symmetry is violated in nature, we study the individual ability of the aforementioned experiments to establish CPT violation. We found that the experiments Hyper-K (T2HK, T2HKK) and ESSnuSB, along with DUNE, will be able to establish CPT violation in their proposed run-times.

Primary authors: Dr K. N., Deepthi (Department of Physics, École Centrale School of Engineering, Mahindra University); SINGHA, Dinesh Kumar (University of Hyderabad); MAJHI, Rudra (UNIVERSITY OF HYDERABAD); MOHANTA, Rukmani (University of Hyderabad)

Presenter: SINGHA, Dinesh Kumar (University of Hyderabad)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **117** Type: **Poster**

The Water Cherenkov Test Experiment at CERN

Monday, January 10, 2022 4:34 PM (1 minute)

Water Cherenkov neutrino experiments have played a crucial role in neutrino discoveries over the years, and provide a well established and affordable way to instrument large target masses. The largest uncertainty in the most recent T2K oscillation results are from the Super-Kamiokande detector systematic errors in the oscillated event samples. As neutrino experiments move from discovery to precision measurements a comprehensive understanding of water Cherenkov detectors becomes increasingly important. The physics and technological development studies that WCTE will be capable of will aid future neutrino experiments such as Hyper-Kamiokande, ESSnuSB and THEIA.

The Water Cherenkov Test Experiment (WCTE) is a small scale water Cherenkov detector which will be located in the T9 experimental area at CERN. WCTE will be used to study the water Cherenkov detector response to hadron, electron and muon beams, and will use new photosensor technologies. The detector will be instrumented with multi-PMT modules consisting of 19, 3-inch PMTs each, and will test a newly developed calibration deployment system. Calibration techniques with known particle fluxes will be used to demonstrate a 1% level calibration for GeV scale neutrino interactions. Other measurements will include those of Cherenkov light production, pion scattering and secondary neutrino production, to provide direct inputs to the T2K and Super-Kamiokande experiments. This talk will describe the WCTE detector design, the newly developed mPMT and calibration hardware and the all important physics program.

Primary author: Dr ANTHONY, Lauren (Imperial College London)

Presenter: Dr ANTHONY, Lauren (Imperial College London)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **119** Type: **Poster**

Combination of searches for resonant and non-resonant Higgs boson pair production in the bbyy, bb⊠⊠ and bbbb decay channels using pp collisions at √s= 13 TeV with the ATLAS detectors = 13 TeV with the ATLAS detector

Monday, January 10, 2022 4:21 PM (1 minute)

A combination of searches for Higgs boson pair production is performed using up to 139fb-1 of proton-proton collision data at a center-of-mass energy √s = 13 TeV recorded with the ATLAS detector at the LHC. The combination exploits three analyses searching for HH decays to bbyy, bbtautau and bbbb. Results are interpreted in the context of non-resonant and resonant Higgs boson pair production scenarios. In the non-resonant interpretation, upper limits are set on the Higgs boson pair production cross-section and on the self-coupling modifier κ_lambda. In the resonant interpretation, upper limits are set on the resonant Higgs boson pair production cross-section as a function of the heavy resonance mass.

Primary author: ATLAS COLLABORATION

Presenter: CHENG, Alkaid (University of Wisconsin Madison (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **121** Type: **Parallel session talk**

Searches for dark matter with the ATLAS detector

Wednesday, January 12, 2022 11:40 AM (20 minutes)

The presence of a non-baryonic Dark Matter (DM) component in the Universe is inferred from the observation of its gravitational interaction. If Dark Matter interacts weakly with the Standard Model (SM) it could be produced at the LHC. The ATLAS experiment has developed a broad search program for DM candidates, including resonance searches for the mediator which would couple DM to the SM, searches with large missing transverse momentum produced in association with other particles (light and heavy quarks, photons, Z and H bosons) called mono-X searches and searches where the Higgs boson provides a portal to Dark Matter, leading to invisible Higgs decays. The results of recent searches on 13 TeV pp data, their interplay and interpretation will be presented. Prospects for HL-LHC will also be discussed.

Primary author: ATLAS COLLABORATION

Presenter: BOGAVAC, Danijela (IFAE - Barcelona (ES))

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **125** Type: **Poster**

$B \to K\nu\bar{\nu}$ measurements and new physics

Monday, January 10, 2022 4:20 PM (1 minute)

Semileptonic flavor changing neutral current transitions with a pair of neutrinos in the final state are very accurately determined in the standard model. The most recent Belle II result on $B \to K\nu\bar{\nu}$ uses an innovative inclusive tagging technique; this together with previous BaBar and Belle results indicates a possible enhancement in the branching fraction of $B \to K\nu\bar{\nu}$. We have explored the possibilities of such an enhancement as a signal of new physics within several scenarios such as leptoquark and generic Z′ models, which can also explain some of the other tensions observed in neutral as well as charged current B-decays.

Primary author: MANDAL, Rusa (Siegen University)

Co-authors: BROWDER, Thomas (University of Hawaii); SINHA, Rahul (The Institute of Mathematical Sciences); DESHPANDE, Nilendra (University of Oregon)

Presenter: MANDAL, Rusa (Siegen University)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **126** Type: **Parallel session talk**

DarkSide-20k and the Future Liquid Argon Dark Matter Program

Tuesday, January 11, 2022 5:10 PM (20 minutes)

DarkSide run since mid 2015 a 50-kg-active-mass dual phase Liquid Argon Time Projection Chamber (TPC), filled with low radioactivity argon from an underground source and produced world class results for both the low mass ($M_{WIMP} < 20GeV/c^2$) and high mass ($M_{WIMP} > 100GeV/c^2$) direct detection search for dark matter.
The next stage of the DarkSide program will be a new generation experiment involving a global collaboration from all the current Argon based experiments. DarkSide-20k, is designed as a 20-tonne fiducial mass dual phase Liquid Argon TPC with SiPM based cryogenic photosensors, and is expected to be free of any instrumental background for an exposure of >100 tonne x year. Like its predecessor, DarkSide-20k will be housed at the INFN Gran Sasso (LNGS) underground laboratory, and it is expected to attain a WIMP-nucleon cross section exclusion sensitivity of $7.4 \times 10^{-48}\ cm^2$ for a WIMP mass of $1TeV/c^2$ in a 200 t yr run. DarkSide-20k will be installed inside a membrane cryostat containing more than 700 t of liquid Argon and be surrounded by an active neutron veto based on a Gd-loaded acrylic shell. The talk will give the latest updates of the ongoing R\&D and prototype tests validating the initial design.
A subsequent objective, towards the end of the next decade, will be the construction of the ultimate detector, ARGO, with a 300 t fiducial mass to push the sensitivity to the neutrino floor region for high mass WIMPs.

Primary author: GARCIA ABIA, Pablo (CIEMAT)

Presenter: TESTERA, Gemma (INFN e Universita Genova (IT))

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **127** Type: **Poster**

Measurement of the underground argon radiopurity for Dark Matter direct searches

Monday, January 10, 2022 4:25 PM (1 minute)

A major worldwide effort is underway to procure the radiopure argon needed for DarkSide-20k (DS-20k), the first large scale detector of the new Global Argon Dark Matter Collaboration. The Urania project will extract and purify underground argon (UAr) from CO2 wells in the USA at a production rate of about 300 kg/day. Additional chemical purification of the UAr will be required prior to its use in the DS-20k LAr-TPC. The Aria project will purify UAr using a cryogenic distillation column (Seruci-I), located in Sardinia (Italy). Assessing the UAr purity in terms of Ar-39 is crucial for the physics program of the DarkSide-20k experiment. DArT is a small (1 litre) radiopure chamber that will measure the Ar-39 depletion factor in the UAr. The detector will be immersed in the active liquid Ar volume of ArDM (LSC, Spain), which will act as a veto for gammas from the detector materials and the surrounding rock. In this talk, I will review the status and prospects of the UAr projects for DarkSide-20k.

Primary author: GARCIA ABIA, Pablo (CIEMAT)

Presenters: LUZZI, Ludovico; LUZZI, Ludovico (CIEMAT)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **128** Type: **Parallel session talk**

Improved V_{cs} determination from $D \to K\ell\nu$ and search for new physics in $B \to K\ell^+\ell^-$ using precise lattice QCD form factors

Wednesday, January 12, 2022 9:20 AM (20 minutes)

We discuss HPQCD's recent precise determinations of the $D \to K$ and $B \to K$ scalar, vector and tensor form factors from full lattice QCD using the HISQ formalism.
Our $D \to K$ form factors allow us to calculate the differential rate for $D \to K\ell\nu$ with improved precision. Comparison with experimental results gives the CKM element V_{cs} to better than 1\% for the first time: $|V_{cs}| = 0.9663(80)$. We also demonstrate that the q^2-dependence of the rate predicted from QCD matches that of experiment.
Increasing the heavy quark mass from charm to bottom in our lattice QCD calculation gives access to the form factors for $B \to K\ell^+\ell^-$ across the full q^2 range of the decay process. We compare Standard Model observables calculated from our form factors to experimental measurements to pin down new physics contributions with improved significance over previous results.

Primary author: Mr PARROTT, William (University of Glasgow)

Presenter: Mr PARROTT, William (University of Glasgow)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **130** Type: **Poster**

New physics searches with the ILD detector at the ILC

Monday, January 10, 2022 4:33 PM (1 minute)

Although the LHC experiments have searched for and excluded many proposed new particles up to masses close to 1 TeV, there are many scenarios that are difficult to address at a hadron collider. This talk will review a number of these scenarios and present the expectations for searches at an electron-positron collider such as the International Linear Collider. The cases discussed include the light Higgsino, the stau lepton in the coannihilation region relevant to dark matter, and heavy vector bosons coupling to the s-channel in e+e- annihilation. The studies are based on the ILD concept at the ILC.

Primary authors: KAWAGOE, Kiyotomo (Kyushu University (JP)); BERGGREN, Mikael (Deutsches Elektronen-Synchrotron (DE))

Presenter: BERGGREN, Mikael (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **131** Type: **Parallel session talk**

Measurement of lepton-jet correlation in deep-inelastic scattering with the H1 detector using machine learning for unfolding

Wednesday, January 12, 2022 10:20 AM (20 minutes)

The first measurement of lepton-jet momentum imbalance and azimuthal correlation in lepton-proton scattering at high momentum transfer is presented. These data, taken with the H1 detector at HERA, are corrected for detector effects using an unbinned machine learning algorithm (OmniFold), which considers eight observables simultaneously in this first application. The unfolded cross sections are compared to calculations performed within the context of collinear or transverse-momentum-dependent (TMD) factorization in Quantum Chromodynamics (QCD) as well as Monte Carlo event generators. The measurement probes a wide range of QCD phenomena, including TMD parton distribution functions and their evolution with energy in so far unexplored kinematic regions.

arxiv:2108.12376, submitted to PRL

Primary authors: H1, Collaboration (DESY); SCHMITT, Stefan (Deutsches Elektronen-Synchrotron (DE))

Presenter: NACHMAN, Ben (Lawrence Berkeley National Lab. (US))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **133** Type: **Poster**

Measurement of Exclusive pi+pi- and rho0 Meson Photoproduction at HERA

Monday, January 10, 2022 4:26 PM (1 minute)

Exclusive photoproduction of $\rho^0(770)$ mesons is studied using the H1 detector at the ep collider HERA. A sample of about 900000 events is used to measure single- and double-differential cross sections for the reaction $\gamma p \to \pi^+\pi^- Y$. Reactions where the proton stays intact ($m_Y = m_p$) are statistically separated from those where the proton dissociates to a low-mass hadronic system ($m_p < m_Y < 10$ GeV). The double-differential cross sections are measured as a function of the invariant mass $m_{\pi\pi}$ of the decay pions and the squared 4-momentum transfer t at the proton vertex. The measurements are presented in various bins of the photon-proton collision energy $W_{\gamma p}$. The phase space restrictions are $0.5 < m_{\pi\pi} < 2.2$ GeV, $|t| < 1.5$ GeV^2, and $20 < W_{\gamma p} < 80$ GeV. Cross section measurements are presented for both elastic and proton-dissociative scattering. The observed cross section dependencies are described by analytic functions. Parametrising the $m_{\pi\pi}$ dependence with resonant and non-resonant contributions added at the amplitude level leads to a measurement of the $\rho^0(770)$ meson mass and width at $m_\rho = 770.8^{+2.6}_{-2.7}$ (tot.) MeV and $\Gamma_\rho = 151.3^{+2.7}_{-3.6}$ (tot.) MeV, respectively. The model is used to extract the $\rho^0(770)$ contribution to the $\pi^+\pi^-$ cross sections and measure it as a function of t and $W_{\gamma p}$. In a Regge asymptotic limit in which one Regge trajectory $\alpha(t)$ dominates, the intercept $\alpha(t=0) = 1.0654^{+0.0098}_{-0.0067}$ (tot.) and the slope $\alpha\ (t=0) = 0.233^{+0.067}_{-0.074}$ (tot.) GeV^{-2} of the t dependence are extracted for the case $m_Y = m_p$.

Eur.Phys.J.C80 (2020), 1189 [arxiv:2005.14471]

Primary authors: H1, Collaboration (DESY); SCHMITT, Stefan (Deutsches Elektronen-Synchrotron (DE))

Presenter: BOLZ, Arthur (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **134** Type: **Parallel session talk**

Measurement of 1-jettiness in the Breit Frame at high Q^2

Wednesday, January 12, 2022 9:40 AM (20 minutes)

A first measurement of the 1-jettiness event shape observable in neutral-current deep-inelastic electron-proton scattering is presented. The 1-jettiness observable τ_{1b} is defined such that it is equivalent to the thrust observable defined in the Breit frame. The data were taken in the years 2003 to 2007 with the H1 detector at the HERA ep collider at a center-of-mass energy of 319 GeV and correspond to an integrated luminosity of 351.6 pb^{-1}. The triple-differential cross sections are presented as a function of the 1-jettiness τ_{1b}, the event virtuality Q^2 and the inelasticity y in the kinematic region $Q^2 > 150$ GeV^2. The data have sensitivity to the parton distribution functions of the proton, the strong coupling constant and to resummation and hadronisation effects. The data are compared to selected predictions.

H1prelim-21-032

Primary authors: H1, Collaboration (DESY); SCHMITT, Stefan (Deutsches Elektronen-Synchrotron (DE))

Presenter: KLEST, Henry (Stony Brook University)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **138** Type: **Parallel session talk**

The THDMa and possible e+e- signatures

Wednesday, January 12, 2022 12:20 PM (20 minutes)

The THDMa is a new physics model that extends the scalar sector of the Standard Model by an additional doublet as well as a pseudoscalar singlet and allows for mixing between all possible scalar states. In the gauge eigenbasis, the additional pseudoscalar serves as a portal to the dark sector, with a priori any dark matter spin states. The option where dark matter is fermionic is currently one of the standard benchmarks for the experimental collaborations, and several searches at the LHC constrain the corresponding parameter space. However, most current studies constrain regions in parameter space by setting all but 2 of the 12 free parameters to fixed values.
I will discuss a generic scan on this model, allowing all parameters to float. All current theoretical and experimental constraints are applied. I identify regions in the parameter space which are still allowed after these have been applied and which might be interesting for an investigation at a future e+e- collider.

Primary author: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Presenter: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **142** Type: **Poster**

Impact of jet production data on the next-to-next-to-leading order determination of HERAPDF2.0 parton distributions

Monday, January 10, 2022 4:25 PM (1 minute)

The HERAPDF2.0 ensemble of parton distribution functions (PDFs) was introduced in 2015. Presented is the final stage, a next-to-next-to-leading order (NNLO) analysis of the HERA data on inclusive deep inelastic ep scattering together with jet data as published by H1 and ZEUS. A pQCD fit to the data with free $\alpha_s(M_Z^2)$ and free PDFs was used to determine $\alpha_s(M_Z^2)$ with the result $\alpha_s(M_Z^2)$ = 0.1156±0.0011 (exp) $^{+0.0001}_{-0.0002}$ (model + parameterisation) ±0.0029 (scale). The PDF sets of HERAPDF2.0Jets NNLO were determined with fits using fixed the fixed values of $\alpha_s(M_Z^2)$ = 0.1155 and $\alpha_s(M_Z^2)$ = 0.118. The latter value was already chosen for the published HERAPDF2.0 NNLO analysis based on inclusive data only. The different sets of PDFs are presented and compared. The similarity of the PDFs demonstrates the consistency of inclusive and jet-production cross-section data. Predictions based on HERAPDF2.0Jets NNLO agree very well with the jet-production data used in the fits.

Primary authors: WING, Matthew (University College London); SCHMITT, Stefan (Deutsches Elektronen-Synchrotron (DE))

Presenter: LORKOWSKI, Florian (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **143** Type: **Parallel session talk**

Azimuthal correlations in photoproduction and deep inelastic ep scattering at HERA

Wednesday, January 12, 2022 10:00 AM (20 minutes)

Collective behaviour of final-state hadrons, and multiparton interactions are studied in high-multiplicity ep scattering at a centre-of-mass energy $\sqrt{s} = 318$ GeV with the ZEUS detector at HERA. Two- and four-particle azimuthal correlations, as well as multiplicity, transverse momentum, and pseudorapidity distributions for charged-particle multiplicities $N_{\mathrm{ch}} \geq 20$ are measured. The dependence of two-particle correlations on the virtuality of the exchanged photon shows a clear transition from photoproduction to neutral current deep inelastic scattering. For the multiplicities studied, neither the measurements in photoproduction processes nor those in neutral current deep inelastic scattering indicate significant collective behaviour of the kind observed in high-multiplicity hadronic collisions at RHIC and the LHC. Comparisons of PYTHIA predictions with the measurements in photoproduction strongly indicate the presence of multiparton interactions from hadronic fluctuations of the exchanged photon.

Primary author: WING, Matthew (University College London)

Presenter: GANGADHARAN, Dhevan Raja (University of Houston (US))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **144** Type: **Poster**

An intelligent Data Delivery Service (iDDS) for and beyond the ATLAS experiment

Monday, January 10, 2022 4:24 PM (1 minute)

The intelligent Data Delivery Service (iDDS) has been developed to cope with the huge increase of computing and storage resource usage in the coming LHC data taking. It has been designed to intelligently orchestrate workflow and data management systems, decoupling data pre-processing, delivery, and main processing in various workflows. It is an experiment-agnostic service that has been deployed to serve data carousel, hyperparameter optimization, multiple-steps DAG (Directed Acyclic Graphs) workflows and so on. Here we will present the motivation for iDDS, the architecture, use cases and current status for ATLAS and Rubin Observatory exercise, and plans for the future.

Primary author: GUAN, Wen (University of Wisconsin (US))

Co-authors: ALEKSEEV, Aleksandr (Universidad Andres Bello (CL)); BOCKELMAN, Brian Paul (University of Wisconsin Madison (US)); LIN, Fa-Hui (University of Texas at Arlington (US)); MAENO, Tadashi (Brookhaven National Laboratory (US)); PADOLSKI, Siarhei (BNL); WENAUS, Torre (Brookhaven National Laboratory (US)); ZHANG, Rui (University of Wisconsin Madison (US))

Presenter: GUAN, Wen (University of Wisconsin (US))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **147** Type: **Parallel session talk**

Status of the MEG II experiment at PSI

Tuesday, January 11, 2022 5:10 PM (20 minutes)

The observation of charged Lepton Flavour Violating (cLFV) processes would be a definitive signature of physics beyond the Standard Model.
The phase I one of the MEG experiment established the best upper limit on the branching ratio of one of the cLFV golden channels, μ →eγ: BR (μ →eγ) < 4.2 ×10-13 (@90% Confidence Level).
This limit will be improved by about one order of magnitude by the phase II of the experiment, which is supposed to run for few years since 2022, taking advantage of a higher beam rate and an upgraded detector. In this talk, starting from MEG I experimental setup and results I will described MEG II improvements and expected sensitivity.

Primary author: DE GERONE, Matteo (INFN - National Institute for Nuclear Physics)

Presenter: DE GERONE, Matteo (INFN - National Institute for Nuclear Physics)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **148** Type: **Poster**

ILC Higgs Physics Potential

Monday, January 10, 2022 4:32 PM (1 minute)

Higgs factories based on e+e- colliders have the potential to measure the complete profile of the Higgs boson at a level of precision that goes qualitatively beyond the expect capabilities of the LHC. This talk will review the program of Higgs boson coupling measurements expected from the International Linear Collider, including the most recent updates. These measurements span the range of e+e- CM energies from 250 GeV to 1 TeV and include precision measurements of the top quark Yukawa coupling and the Higgs self-coupling.

Primary author: BOZOVIC-JELISAVCIC, Ivanka (University of Belgrade (RS))

Presenter: KAWADA, Shin-ichi (KEK)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **149** Type: **Poster**

t-quark physics at ILC

Monday, January 10, 2022 4:31 PM (1 minute)

The top quark has not yet been studied in the extremely favorable and low-background environment of e+e- annihilation. This talk will review the opportunities for precision measurements of the top quark properties at the International Linear Collider. These include the archival measurement of the top quark mass, the search for beyond-Standard-Model contributions to the top quark electroweak form factors, and the search for CP violation in the top quark couplings.

Primary author: BOZOVIC-JELISAVCIC, Ivanka (University of Belgrade (RS))

Presenter: IRLES, Adrian (IFIC CSIC/UV)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **150** Type: **Poster**

Higgs invisible and rare decays at ILC

Monday, January 10, 2022 4:30 PM (1 minute)

The operation of an e+e- collider at a CM energy of 250 GeV will yield a large sample of Higgs bosons that are tagged by recoil against an observed Z boson at a fixed laboratory energy. By selecting these Z bosons and looking on the other side of the event, e+e- colliders will be sensitive to essentially all possible rare and exotic Higgs boson decay channels, in most cases down to branching ratios of order 10^{-4}. This includes channels important for theories beyond the Standard Model such as H-> b bbar + (missing energy) and H-> b sbar that are very difficult to observe at the LHC. This talk will review the expectations for the discovery of new decay modes of the Higgs boson at the International Linear Collider.

Primary author: BOZOVIC-JELISAVCIC, Ivanka (University of Belgrade (RS))

Presenter: SUTER, Bethany (UC Berkeley)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **151** Type: **Parallel session talk**

New ideas on detector technology for the ILC experiments

Tuesday, January 11, 2022 4:30 PM (20 minutes)

The International Linear Collider project develops a linear electron-positron collider with a first "Higgs factory" stage at 250 GeV, followed by an upgrade to higher energy. The precision physics program of the ILC places demanding requirements on the detectors that are to equip the interaction region. Extensive Monte Carlo simulations of complete detector concepts have been used to draw up the main specifications for the detector performance. A global design and R&D effort has addressed these challenging goals, with important progress in ultra-transparent vertex detector and tracker solutions and highly granular calorimeter systems. An overview will be given of the detector requirements and highlights of the R&D effort will be presented in this contribution.

Primary author: BOZOVIC-JELISAVCIC, Ivanka (University of Belgrade (RS))

Presenter: TITOV, Maksym (Université Paris-Saclay (FR))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **153** Type: **Parallel session talk**

Status of the DEAP-3600 experiment

Tuesday, January 11, 2022 5:50 PM (20 minutes)

The Dark matter Experiment using Argon Pulseshape discrimination (DEAP) utilizes a single-phase liquid argon (LAr) detector aiming to acquire the scintillation light produced by nuclear recoils expected to be induced by Weakly Interacting Massive Particle (WIMP) candidate of dark matter. The DEAP-3600 detector consists of about 3.3 tonnes of LAr in a spherical acrylic vessel viewed by 255 photomultiplier tubes. It is located in the SNOLAB underground facility at a depth of approximately 2 km to reduce the cosmic-ray muon induced neutron backgrounds and has been taking data stably since November 2016. DEAP-3600 demonstrated excellent performance for pulseshape discrimination between nuclear recoils and electronic recoils induced by β and γ-rays originating from internal and external radioactivity in the detector material. It has achieved the most sensitive limit for the spin-independent WIMP-nucleon cross-section above 30 GeV/c^2 WIMP mass among argon-based experiments and leading sensitivity among all experiments for various dark matter scenarios. The talk presents the latest DEAP-3600 results demonstrating the background rejection, sensitivity to dark matter and the status of ongoing analyses.

Primary author: Dr SETH, Susnata (Department of Physics, Carleton University, Ottawa, Ontario, K1S 5B6, Canada, Arthur B. McDonald Canadian Astroparticle Physics Research Institute, Queen's University, Kingston, Ontario K7L 3N6, Canada)

Presenter: Dr SETH, Susnata (Department of Physics, Carleton University, Ottawa, Ontario, K1S 5B6, Canada, Arthur B. McDonald Canadian Astroparticle Physics Research Institute, Queen's University, Kingston, Ontario K7L 3N6, Canada)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **155** Type: **Poster**

Heavy Flavor Averaging Group (HFLAV) methodology and latest results

Monday, January 10, 2022 4:19 PM (1 minute)

The Heavy Flavor Averaging Group has for the past two decades formed averages of measurements involving the properties of b-hadron, c-hadron and τ leptons. The averages are taking into account direct as well as indirect measurements of properties and are updating external constraints to include their latest values.

We will in the presentation outline the averaging methodology used and highlight new results as well as instances where the more in depth treatment of indirect measurements and correlations leads to big differences with respect to a naive average.

Primary author: EGEDE, Ulrik (Monash University (AU))

Presenter: PRIM, Markus Tobias (University of Bonn (DE))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **156** Type: **Poster**

Implications of A_4 modular symmetry on neutrino mass, mixing and leptogenesis with linear seesaw

Monday, January 10, 2022 4:18 PM (1 minute)

We consider the application of A_4 modular symmetry in the linear seesaw framework, which restricts the use of multiple flavon fields. Linear seesaw is realized with six heavy $SU(2)_L$ singlet fermion superfields and a weighton in a supersymmetric framework. The non-trivial transformation of Yukawa couplings under the A_4 modular symmetry helps to explore the neutrino phenomenology with a specific flavor structure of the mass matrix. We discuss the phenomena of neutrino mixing and show that the obtained mixing angles and CP violating phase in this framework are compatible with the observed 3σ range of the current oscillation data. In addition, we also investigate the non-zero CP asymmetry from the decay of lightest heavy fermion superfield to explain the preferred phenomena of baryogenesis through leptogenesis including flavor effects.

Primary authors: Mr BEHERA, Mitesh Kumar (University of Hyderabad); MOHANTA, Rukmani (University of Hyderabad); Dr SINGIRALA, Shivaramakrishna (University of Hyderabad, Hyderabad, India); Dr MISHRA, Subhasmita (Centurion University of Technology and Management, Odisha)

Presenter: MOHANTA, Rukmani (University of Hyderabad)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **157** Type: **Poster**

Quark production in high energy electron positron collisions: from strange to top

Monday, January 10, 2022 4:29 PM (1 minute)

The process ee->qq with qq=ss,cc,bb,tt plays a central role in the physics programs of high energy electron-positron colliders operating from the O(100GeV) to O(1TeV) center of mass energies. Furthermore, polarised beams as available at the International Linear Collider (ILC) are an essential input for the complete measurement of the helicity amplitudes that govern the production cross section. Quarks, specially the heaviers, are likely messengers to new physics and at the same time they are ideal benchmark processes for detector optimisation. All four processes call for superb primary and secondary vertex measurements, a high tracking efficiency to correctly measure the vertex charge and excellent hadron identification capabilities. Strange, charm and bottom production are already available below the ttbar threshold. We will show with detailed detector simulations of the International Large Detector (ILD) that production rate and the forward backward asymmetries of the the different processes can be measured at the 0.1% - 0.5% level and how systematic errors can be controlled to reach this level of accuracy. The importance of operating at different center of mass energies and the discovery potential in terms of Randall-Sundrum models with warped extra dimensions will be outlined.

Primary authors: IRLES, Adrian (IFIC CSIC/UV); KAWAGOE, Kiyotomo (Kyushu University (JP)); POESCHL, Roman (Université Paris-Saclay (FR))

Presenter: OKUGAWA, Yuichi (Tohoku University)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **158** Type: **Poster**

BSM physics explanations of a_μ in light of the FNAL muon $g-2$ measurement

Monday, January 10, 2022 4:16 PM (1 minute)

The Fermilab Muon $g-2$ experiment reported the results of its Run-1 measurement of the anomalous magnetic moment $a_\mu^{\rm FNAL}$, which is in full agreement with the previous BNL measurement and pushes the world average deviation Δa_μ^{2021} from the Standard Model to a significance of 4.2σ. In this talk I will present an extensive survey of its impact on beyond the Standard Model physics, based on the work in Ref. [1]. In this work we used state-of-the-art calculations and a sophisticated set of tools to make predictions for a_μ, dark matter and LHC searches. We examined a wide range of simple models with up to three new fields, that represent some of the few ways that large Δa_μ can be explained. The results show that the new measurement excludes a large number of models and provides crucial constraints on others. Generally, these models provide viable explanations of the a_μ result only by using rather small masses and/or large couplings with chirality flip enhancements, which can lead to conflicts with limits from LHC and dark matter experiments. I will present results for a range of models extending the standard model by one, two and three new fields including scalar leptoquarks and simple models constructed to explain dark matter and g-2 simultaneously.

[1] Athron P, Balázs C, Jacob D H, Kotlarski W, Stöckinger D and Stöckinger-Kim H 2021 (Preprint 2104.03691)

Primary authors: BALAZS, Csaba (Monash University); JACOB, Douglas (Monash University); STOECKINGER, Dominik (TU Dresden); STOECKINGER-KIM, Hyejung (TU Dresden); ATHRON, Peter; KOTLARSKI, Wojciech (TU - Dresden)

Presenter: JACOB, Douglas (Monash University)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **159** Type: **Poster**

Exploring the effects of scalar Non Standard Interactions at DUNE and T2HK

Monday, January 10, 2022 4:18 PM (1 minute)

The discovery of the phenomena of neutrino oscillation was the first clear evidence of physics beyond the Standard Model (SM). It requires as extension of the SM to explain the masses and mixing of neutrinos. The models explaining beyond SM (BSM) physics naturally comes with some additional unknown interactions of neutrinos which are beyong the scope of SM, often called as Non Standard Interactions (NSIs) [1]. Wolfenstein [2] was the first to propose the idea of NSI where he explored how neutrino coupling with a vector field can give rise to matter effect in neutrino oscillations. Apart from that, there is also a possibility of neutrinos coupling with a scalar field called scalar NSI [3, 4]. Instead of appearing as a matter potential, scalar NSI appears as a medium dependent correction to the mass matrix, which may offer unique phenomenology in neutrino oscillations.

In this work, we have studied the effects of scalar NSI at two proposed flagship Long Baseline Experiments - DUNE [5] and T2HK [6]. As the effect of scalar NSI scales linearly with the matter density, it can feel the matter density variations which makes LBL experiments one of the best candidate to probe it. We have seen that the effect of scalar NSI on the oscillation probabilities of DUNE and T2HK is significant. Moreover, scalar NSI can significantly effect the CP violation sensitivity as well as θ 23 octant sensitivity of these LBL experiments. Finally, we have also done a combined sensitivity of these experiments towards finding the effects of scalar NSI. In addition, as the scalar NSI affects the neutrino mass term probing it to various neutrino mass models is quite interesting and promising.

Keywords: Neutrino Oscillations, Non Standard Interactions, Beyond Standard Model.

References

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[2] L. Wolfenstein, Neutrino Oscillations in Matter, Phys. Rev. D 17 (1978) 2369.
[3] S.-F. Ge and S. J. Parke, Scalar Nonstandard Interactions in Neutrino Oscillation, Phys. Rev. Lett. 122 (2019) 211801 [1812.08376].
[4] K. Babu, G. Chauhan and P. Bhupal Dev, Neutrino nonstandard interactions via light scalars in the Earth, Sun, supernovae, and the early Universe, Phys. Rev. D 101 (2020) 095029 [1912.13488].
[5] DUNE collaboration, Deep Underground Neutrino Experiment (DUNE), Far Detector Technical Design Report, Volume IV Far Detector Single-phase Technology, JINST 15 (2020) T08010 [2002.03010].
[6] Hyper-Kamiokande Proto- collaboration, Physics potential of a long-baseline neutrino oscillation experiment using a J-PARC neutrino beam and Hyper-Kamiokande, PTEP 2015 (2015) 053C02 [1502.05199].

Primary authors: Mr MEDHI, Abinash (Tezpur University, Assam, India); Dr DUTTA, Debajyoti (Assam Don Bosco University,Assam, INDIA,); Dr DEVI, Moon Moon (Tezpur University, India)

Presenter: Mr MEDHI, Abinash (Tezpur University, Assam, India)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **160** Type: **Parallel session talk**

Measuring CP violating phase in B Baryon decays

Wednesday, January 12, 2022 10:20 AM (20 minutes)

One of the outstanding problems in physics is to explain the baryon-anti-baryon asymmetry observed in nature. According to the well-known Sakharov criterion for explaining the observed baryon-anti-baryon asymmetry, it is essential that CP violation exist in the baryon sector. However, CP violation has only been observed in mesons decays and is yet to be convincingly demonstrated in baryons decays. A critical test of the standard model (SM) goes beyond just observing CP violation in baryons and requires that it be measured in baryon decays as well, in order to verify that it agrees with that measured in the meson decays. In this letter we propose a new method to measure CP violating phase in b-baryons, using interference arising implicitly due to Bose symmetry considerations of the decaying amplitudes.

Primary authors: DESHPANDE, Nilendra (University of Oregon); SINHA, Rahul (The Institute of Mathematical Sciences); ROY, Shibasis

Presenter: SINHA, Rahul (The Institute of Mathematical Sciences)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **161** Type: **Poster**

Unravelling the Mystery of Dark Matter with Black Holes

Monday, January 10, 2022 4:17 PM (1 minute)

Primordial black holes (PBHs), possibly formed via gravitational collapse of large density perturbations in the very early universe, are one of the earliest proposed and viable dark matter (DM) candidates. PBHs can make up a large or even entirety of DM density over a wide range of masses. Ultralight PBHs in the mass range of 10^{15} - 10^{17} g, emit particles via Hawking radiation, act as a decaying DM, and can be probed via observations of those emitted particles in various space as well as ground based detectors. In this talk, I will discuss how diffuse supernova neutrino background searches at the Super-Kamiokande neutrino observatory, measurement of the 511 keV gamma-ray line by INTEGRAL telescope, observations of low energy Galactic Center photons by the imminent soft gamma-ray telescope AMEGO, and EDGES measurement of the global 21-cm signal can set robust, world-leading exclusions on the fraction of DM composed of ultralight PBHs.

Primary author: Mr RAY, Anupam (Tata Institute of Fundamental Research, India)

Presenter: Mr RAY, Anupam (Tata Institute of Fundamental Research, India)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **162** Type: **Poster**

Study of the $\omega \to \pi^0 e^+ e^-$ conversion decay with the CMD-3 detector at VEPP-2000 collider

Monday, January 10, 2022 4:23 PM (1 minute)

The study of the conversion decay $\omega \to \pi^0 e^+ e^-$ in the decay channel $\pi^0 \to \gamma\gamma$ was performed with the CMD-3 detector at the VEPP-2000 $e^+ e^-$ collider in Novosibirsk. Main background processes are events of $\omega \to \pi^+ \pi^- \pi^0$ decay, QED events and events of the radiative decay $\omega \to \pi^0 \gamma$, where monochromatic photon converts on the material in front of the sensitive volume of the detector. To suppress the last type of background the deep neural network was used. Using an integrated luminosity of about 10 pb^{-1} collected at the c.m. energy range from 760 MeV to 840 MeV the visible cross-section of the process under study was measured and the preliminary result for branching ratio $Br(\omega \to \pi^0 e^+ e^-)$ was obtained. The result is more precise than any previous measurements. The current status of the analysis is presented.

Primary author: KUTSENKO, Bogdan (Budker Institute of Nuclear Physics (RU))

Presenter: KUTSENKO, Bogdan (Budker Institute of Nuclear Physics (RU))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **163** Type: **Poster**

The Bc lifetime in the Standard Model and beyond

Monday, January 10, 2022 4:18 PM (1 minute)

Applying an operator product expansion approach an updated Standard Model prediction of the Bc lifetime will be presented. The non-perturbative velocity expansion is carried out up to third order in the relative velocity of the heavy quarks. Scheme dependence is studied using three different mass schemes for the b and c quarks, resulting in three different values consistent with each other and with experiment. Furthermore, a novel way on how to compute the Bc lifetime from B and D meson lifetimes will be discussed in the talk.
Finally, since the Bc lifetime puts strong constraints on New Physcs (NP) models I will review the bounds on NP scenarios resulting from the updated computation of the Bc lifetime.

Primary author: GRINSTEIN, Benjamin (Univ. of California San Diego (US))

Presenters: AEBISCHER, Jason (University of Zurich); AEBISCHER, Jason (TUM)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **164** Type: **Poster**

The challenge of track reconstruction at a multi-TeV muon collider

Monday, January 10, 2022 4:28 PM (1 minute)

Among the projects currently under study for the post-LHC generation of particle accelerators, the muon collider represents a unique machine, which has the capability to provide leptonic collisions at energies of several TeV and to open the path to a broad and mostly unexplored Physics programme. However, on the experimental side, such a great Physics potential is accompanied by unprecedented technological challenges, due to the fact that muons are unstable particles. Their decay products interact with the machine elements and produce an intense flux of background particles that eventually reach the detector and might degrade its performance. Being the closest detector to the beamline, the tracker is affected the most by the beam-induced background. This contribution will outline the measures adopted in order to mitigate the background effects on the track reconstruction and will present the tracking performance in the presence of the beam-induced background.

Primary author: CASARSA, Massimo (INFN, Trieste (IT))

Co-authors: BARTOSIK, Nazar (Universita e INFN Torino (IT)); MONTELLA, Alessandro (University of Trieste and INFN-Trieste)

Presenter: BARTOSIK, Nazar (Universita e INFN Torino (IT))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **165** Type: **Poster**

H → μμ at a 3-TeV muon collider

Monday, January 10, 2022 4:27 PM (1 minute)

Among the projects currently under study for the next generation of particle accelerators, the muon collider represents a unique machine, which has the capability to provide leptonic collisions at energies of several TeV. The multi-TeV energy regime is as yet unexplored and holds a huge physical potential that will enable a novel research programme ranging from high precision measurements of known standard model processes to high-sensitivity searches for phenomena beyond the standard model. A multi-TeV muon collider will produce huge samples of Higgs bosons that will allow a precise determination of the Higgs boson properties, like its couplings to fermions and bosons and its trilinear and quartic self-couplings with unprecedented precision.
This contribution will present an estimate of the muon collider reach on the production of the process H → μμ, one of the rarest Higgs boson decays that represents a gateway to the determination of the Higgs boson coupling to the second generation leptons.

Primary author: CASARSA, Massimo (INFN, Trieste (IT))

Co-authors: MONTELLA, Alessandro (University of Trieste and INFN-Trieste); CANDELISE, Vieri (Universita e INFN Trieste (IT))

Presenters: M., A.; MONTELLA, Alessandro (University of Trieste and INFN-Trieste)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **167** Type: **Poster**

Probing Lorentz Invariance Violation with Atmospheric Neutrinos at INO-ICAL

Monday, January 10, 2022 4:26 PM (1 minute)

Unified theories such as string theory suggests spontaneous Lorentz Invariance Violation(LIV) by introducing a new spacetime structure at the Planck Scale ($m_p \sim 10^{19}$ GeV). This effect can be observed at low energies with strength of $\sim 1/m_p$ using perturbative approach. In the Minimal Standard Model Extension (SME) framework, the neutrino mass-induced flavor oscillation gets modified in the presences of LIV. The Iron Calorimeter (ICAL) detector at the proposed India-based Neutrino Observatory (INO) offers an unique window to probe these LIV parameters by observing atmospheric neutrinos and anti neutrinos separately over a wide range of baselines in the multi-GeV energy range. In this paper, for the first time, we study in detail how the CPT-violating LIV parameters $(a_{e\mu}, a_{e\tau}, a_{\mu\tau})$ can alter muon survival probabilities and expected μ^- and μ^+ event rates at ICAL. Using 500 kt·yr exposure of ICAL, we place stringent bounds on these CPT-violating LIV parameters at 95% C.L which are slightly better than the present Super-Kamiokande limits. We discuss the effect of the marginalization over the oscillation parameters and the advantage of having the hadron energy information and charge identification capability at ICAL in constraining these LIV parameters. We also study the impact of these LIV parameters on mass ordering determination and precision measurement of atmospheric oscillation parameters.

Primary author: Mr SAHOO, SADASHIV (Institute of Physics, Bhubaneswar, Homi Bhabha National Institute, Mumbai, INDIA)

Co-authors: KUMAR, Anil (Institute of Physics, Bhubaneswar, India); Dr AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar, INDIA)

Presenter: Mr SAHOO, SADASHIV (Institute of Physics, Bhubaneswar, Homi Bhabha National Institute, Mumbai, INDIA)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **168** Type: **Poster**

The SMEFT analysis of $\Lambda_b \to (\Lambda^*, \Lambda)\mu^+\mu^-$ and $\Lambda_b \to (\Lambda^*, \Lambda)\nu\bar{\nu}$ baryonic decays

Monday, January 10, 2022 4:17 PM (1 minute)

We study $\Lambda_b \to (\Lambda^*, \Lambda)\mu^+\mu^-$ and $\Lambda_b \to (\Lambda^*, \Lambda)\nu\bar{\nu}$ baryonic decays undergoing $b \to s\ell^+\ell^-$ and $b \to s\nu\bar{\nu}$ neutral transitions in a standard model effective field theory formalism. The $b \to sl^+l^-$ and $b \to s\nu\bar{\nu}$ transition decays are related in beyond the Standard Model physics by $SU(2)_L$ gauge symmetry and can be best exploited by using the Standard Model effective field theory which is based on an operator product expansion in inverse powers of the NP scale. We constrain the New physics parameter space by fitting the latest measurements of $R_{K^{(*)}}$, P_5', $\mathcal{B}(B_s \to \phi\mu^+\mu^-)$ and $\mathcal{B}(B_s \to \mu^+\mu^-)$ and give predictions of several observables pertaining to $\Lambda_b \to (\Lambda^*, \Lambda)\mu^+\mu^-$ and $\Lambda_b \to (\Lambda^*, \Lambda)\nu\bar{\nu}$ decays. Study of $b \to s\nu\bar{\nu}$ transition decays is well motivated because they are theoretically clean as they do not suffer from hadronic uncertainties beyond the form factors such as non-factorizable corrections and photon-penguin corrections. Simultaneous study of decays mediated via $b \to s\nu\bar{\nu}$ and $b \to sl^+l^-$ quark level transitions will provide valuable information about possible new flavor dynamics that is responsible for the anomalies present in $b \to sl^+l^-$ decays.

Primary authors: DAS, Nilakshi (NIT Silchar, Assam , India); DUTTA, Rupak (University of Kentucky); N, Rajeev

Presenter: DAS, Nilakshi (NIT Silchar, Assam , India)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **169** Type: **Poster**

ALP-portal heavy neutrino dark matter

Monday, January 10, 2022 4:18 PM (1 minute)

Axion like particles(ALPs) and right handed neutrinos~(RHNs) are two well-motivated dark matter(DM) candidates. However, these two particles have a completely different origin. Axion was proposed to solve the Strong CP problem, whereas RHNs were introduced to explain light neutrino masses through seesaw mechanisms. We study the case of ALP portal RHN DM taking into account existing constraints on ALPs. We consider the leading effective operators mediating interactions between the ALP and SM particles and three RHNs to generate light neutrino masses through type-I seesaw. Further, ALP-RHN neutrino coupling is introduced to generalize the model which is restricted by the relic density and indirect detection constraint.

Primary author: Mr GOLA, Shivam (IMSc, Chennai)

Co-authors: Dr MONDAL, Sanjoy (IFIC, Valencia); Prof. SINHA, Nita (IMSc, Chennai)

Presenter: Mr GOLA, Shivam (IMSc, Chennai)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **170** Type: **Parallel session talk**

Prospects for observing the charged IDM scalars at high energy CLIC

Tuesday, January 11, 2022 4:50 PM (20 minutes)

The Compact Linear Collider (CLIC) was proposed as the next energy-frontier infrastructure at CERN, to study e^+e^- collisions at three centre-of-mass energy stages: 380 GeV, 1.5 TeV and 3 TeV. The main goal of its high-energy stages is to search for the new physics beyond the Standard Model (SM). The Inert Doublet Model (IDM) is one of the simplest SM extensions and introduces four new scalar particles: $H^{\pm}$, A and H; the lightest, H, is stable and hence a natural dark matter (DM) candidate. A set of benchmark points is considered, which are consistent with current theoretical and experimental constraints and promise detectable signals at future colliders.

Prospects for observing pair-production of the IDM scalars at CLIC were previously studied using signatures with two leptons in the final state. In the current study, discovery reach for the IDM charged scalar pair-production is considered for the semi-leptonic final state at the two high-energy CLIC stages. Full simulation analysis, based on the current CLIC detector model, is presented for five selected IDM scenarios. Results are then extended to the larger set of benchmarks using the Delphes fast simulation framework. The CLIC detector model for Delphes has been modified to take pile-up contribution from the beam-induced $\gamma\gamma$ interactions into account, which is crucial for the presented analysis. Results of the study indicate that heavy, charged IDM scalars can be discovered at CLIC for most of the proposed benchmark scenarios, with very high statistical significance.

Primary author: KLAMKA, Jan Franciszek (University of Warsaw (PL))

Co-author: ZARNECKI, Aleksander Filip (University of Warsaw)

Presenter: KLAMKA, Jan Franciszek (University of Warsaw (PL))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **171** Type: **Poster**

CLICdp-Pub-2021Optimising top-quark threshold scan at CLIC using genetic algorithm

Monday, January 10, 2022 4:25 PM (1 minute)

One of the important goals at the future e^+e^- colliders is to measure the top-quark mass and width in a scan of the pair production threshold. However, the shape of the pair-production cross section at the threshold depends also on other model parameters, as the top Yukawa coupling, and the measurement is a subject to many systematic uncertainties. Presented in this work is the study of the top-quark mass determination from the threshold scan at CLIC. The most general approach is used with all relevant model parameters and selected systematic uncertainties included in the fit procedure. Expected constraints from other measurements are also taken into account. It is demonstrated that the top-quark mass can be extracted with precision of the order of 30 to 40 MeV, including considered systematic uncertainties, already for 100 $\text{fb}^{-1}$of data collected at the threshold. Additional improvement is possible, if the running scenario is optimised. With the optimisation procedure based on the genetic algorithm the statistical uncertainty of the mass measurement can be reduced by about 20%. Influence of the collider luminosity spectra on the expected precision of the measurement is also studied.

Primary authors: ZARNECKI, Aleksander Filip (University of Warsaw); NOWAK, Kacper (University of Warsaw)

Presenter: NOWAK, Kacper (University of Warsaw)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **172** Type: **Poster**

Improving Hyper-Kamiokande sensitivity to CP violation with high precision near detector electron neutrino cross-section measurements

Monday, January 10, 2022 4:16 PM (1 minute)

The next generation long-baseline neutrino oscillation experiment, Hyper-Kamiokande, will consist of a 260 kt underground water Cherenkov detector, placed 295 km from the neutrino source at J-PARC. This is generated by a 1.3 MW proton beam striking a target. In addition, a suite of near detectors, both on and off-axis will be used. With this, Hyper-Kamiokande aims to perform precision measurements of the parameters governing neutrino oscillations, the observation of CP violation being one of the main aims of the experiment. To achieve these goals, Hyper-Kamiokande will require smaller systematic uncertainties than in any previous long-baseline experiment.

Many of these systematic uncertainties are related to neutrino-nucleus interactions, and can be constrained by a detector placed close to the beam production point. For this, the Hyper-Kamiokande long-baseline programme includes an Intermediate Water Cherenkov Detector, the IWCD. This is a 500 tonne water Cherenkov detector located 1 km from the beam production point. This detector is able to move within a vertical shaft and span a range of off-axis angles relative to the beam, from 1 to 4 degrees. The combination of large target mass, precise water Cherenkov reconstruction and off-axis angle flux dependence allows for high purity and high statistics electron neutrino and electron antineutrino samples. In this talk I will describe how this detector can be used to constrain the major systematic uncertainty affecting the measurement of CP violation at Hyper-Kamiokande: the electron neutrino and antineutrino interaction cross section.

Primary author: NASEBY, Charlie (Imperial College London)

Presenter: NASEBY, Charlie (Imperial College London)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **173** Type: **Parallel session talk**

Next-to SV resummed Drell-Yan cross section beyond leading-logarithm

Wednesday, January 12, 2022 12:20 PM (20 minutes)

We present the resummed predictions for inclusive cross section for Drell-Yan (DY) production up to next-to-next-to leading logarithmic ($\overline{\text{NNLL}}$) accuracy taking into account both soft virtual (SV) and next-to SV (NSV) threshold logarithms. We restrict ourselves to resummed contributions only from quark anti-quark ($q\bar{q}$) initiated channels. The resummation is performed in Mellin-N space. We derive the N-dependent coefficients and the N-independent constants to desired accuracy
for our study. The resummed results are matched through the minimal prescription procedure with the fixed order results. We find that the resummation, taking into account the NSV terms, appreciably increases the cross section while decreasing the sensitivity to renormalisation scale. We observe that, at 13 TeV LHC energies, the SV+NSV resummation at $\overline{\text{NLL}}(\overline{\text{NNLL}})$ gives about 8\% (2\%) corrections respectively to the NLO (NNLO) results for the considered Q range: 150-3500 GeV. In addition, the absence of quark gluon initiated
contributions to NSV part in the resummed terms leaves large
factorisation scale dependence indicating their importance
at NSV level. We also study
the numerical impact of N-independent constants and explore the ambiguity involved in exponentiating them.
Finally we present our predictions for the neutral Drell-Yan process at various center of mass of energies.

Primary author: SANKAR, Aparna (IMSc, Chennai)

Co-authors: Dr V, Ravindran (IMSc,Chennai); Dr MUKHERJEE, Pooja (IMSc,Chennai); Ms TIWARI, Surabhi (IMSc,Chennai); Dr A.H, Ajjath (IMSc,Chennai)

Presenter: SANKAR, Aparna (IMSc, Chennai)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **174** Type: **Poster**

A New ATLAS Visitor Centre

Monday, January 10, 2022 4:20 PM (1 minute)

The ATLAS Visitor Centre at CERN is a guided exhibition space that has been welcoming visitors from around the world since 2009. In a recent effort, ATLAS has reinvented the whole concept, replacing the original installation with a completely new exhibition. This contribution will highlight the basic concept behind the new exhibition, introduce its main components along with details on their implementation and hint at the process of getting from an idea to the final implementation. This contribution will also present some of the efforts to make the exhibition more inclusive and accessible to a wider and more diverse audience.

Primary author: GOLDFARB, Steven (University of Melbourne (AU))

Presenter: MEHLHASE, Sascha (LMU Munich)

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **175** Type: **Poster**

Live on YouTube! ATLAS public talks go digital

Monday, January 10, 2022 4:19 PM (1 minute)

Launched in 2020, the ATLAS YouTube Live series brings public talks to the digital audiences. Originally created as a way to engage audiences in public events due to the cancellation of in-person events, the ATLAS Youtube live programme has become a regular feature of ATLAS communications. Members of the ATLAS Collaboration are invited to give a 30-45 min talk aimed at the general public live on Youtube, with a live Q&A session held afterwards. Subjects covered by these talks range from physics to detector… The success of the talks is evaluated and plans for future events discussed.

Primary author: GOLDFARB, Steven (University of Melbourne (AU))

Presenter: NELLIST, Clara (Radboud University Nijmegen and NIKHEF (NL))

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **176** Type: **Parallel session talk**

Sharing ATLAS Science: communicating to the public

Wednesday, January 12, 2022 10:00 AM (20 minutes)

Communicating the science and achievements of the ATLAS Experiment is a core objective of the ATLAS Collaboration. This talk will explore the range of communication strategies adopted in ATLAS communications, with particular focus on how these have been impacted by the COVID-19 pandemic. In particular, an overview of ATLAS' digital communication platforms will be given – with focus on social media, YouTube and Virtual Visits – and the effect on target audiences evaluated with best practices are shared.

Primary author: GOLDFARB, Steven (University of Melbourne (AU))

Presenter: MEHLHASE, Sascha (LMU Munich)

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **177** Type: **Poster**

ATLAS Virtual Visits – Take part from anywhere in the world

Monday, January 10, 2022 4:18 PM (1 minute)

The Virtual Visit service run by the ATLAS Collaboration has been provided since 2010. The ATLAS Collaboration has used this popular and effective method to bring the excitement of scientific exploration and discovery into classrooms and other public places around the world. The programme, which uses a combination of video conferencing, webcasts, and video recording to communicate with remote audiences, has already reached tens of thousands of viewers, with a large number of languages, from tens of countries covering the six populated continents. We present a summary of the ATLAS Virtual Visit service that is currently in use – including a new booking system and hand-held video conference setup from the ATLAS cavern – and present a new system that is being installed in the ATLAS Visitors Center and in ATLAS cavern. In addition, we show the reach of the programme over the last few years.

Primary author: GOLDFARB, Steven (University of Melbourne (AU))

Presenter: RENNIE, Adam (University of Glasgow (GB))

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **178** Type: **Poster**

Educational Printables: from colouring books to cheat & fact sheets

Monday, January 10, 2022 4:17 PM (1 minute)

The ATLAS Collaboration has developed a variety of printables for education and outreach activities. We present two ATLAS Colouring Books, the ATLAS Fact Sheets, the ATLAS Physics Cheat Sheets, and ATLAS Activity Sheets. These materials are intended to cover key topics of the work done by the ATLAS Collaboration and the physics behind the experiment for a broad audience of all ages and levels of experience. In addition, there is ongoing work in translating these documents to different languages, with one of the colouring books already available in 18 languages. These printables are prepared to complement the information found in all ATLAS digital channels, they are particularly useful in outreach events and in the classroom.

Primary author: GOLDFARB, Steven (University of Melbourne (AU))

Presenter: LE BOULICAUT, Elise Maria (Duke University (US))

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **179** Type: **Poster**

Reconstructing muons at a Muon Collider

Monday, January 10, 2022 4:24 PM (1 minute)

A Muon Collider represents a promising proposal for the future of particle accelerators. Lepton colliders, indeed, allow to probe much higher energy scales than hadrons with higher precision; in addition, the usage of muons guarantees a much lower level of synchrotron radiation than the electron case. However, a muon collider poses relevant technological challenges: worth to mention, at least, the production of a large number of muons in low emittance bunches and the need to deal with the Beam-Induced Background (BIB), i.e. background generated by muon decays.
In this context, a detailed simulation of the detector is mandatory to understand the feasibility of the experiment implementation. Currently a complete simulation, mostly inherited from the CLIC ILC software, is ongoing to understand the performance of the full detector.
The CLIC muon system foresees instrumenting the iron yoke plates with layers of track sensitive chambers in order to enhance the muon identification. The glass Resistive Plate Chambers technology has been adopted both for barrel and endcap region with readout cells of 30x30 mm^2.
Alternative MicroPattern Gaseous Detector technologies are under investigation.
Simulated data of the particles reaching the muon chambers have been analyzed both for a single muon and multimuon final state processes, also including the BIB hits in the muon system.
This contribution will present preliminary studies of the muon reconstruction efficiency, BIB sensitivity and background mitigation giving a general overview of the muon spectrometer expected performance.

Primary authors: AIME', Chiara (Pavia University and INFN (IT)); RICCARDI, Cristina (University of Pavia, INFN Pavia); VAI, Ilaria (University of Bergamo & INFN Pavia); VALLE, Nicolò (University of Pavia, INFN Pavia); SALVINI , Paola (University of Pavia, INFN Pavia)

Presenter: AIME', Chiara (Pavia University and INFN (IT))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **181** Type: **Parallel session talk**

Detector performance and physics reach of at Muon Collider

Wednesday, January 12, 2022 12:00 PM (20 minutes)

The Muon Collider is becoming a realistic option for the next generation of high energy collider machines. Beams with intensity of the order of 10^12 muons per bunch are necessary to obtain the desired luminosity, which entails a very high rate of muons decay. Among the technological challenges, the treatment of the beam-induced background is one of the most critical issues for the detector design. The detector performance for collider machines working at center of mass energies up to 3 TeV, will be presented discussing, in particular, the strategies studied to mitigate the effect of the beam-induced background. In this contest, the reach of the most representative physics processes will also be presented.

Primary author: LUCCHESI, Donatella (Universita e INFN, Padova (IT))

Presenter: CASARSA, Massimo (INFN, Trieste (IT))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **182** Type: **Poster**

Implementation of large imaging calorimeters

Monday, January 10, 2022 4:23 PM (1 minute)

The next generation of collider detectors will make full use of Particle Flow algorithms, requiring high precision tracking and full imaging calorimeters. The latter, thanks to granularity improvements by 2 to 3 orders of magnitude compared to existing devices, have been developed during the past 15 years by the CALICE collaboration and are now reaching maturity. The state-of-the-art status and the remaining challenges will be presented for all investigated readout types: silicon diode and scintillator for a electromagnetic calorimeter, gaseous with semi-digital readout as well as scintillator with SiPM readout for a hadronic one. We will describe the commissioning, including beam test results, of large scale technological prototypes and the raw performances such as energy resolution, linearity and studies exploiting the distinct features of granular calorimeters regarding pattern recognition. Note that, at the time of conference new results obtained in a beam test in Autumn 2021 with a technological prototype of a highly granular silicon tungsten electromagnetic calorimeter will be available. Beyond the mentioned prototypes, the design of experiments addressing the requirements and potential of imaging calorimetry will be discussed. In addition, less established but promising techniques for dedicated devices inverse APD or segmented crystal calorimeters will also be highlighted. In the last year also first results with high resolution timing devices have been obtained. The integration of these devices in the CALICE prototypes is one of the major goals in the coming years.

Primary author: POESCHL, Roman (Université Paris-Saclay (FR))

Presenter: BOSLEY, Robert Ross (University of Birmingham (GB))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **183** Type: **Parallel session talk**

Exploring the structure of hadronic showers and the hadronic energy reconstruction with highly granular calorimeters

Tuesday, January 11, 2022 3:40 PM (20 minutes)

Prototypes of electromagnetic and hadronic imaging calorimeters developed and operated by the CALICE collaboration provide an unprecedented wealth of highly granular data of hadronic showers for a variety of active sensor elements and different absorber materials. In this presentation, we discuss detailed measurements of the spatial and the time structure of hadronic showers to characterise the different stages of hadronic cascades in the calorimeters, which are then confronted with GEANT4-based simulations using different hadronic physics models. These studies also extend to the two different absorber materials, steel and tungsten, used in the prototypes. The high granularity of the detectors is exploited in the reconstruction of hadronic energy, both in individual detectors and combined electromagnetic and hadronic systems, making use of software compensation and semi-digital energy reconstruction. The results include new simulation studies that predict the reliable operation of granular calorimeters. Further we show how granularity and the application of multivariate analysis algorithms enable the separation of close-by particles. We will report on the performance of these reconstruction techniques for different electromagnetic and hadronic calorimeters, with silicon, scintillator and gaseous active elements. Granular calorimeters are also an ideal testing ground for the application of machine learning techniques. We will outline how these techniques are applied to CALICE data and in the CALICE simulation framework.

Primary author: POESCHL, Roman (Université Paris-Saclay (FR))

Presenter: GARCIA CABRERA, Hector (Centro de Investigaciones Energéti cas Medioambientales y Tecnológicas (ES))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **186** Type: **Poster**

Scintillating sampling ECAL technology for the Upgrade II of LHCb

Monday, January 10, 2022 4:22 PM (1 minute)

The aim of the LHCb Upgrade II is to operate at a luminosity in the range of 1 to 2 x 10^{34} cm^{-2} s^{-1} to collect a data set of 300 fb^{-1}. This will require a substantial modification of the current LHCb ECAL due to high radiation doses in the central region and increased particle densities. The ECAL has to provide good energy and position resolutions in these conditions. Timing capabilities with tens of picoseconds precision for neutral electromagnetic particles and increased granularity with dense absorber in the central region are needed for pile-up mitigation.

Several scintillating sampling ECAL technologies are currently being investigated for this purpose: Spaghetti Calorimeter (SpaCal) with garnet scintillating crystals and tungsten absorber, SpaCal with scintillating plastic fibres and tungsten or lead absorber, and Shashlik with polystyrene tiles, lead absorber and fast WLS fibres. Results from an ongoing R&D campaign to optimise the Upgrade II ECAL are shown. This includes studies of radiation-hard scintillation materials, performance optimisation using detailed simulations and test beam measurements. The presentation also includes an overview of the overall plans for the Upgrade II of the LHCb ECAL.

Primary author: ROLOFF, Philipp (CERN)

Presenter: BETTI, Federico (CERN)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **187** Type: **Poster**

Measurement of sigma(e+e- ->HZ) x Br(H ->ZZ*) at the 250 GeV ILC

Monday, January 10, 2022 4:21 PM (1 minute)

We report on studies of the Higgsstrahlung process with the subsequent decay of the Higgs boson to ZZ, *where four different final state signatures from ZZ* decays are considered. The analysis is performed using Monte Carlo data samples obtained with full detector simulation and polarized beams at the center-of-mass energy of 250 GeV. Overall statistical uncertainty of 5.3% indicates that the Higgs width can be measured using this method with about the same accuracy in the model-independent approach.

Primary author: BOZOVIC-JELISAVCIC, Ivanka (University of Belgrade (RS))

Presenter: ANTONOV, Evgeny (Lebedev Physical Institute of the Russian Academy of Science)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **188** Type: **Poster**

A Deep Learning Search of Dark Tridents at the MicroBooNE Experiment

Monday, January 10, 2022 4:19 PM (1 minute)

The use of Convolutional Neural Networks (CNN) techniques has grown widely among the Liquid Argon Time Projection Chamber (LArTPC) community, mainly because the high-resolution images produced by these detectors are suitable to be processed by such neural networks. Current and future LArTPC experiments are constantly investigating different applications of CNNs as is the case in the MicroBooNE and DUNE collaborations. In this poster, we present preliminary results of using a CNN in the search of dark tridents in the MicroBooNE experiment. The dark trident signal is a new interaction channel that allows a dark sector composed of a dark matter fermion and a dark photon that could be explored in neutrino LArTPC experiments. We show that the CNN achieves good discrimination of the signal from the background (NCπ^0), using a simulated dataset. We include robustness checks, such as the performance over different backgrounds, presence of cosmic ray activity in the dataset and accuracy for different dark photon mass values.

Primary author: Mr MORA, Luis (The University of Manchester)

Presenter: Mr MORA, Luis (The University of Manchester)

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **189** Type: **Poster**

Resummed Higgs boson cross section at next-to SV to NNLO+$\overline{\text{NNLL}}$

Monday, January 10, 2022 4:32 PM (1 minute)

We present the resummed predictions for inclusive cross-section for the production of Higgs boson
at next-to-next-to leading logarithmic ($\overline{\text{NNLL}}$) accuracy taking into account both soft-virtual (SV) and next-to SV (NSV) threshold logarithms. We derive the N-dependent coefficients and the N-independent constants in Mellin-N space for our study. We match the resummed result through the framework of minimal prescription with the fixed order results. We report in detail the numerical impact of N-independent part of resummed result and explore the ambiguity involved in exponentiating them. By studying the K factors at different logarithmic accuracy from resummed $\text{SV} + \text{NSV}$ logarithms we find that the perturbative expansion shows better convergence improving the reliability of the prediction at $\text{NNLO}+\overline{\text{NNLL}}$ accuracy. We also observe that the resummed $\text{SV} + \text{NSV}$ result improves the renormalisation scale uncertainty at every order in perturbation theory. The uncertainty from the renormalisation scale μ_R ranges between $(+8.85\%, -10.12\%)$ at NNLO whereas it goes down to $(+6.54\%, -8.32\%)$ at $\text{NNLO} + \overline{\text{NNLL}}$ accuracy. However, the factorisation scale uncertainty is worsened by the inclusion of these NSV logarithms hinting the importance of resumming beyond NSV terms. We also present our predictions for $\text{SV} + \text{NSV}$ resummed result at different collider energies.

Primary author: TIWARI, Surabhi (Institute of Mathematical Sciences)

Co-authors: A.H, Ajjath (IMSc,Chennai); MUKHERJEE, Pooja (IMSc,Chennai); RAVINDRAN, Vajravelu (Harish-Chandra Research Institute); SANKAR, Aparna (IMSc, Chennai)

Presenter: TIWARI, Surabhi (Institute of Mathematical Sciences)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **190** Type: **Parallel session talk**

Electron Yukawa determination at FCC-ee

Tuesday, January 11, 2022 5:30 PM (20 minutes)

Measuring the electron Yukawa is impossible in Higgs boson decays, H -> e+e- , given the smallness of the electron mass that leads to a vanishingly small decay branching fraction. The only direct method to extract the Higgs-electron coupling is through resonant s-channel production in e+e- collisions running at the Higgs pole mass. Such a measurement is possible at the FCC-ee provided one can monochromatize the beams, leading to a center-of-mass energy spread not much larger than the Higgs boson width of ~4 MeV, as well as having a prior accurate and precise knowledge of the Higgs boson mass, within MeV uncertainties. Under such conditions, a study combining 10 different Higgs decay modes indicates that a ~1.3sigma significance for the e+e- -> H process can be reached, above the (much larger) backgrounds, for every 10 ab-1 of integrated luminosity per FCC-ee interaction point (IP). Depending on the number of IPs and years running at the Higgs pole, such a measurement will provide the only means known to access the electron Yukawa.

Primary author: KLUTE, Markus (Massachusetts Inst. of Technology (US))

Presenter: D'ENTERRIA, David (CERN)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **191** Type: **Parallel session talk**

A common software for future colliders: The Key4hep turnkey software stack

Wednesday, January 12, 2022 10:40 AM (20 minutes)

Software tools are foundational for the development of future collider experiments. Detector optimization and physics performance studies crucially depend on the availability of performant and reliable software libraries for Monte Carlo generation, detector simulation, reconstruction, and analysis. The Key4hep project aims at providing infrastructure, interfaces, and a common stack of easy-to-use software tools for future, or even present, High Energy Physics projects. Key4hep is to a large extent based on software tools that are already very actively used in the community - like ROOT, Geant4 and DD4hep - or those that are currently under active development like EDM4hep or ACTS. The Key4hep project is supported by, among others, the HEP Software Foundation, CERN, DESY, IHEP and the AIDAinnova project and has active developers from all large future collider projects: CEPC, CLIC, FCC, and ILC. In this talk we present an overview of the Key4hep project and describe the adaptation processes of the different future experiments, thereby showing that Key4hep is a viable long term solution as baseline software for high energy experiments that will facilitate the scientific exchange and make similar studies easier and more efficient.

Primary authors: SAILER, Andre (CERN); HEGNER, Benedikt (CERN); VOLKL, Valentin (CERN); HELSENS, Clement (CERN); GAEDE, Frank-Dieter (Deutsches Elektronen-Synchrotron (DE)); GANIS, Gerardo (CERN); XINGTAO, Huang (Shandong University, Qingdao, Shandong, China); ZOU, Jiaheng (Chinese Academy of Sciences (CN)); FERNANDEZ DECLARA, Placido (CERN); KO, Sang Hyun (Seoul National University (KR)); LIN, Tao; LI, Teng (Shandong University, CN); MADLENER, Thomas (Deutsches Elektronen-Synchrotron (DESY)); FANG, Wenxing; ZHANG, xiaomei (IHEP,Beijing)

Presenter: VOLKL, Valentin (CERN)

Session Classification: R&D

Track Classification: R&D

Contribution ID: **194** Type: **Parallel session talk**

Higgs measurements at the Future Circular Colliders

Tuesday, January 11, 2022 5:10 PM (20 minutes)

Precision measurements and searches for new phenomena in the Higgs sector are among the most important goals in particle physics. Experiments at the Future Circular Colliders (FCC) are ideal to study these questions. Electron-positron collisions (FCC-ee) up to an energy of 365 GeV provide the ultimate precision with studies of Higgs boson couplings, mass, total width, and CP parameters, as well as searches for exotic and invisible decays. Very high energy proton-proton collision (up to 100 TeV) provided by the FCC-hh will allow studying the Higgs self-coupling. There is a remarkable complementarity of the FCC-ee and FCC-hh colliders, which in combination offer the best possible overall study of the Higgs boson properties.

Primary author: KLUTE, Markus (Massachusetts Inst. of Technology (US))

Presenter: ROMPOTIS, Nikolaos (University of Liverpool (UK))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **196** Type: **Parallel session talk**

Establishing non-maximal 2-3 mixing with DUNE in light of current neutrino oscillation data

Tuesday, January 11, 2022 2:00 PM (20 minutes)

Global analyses [1-3] of the existing neutrino oscillation data point to near–percent-level relative 1σ-precision in oscillation parameters such as $|\Delta m^2_{31}|$ (1.1%), Δm^2_{21} (2.3%), $\sin^2\theta_{13}$ (3.0%) and $\sin^2\theta_{12}$ (4.5%). All these analyses show a preference for the normal mass ordering, thus disfavoring the inverted mass ordering at nearly $\sim 2.5\sigma$. Refs. [1] and [2] find the best fit for θ_{23} in the higher octant at $\sin^2\theta_{23} \sim 0.57$ while Ref. [3] finds the best fit for θ_{23} in the lower octant at $\sin^2\theta_{23} \sim 0.46$. All three of them allow the solution in the other octant at 2σ or less. It should also be noted that all these analyses allow maximal 2-3 mixing i.e. the value $\sin^2\theta_{23} = 0.5$ at $\sim 2.5\sigma$ or less. The primary goal of the next-generation experiments such as the Deep Underground Neutrino Experiment (DUNE) [4] is to {\it conclusively} find out the sign of $m^2_3 - m^2_1$, the value of $\sin^2\theta_{23}$, the existence of leptonic CP-violation in neutrino sector and the value of its phase $\delta_{\rm CP}$. The main aim of this work is to explore if DUNE can conclusively rule-out maximal 2-3 mixing if the true 1σ range of $\sin^2\theta_{23}$ is $\sim (0.44,\ 0.47)$ as indicated in Ref. [3]. Our work highlights that while this measurement is, by and large, independent of the systematic uncertainties and an imprecise understanding of $\delta_{\rm CP}$; it crucially depends on performing a spectral analysis to resolve the $|\Delta m^2_{31}|$–$\sin^2\theta_{23}$ degeneracy - a feature that can potentially ruin DUNE's sensitivity for $\sin^2\theta_{23}$ resolution if $|\Delta m^2_{31}|$ is not known accurately-enough. We find that disappearance data from DUNE can improve the current precision in the measurements of $|\Delta m^2_{31}|$ and $\sin^2 2\theta_{23}$ by a factor of three while the appearance data can very effectively eliminate the wrong-octant solution. {\it Our results show that DUNE can exclude $\sin^2\theta_{23} = 0.5$ at $\sim 2\sigma$ for the current 1σ-upper bound of $\sin^2\theta_{23} \sim 0.47$. For the current best-fit of $\sin^2\theta_{23} = 0.455$, a $\sim 4\sigma$ exclusion is possible.

Primary authors: SINGH, Masoom (Institute of Physics and Utkal University, Bhubaneswar, India); KUNDU, Ritam (Institute of Physics, Bhubaneswar, India); Dr AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar, India); Dr PRAKASH, Suprabh (The Institute of Mathematical Sciences, Chennai, India)

Presenter: KUNDU, Ritam (Institute of Physics, Bhubaneswar, India)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **197** Type: **Poster**

Jet energy calibration and study of Left-Right Asymmetry using e+e- → γZ process at the ILC

Monday, January 10, 2022 4:17 PM (1 minute)

For the electroweak precision study, left-right asymmetry in the total rate for Z boson production (ALR) is important since it can provide a very useful constraint for new physics as well as for operators in the Standard Model (SM) Effective Field Theory, which provides a mathematical framework to express the deviation from the SM by a set of higher dimensional operators model independently. It turned out that the precision of the ALR measurement done at SLC, being at around 1%, is not good enough for the global fit. It is hence motivated to improve this observable at the ILC. Complementary to the method at Z-pole, at the ILC250 we can use the radiative return process, e+e- -> γZ, to measure ALR. We will report the full detector simulation based on the International Large Detector (ILD), which is a detector concept for the ILC, for the ALR measurement including estimation of systematic errors.

Primary author: MIZUNO, Takahiro (Sokendai University)

Co-authors: FUJII, Keisuke (KEK); TIAN, Junping (Tokyo University)

Presenters: MIZUNO, Takahiro (Sokendai University); MIZUNO, Takahiro (Sokendai)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **200** Type: **Poster**

Decoherence effect on neutrino oscillation probabilities

Monday, January 10, 2022 4:15 PM (1 minute)

Neutrinos propagating through matter behaves like an open-quantum system. These neutrinos interact with the environment via weak coupling. It leads to a loss of coherence of the neutrino mass states. We generally observe this phenomenon of decoherence in systems interacting with a dissipative environment. In this present work, we are exploring how environmental decoherence affects neutrino survival and appearance probabilities. Considering neutrinos as an open-quantum system, we apply the Lindblad Master equation to study the evolution of the neutrino states. Moreover, we also incorporate the matter effects using the Cayley-Hamilton formalism.
We are working on a general algorithm that will give out the neutrino oscillation probabilities by solving the Lindblad Master equation taking into account the environmental decoherence. We'll present our work on understanding the potential effect of induced decoherence on the oscillation probabilities for the long baseline sector.

Primary authors: Mr SARKER, Arnab (Tezpur University, Assam, India); Dr DEVI, Moon Moon (Tezpur University, Assam, India)

Presenter: Mr SARKER, Arnab (Tezpur University, Assam, India)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **201** Type: **Parallel session talk**

The Intermediate Water Cherenkov Detector for the Hyper-Kamiokande experiment

Tuesday, January 11, 2022 5:50 PM (20 minutes)

The Hyper-Kamiokande (HK) experiment will perform a broad physics program including the study of long-baseline neutrino oscillations. Following the successful T2K experiment, this will be achieved by detecting neutrinos produced at an upgraded 1.3 MW beam at the J-PARC with a far water Cherenkov detector with around 8 times larger detector volume than that of the Super-Kamiokande detector. To make full use of the high statistics data, an accurate prediction of neutrino interaction rates at the HK detector is essential. For this purpose, the Intermediate Water Cherenkov Detector (IWCD) is planned as one of HK's near detectors, using a kiloton scale water Cherenkov detector to be located around 1 km from the neutrino source at J-PARC. The unique feature of IWCD enables it to move vertically relative to the beam direction, changing the energies of neutrinos impinging the detector. By collecting data at various vertical positions, IWCD will study the relation between neutrino energy and products of neutrino interactions directly. This talk will describe the IWCD design and its physics program, including key technology, new photosensor module, and challenges for the IWCD measurements.

Primary author: PROUSE, Nick (TRIUMF)

Presenter: PROUSE, Nick (TRIUMF)

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **202** Type: **Poster**

Increasing Multilingualism in ATLAS' Science Communication

Monday, January 10, 2022 4:16 PM (1 minute)

Despite modern particle physics being an international endeavour, the vast majority of its educational material is only published in English. By making material available in other languages, physicists can make in-roads with new audiences – especially those very young or very old – in their home countries. The ATLAS Collaboration has published colouring books, activity sheets, fact sheets and cheat sheets aimed at communicating science to a non-expert audience. An effort is underway to translate this content into as many languages as possible, taking advantage of the countless multilingual members of the collaboration. Currently all of this content is available in at least two languages other than English, with the ATLAS Colouring Book being the one available in the most languages (18 so far). The reach of this multilingual content is presented.

Primary author: GOLDFARB, Steven (University of Melbourne (AU))

Presenter: RODRIGUEZ VERA, Ana Maria (York University (CA))

Session Classification: Science in Society

Track Classification: Equality, Diversity, and Inclusion

Contribution ID: **205** Type: **Parallel session talk**

Dark matter as the origin of neutrino mass in the inverse seesaw mechanism

Wednesday, January 12, 2022 12:00 PM (20 minutes)

We propose that neutrino masses are "seeded" by a dark sector within the inverse seesaw mechanism. The simplest way to have a "dark sector" as origin for neutrino masses in such inverse seesaw mechanism is to postulate the existence of an extra dark fermion f, as well as a new complex dark scalar ξ. This way we have a new, "hidden", variant of the scotogenic scenario for radiative neutrino masses. We discuss both explicit and dynamical lepton number violation. In the case of dynamical breaking of lepton number, we need one extra complex scalar which further implies the existence of a massless majoron. In addition to invisible Higgs decays with majoron emission, we discuss in detail the pheneomenolgy of scalar dark matter ξ, as well as the novel features associated to charged lepton flavour violation, and neutrino physics.

Primary authors: Prof. WF VALLE, Jose (AHEP Group at IFIC, CSIC- U Valencia); Dr MANDAL, Sanjoy (IFIC, University of Valencia); Dr ROJAS, Nicolas; Dr SRIVASTAVA, Rahul (Department of Physics, Indian Institute of Science Education and Research - Bhopal, Bhopal Bypass Road, Bhauri, Bhopal 462066, India)

Presenter: Dr MANDAL, Sanjoy (IFIC, University of Valencia)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **206** Type: **Parallel session talk**

Development of the BCM' system for beam abort and luminosity determination at the HL-LHC based on polycrystalline CVD diamond

Wednesday, January 12, 2022 11:40 AM (20 minutes)

The High Luminosity upgrade of Large Hadron Collider (HL-LHC) will increase the LHC Luminosity by an order of magnitude increasing with it the density of particles on the detector by an order of magnitude. For protecting the inner detectors of experiments and for monitoring the delivered luminosity, a radiation hard beam monitor is being developed. We are developing a set of detectors based on poly-crystalline Chemical Vapor Deposition (pCVD) diamonds and a new dedicated rad-hard ASIC. Due to the large range of particle flux through the detector, flexibility is very important. To satisfy the constraints imposed by the HL-LHC, our solution is based on segmenting each single diamond sensor into multiple devices of varying size and reading them out with a new multichannel readout chip. In this talk we describe the proposed system design including detectors, electronics, mechanics and services and present preliminary results from the first detectors fabricated using our prototype ASIC.

Primary authors: OH, Alexander (University of Manchester (GB)); GORISEK, Andrej (Jozef Stefan Institute (SI)); KAGAN, Harris (Ohio State University (US)); PORTER, Alice Laura (University of Manchester (GB)); HITI, Bojan (Jozef Stefan Institute (SI)); MACEK, Bostjan (Jozef Stefan Institute (SI)); SMITH, Dale Shane (Ohio State University (US)); MIKUZ, Marko (Jozef Stefan Institute (SI)); Mr ABUSAREYA, Mo'men (Ohio State University)

Presenter: HITI, Bojan (Jozef Stefan Institute (SI))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **207** Type: **Parallel session talk**

New measurement of radiative decays at the NA62 Experiment at CERN

Tuesday, January 11, 2022 5:30 PM (20 minutes)

The NA62 experiment at CERN reports new results from studies of radiative kaon decays K+ → pi0 e+ v gamma (Ke3g), using a data sample recorded in 2017-2018. The sample comprises O(100k) Ke3g candidates with sub-percent background contaminations. Preliminary results with the most precise measurement of the Ke3g branching ratios and T-asymmetry measurement in the Ke3g decay, are presented.

Primary author: CENCI, Patrizia (INFN Perugia (IT))

Presenter: MADIGOZHIN, Dmitri (Joint Institute for Nuclear Research (RU))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **208** Type: **Parallel session talk**

Measurement of the very rare K+ to pi+ nu nubar decay

Tuesday, January 11, 2022 5:50 PM (20 minutes)

The decay K+⟶π+ νν̄, with a very precisely predicted branching ratio of less than 10-10, is among the best processes to reveal indirect effects of new physics.
The NA62 experiment at CERN SPS is designed to study the K+⟶π+ νν̄ decay and to measure its branching ratio using a decay-in-flight technique. NA62 took data in 2016, 2017 and 2018, reaching the sensitivity of the Standard Model for the K+⟶π+ νν̄ decay by the analysis of the 2016 and 2017 data, and providing the most precise measurement of the branching ratio to date by the analysis of the 2018 data. This measurement is also used to set limits on BR(K+⟶π+X), where X is a scalar or pseudo-scalar particle.
The final result of the K+⟶π+ νν̄ branching ratio measurement and its interpretation in terms of K+⟶π+ X decay from the analysis of the full 2016-2017-2018 data set is presented, and future plans and prospects reviewed.

Primary author: CENCI, Patrizia (INFN Perugia (IT))

Presenter: PEPE, Monica (INFN Perugia (IT))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **209** Type: **Parallel session talk**

Search for K+ decays to a lepton and invisible particles

Tuesday, January 11, 2022 5:30 PM (20 minutes)

The NA62 experiment at CERN reports searches for K+ ⟶ e+N, K+⟶μ+N and K+⟶μ+νX decays, where N and X are massive invisible particles, using the 2016-2018 data set. The N particle is assumed to be a heavy neutral lepton, and the results are expressed as upper limits of O(10−9) and O(10−8) of the neutrino mixing parameter |Ue4|2 and |Uμ4|2, improving on the earlier searches for heavy neutral lepton production and decays in the kinematically accessible mass range.The X particle is considered a scalar or vector hidden sector mediator decaying to an invisible final state, and upper limits of the decay branching fraction for X masses in the range 10-370 MeV/c2 are reported for the first time, ranging from O(10−5) to O(10−7).
An improved upper limit of 1.0 10−6 is established at 90% CL on the K+⟶μ+νν branching fraction.

Primary author: CENCI, Patrizia (INFN Perugia (IT))

Presenter: WANKE, Rainer (Universität Mainz)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **210** Type: **Poster**

Search for lepton number and flavour violation in K+ and pi0 decays

Monday, January 10, 2022 4:16 PM (1 minute)

The NA62 experiment at CERN collected a large sample of charged kaon decays into final states with multiple charged particles in 2016-2018. This sample provides sensitivities to rare decays with branching ratios as low as 10-11.
Results from searches for lepton flavour/number violating decays of the charged kaon and the neutral pion to final states containing a lepton pair based on this data set are presented.

Primary author: CENCI, Patrizia (INFN Perugia (IT))

Presenter: JERHOT, Jan (Universite Catholique de Louvain (UCL) (BE))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **212** Type: **Poster**

New bounds on heavy quark EDMs and implications for coloured scalar models

Monday, January 10, 2022 4:15 PM (1 minute)

New physics (NP) models with additional CP violation sources are heavily constrained by the experimental limits on permanent electric dipole moments (EDMs) of particles. Using the stringent limits on their chromo-EDMs, new bounds on the EDM of charm and bottom quarks are derived. The new limits improve the previous ones by about three orders of magnitude. The implications for different NP models are explored, giving special attention to colored scalar extensions of the Standard Model. For this model, we compute the full set of one-loop diagrams and the enhanced higher-order effects from Weinberg operators, CP-odd four-fermion interactions and Barr-Zee diagrams.

Primary authors: GISBERT MULLOR, Hector (TU Dortmund); RUIZ VIDAL, Joan (Univ. of Valencia and CSIC (ES)); MIRALLES, Victor (IFIC)

Presenter: RUIZ VIDAL, Joan (Univ. of Valencia and CSIC (ES))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **213** Type: **Poster**

Theory and phenomenology of BSM dark mesons

Monday, January 10, 2022 4:17 PM (1 minute)

In this talk, I will introduce our recent progress approaching a detailed exploration of the phenomenology of the dark pions with masses much below the EW scale, based on the Z and Higgs portal coupling model benchmarks.

Primary author: LI, LINGFENG (Brown U.)

Presenter: LI, LINGFENG (Brown U.)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **215** Type: **Parallel session talk**

Diversity and Inclusion at Belle II

Wednesday, January 12, 2022 9:20 AM (20 minutes)

Abstract: Belle II is a particle physics collaboration that has over 1000 people from institutions in 26 countries who work together to achieve its physics goals. Belle II is committed to fostering an open, diverse, and inclusive environment; as part of this commitment it created a diversity office to raise awareness of diversity and inclusion issues, promote an inclusive atmosphere within the collaboration, provide a safe and confidential point to contact for collaborators to report any issues, particularly those related to discrimination and harassment, and ensure that persons from underrepresented groups are considered for positions of responsibility within the collaboration. Diversity and inclusion activities and initiatives at Belle II and analysis of the demographics of the collaboration will be presented."

Primary author: PRENCIPE, Elisabetta

Co-author: BARRETT, Matthew (KEK)

Presenter: WAKELING, Hannah (Belle II Group at McGill University)

Session Classification: Science in Society

Track Classification: Equality, Diversity, and Inclusion

Contribution ID: **217** Type: **Parallel session talk**

Precise W mass measurement at LHCb

Wednesday, January 12, 2022 11:20 AM (20 minutes)

The LHCb experiment covers the forward region of proton-proton collisions, and it can improve the current electroweak landscape by studying the production of W and Z boson in this phase space complementary to ATLAS and CMS. In this talk an overview of the wide LHCb electroweak measurement program will be presented. In particular several preliminary studies have shown the potential of the LHCb experiment to measure the W boson mass with a muon pT based technique, which could yield a statistical precision of 10 MeV if using the full Run 2 dataset. A proof-of-concept measurement of the W boson mass, using only the 2016 dataset, will be presented.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: BARTER, William (Imperial College (GB))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **218** Type: **Parallel session talk**

Study of pPb and PbPb collisions in the forward direction

Wednesday, January 12, 2022 10:40 AM (20 minutes)

The LHCb detector is a full spectrometer at forward rapidity covering a pseudorapidity range of $2 < \eta < 5$. With its excellent vertex resolution, particle identification and tracking capability, the LHCb is able to perform precision measurements down to very low transverse momentum. We present first LHCb results on heavy flavor in lead-lead collisions at 5.02 TeV, including photo-production of J/ψ mesons in peripheral and ultra-peripheral collisions, and prompt open charm production, using the datasets collected during 2015 and 2018.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: LI, Hengne (South China Normal University (CN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **219** Type: **Parallel session talk**

Recent results on exotic (hidden-charm) hadrons from LHCb

Tuesday, January 11, 2022 3:40 PM (20 minutes)

Many mesons and baryons with additional valence constituents with respect to the conventional quark-antiquark pair or three-quark combinations have been discovered in the last decades, leading to a renaissance of hadron spectroscopy. Interpretations of such states span from compact objects to hadronic molecules and searches for new exotic candidates provide important insights on the quarks binding mechanisms inside hadrons. In this talk the recent LHCb results on this topic are presented.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: CHEN, Chen (Tsinghua University (CN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **221** Type: **Parallel session talk**

Study of heavy b and c baryons at LHCb

Tuesday, January 11, 2022 2:40 PM (20 minutes)

LHCb has recently measured the properties and production of many known charm and beauty baryons, as well as discovered many previously unobserved states. The latest results from the LHCb Collaboration on heavy flavoured baryons are presented.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: GORELOV, Igor (M.V. Lomonosov Moscow State University (RU))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **222** Type: **Parallel session talk**

CP violation and mixing in charm at LHCb

Wednesday, January 12, 2022 11:40 AM (20 minutes)

LHCb has collected the world's largest sample of charmed hadrons. This sample is used to 1) measure direct CP violation in D mesons and charmed baryons 2) measure $D^0 - \bar{D}^0$ mixing and the first non-zero mass difference and to 3) search for CP violation in mixing and interference. New measurements from several decay modes are presented, as well as prospects for future sensitivities.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: RUIZ VIDAL, Joan (Univ. of Valencia and CSIC (ES))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **223** Type: **Parallel session talk**

Rare charm decays at LHCb

Wednesday, January 12, 2022 12:40 PM (20 minutes)

The LHCb experiment is playing a crucial role in the study of rare and forbidden decays of charm hadrons, which are sensitive to effects beyond the Standard Model in the up-quark sector. New searches for FCNC-mediated processes and asymmetry measurements in final states with two leptons are presented.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: MITZEL, Dominik Stefan (Technische Universitaet Dortmund (DE))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **224** Type: **Parallel session talk**

CP violation and CKM measurements with beauty decays at LHCb

Wednesday, January 12, 2022 10:40 AM (20 minutes)

The tree-level determination of the CKM angle gamma is a standard candle measurement of CP violation in the Standard Model. The latest LHCb results from time-integrated measurements of CP violation using beauty to open charm decays are presented. A new combination of all LHCb measurements is also performed. A precision below four degrees is obtained, which dominates the world average.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: BUTTER, Jordy (Nikhef National institute for subatomic physics (NL))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **225** Type: **Parallel session talk**

Lepton-flavour-non-universal measurements from LHCb

Tuesday, January 11, 2022 2:40 PM (20 minutes)

The coupling of the electroweak gauge bosons of the Standard Model (SM) to leptons is independent of the lepton flavour. Extensions of the SM do not necessarily respect this lepton flavour universality. Semileptonic rare decays of heavy flavour, to which new particles can give sizeable contributions, allow for sensitive tests of lepton flavour universality, and constitute powerful indirect searches for phenomena beyond the SM. Of particular interest are rare $b \to sll$ decays that are readily accessible at the LHCb experiment. Recent results from LHCb on lepton flavour universality in rare $b \to sll$ decays are discussed.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: MARIN BENITO, Carla (CERN)

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **226** Type: **Parallel session talk**

Semileptonic decays at LHCb

Tuesday, January 11, 2022 2:00 PM (20 minutes)

The semileptonic b-hadron decays with a heavy lepton are sensitive to new couplings like those generated by charged Higgses or Leptoquarks. The B-Factories and LHCb have previously performed various measurements of these decays, using different approaches and techniques. A global average of these measurements shows a discrepancy with the Standard Model expectations, which is above 3 standard deviations. A measurement of the combined ratios BF($B \to D\tau\nu$)/BF($B \to D\mu\nu$) and BF($B \to D^*\tau\nu$)/BF($B \to D^*\mu\nu$) using 3/fb collected by LHCb in Run1, is presented.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: WORMSER, Guy Henri Maurice (Université Paris-Saclay (FR))

Session Classification: Quark and charged lepton flavour

Track Classification: Flavour

Contribution ID: **228** Type: **Poster**

Run-3 offline data processing and analysis at LHCb

Monday, January 10, 2022 4:19 PM (1 minute)

The LHCb detector is undergoing a comprehensive upgrade for data taking in the LHC's Run 3, which is scheduled to begin in 2022. The increased data rate in Run 3 poses significant data-processing and handling challenges for the LHCb experiment. The offline computing and dataflow model is consequently also being upgraded to cope with the factor 30 increase in data volume and associated demands of user-data samples of ever-increasing size. Coordinating these efforts is the charge of the newly created Data Processing and Analysis (DPA) project. The DPA project is responsible for ensuring the LHCb experiment can efficiently exploit the Run 3 data, dealing with the data from the online system with central skimming/slimming (a process known as "Sprucing") and subsequently producing analyst-level ntuples with a centrally managed production system (known as "Analysis Productions") utilising improved analysis tools and infrastructure for continuous integration and validation.It is a multi-disciplinary project involving collaboration between computing experts, trigger experts and physics analysis experts. This talk will present the evolution of the data processing model, followed by a review of the various activities of the DPA project. The associated computing, storage and network requirements are also discussed.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: FERRILLO, Martina (University of Zurich (CH))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **229** Type: **Parallel session talk**

A GPU High Level Trigger 1 for the upgraded LHCb detector

Tuesday, January 11, 2022 2:20 PM (20 minutes)

In 2022 the upgraded LHCb experiment will use a triggerless readout system collecting data at an event rate of 30 MHz. A software-only High Level Trigger will enable unprecedented flexibility for trigger selections. During the first stage (HLT1), a sub-set of the full offline track reconstruction for charged particles is run to select particles of interest. After this first stage, the event rate is reduced by at least a factor 30. Track reconstruction at 30 MHz represents a significant computing challenge, requiring a renovation of current algorithms and the underlying hardware. In this talk, we present the approach of executing the full HLT1 chain on GPUs. This includes decoding the raw data, clustering of hits, pattern recognition, as well as track fitting. We discuss the design of HLT1 algorithms optimized for many-core architectures. Both the computing and physics performance of the full HLT1 chain will be presented.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: AGAPOPOULOU, Christina (Centre National de la Recherche Scientifique (FR))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **230** Type: **Parallel session talk**

Direct searches for lepton flavour anomalies

Wednesday, January 12, 2022 11:20 AM (20 minutes)

Measurements from dedicated B decay experiments hint at indirect evidence for lepton flavor universality violation (LFUV). In this talk, we will review results from the CMS experiment that use high-momentum direct searches for new particles and interactions that could account for LFUV. The talk will highlight recent searches such as third-generation leptoquarks, vector-like leptons, and flavor-changing mediators

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: KILMINSTER, Ben (Universitaet Zuerich (CH))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **232** Type: **Parallel session talk**

Searches for new physics in CMS in events with jets, leptons and photons in the final state

Wednesday, January 12, 2022 9:36 AM (20 minutes)

Many new physics models, e.g., compositeness, extra dimensions, extended Higgs sectors, supersymmetric theories, and dark sector extensions, are expected to manifest themselves in the final states with leptons and photons. This talk presents searches in CMS for new phenomena in the final states that include leptons and photons, focusing on the recent results obtained using the full Run-II data-set collected at the LHC.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: RASTOGI, Angira (Indian Institute of Science Education and Research (IN))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **233** Type: **Parallel session talk**

Search for Dark Matter and new physics with long-lived and unconventional signatures in CMS

Wednesday, January 12, 2022 11:40 AM (20 minutes)

Searches for dark matter at colliders are a powerful complementary probe to elucidate the nature of this hitherto unobserved form of matter. We present CMS searches for dark matter candidate particles and new mediators interacting with them. Various final states, topologies, and kinematic variables are explored utilizing the full Run-II data-set collected at the LHC. Furthermore, we interpret the results of the searches for direct dark matter production as well as visible decays of new mediators in the broader dark matter search landscape.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: ESCALANTE DEL VALLE, Alberto (Austrian Academy of Sciences (AT))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **235** Type: **Parallel session talk**

Search for heavy resonances decaying to bosons and for new resonances coupling to third generation quarks at CMS

Wednesday, January 12, 2022 9:00 AM (20 minutes)

Searches for new resonances in di-boson (VV, VH, HH, where V = W, Z) and tri-boson (VVV) final states, with the CMS detector are presented. The results are based on the large dataset collected during Run 2 of the LHC at a centre-of-mass energy of 13 TeV. The analyses are optimised for high sensitivity over a large range in resonance mass. Jet substructure techniques are used to identify hadronic decays of highly-boosted W, Z, and H bosons. A statistical combination of these searches provides the most stringent constraints on heavy vector bosons with large couplings to standard model bosons and fermions.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: LYU, Xudong (Peking University (CN))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **237** Type: **Poster**

Searches for vector-like quarks and leptons at CMS

Monday, January 10, 2022 4:16 PM (1 minute)

We present results of searches for massive vector-like third-generation quark and lepton partners using proton-proton collision data collected with the CMS detector at the CERN LHC at a center-of-mass energy of 13 TeV. Pair production of vector-like leptons is studied, with decays into final states, containing third generation quarks and leptons. Vector-like quarks are studied in both single and pair production, considering final states, containing top and bottom quarks, electroweak gauge and Higgs bosons. We search using several categories of reconstructed objects, from multi-leptonic to fully hadronic final states. We set exclusion limits on both the vector-like particle mass and cross sections, for combinations of the vector-like particle branching ratios.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: RASTOGI, Angira (Indian Institute of Science Education and Research (IN))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **238** Type: **Poster**

Search for long-lived Heavy Neutral Leptons with the CMS experiment

Monday, January 10, 2022 4:19 PM (1 minute)

A search for long-lived Heavy Neutral Leptons (HNLs) in proton-proton collisions at 13 TeV with the CMS detector is presented. The theorized right-handed neutrinos are a possible candidate for HNLs, and within a mass range from 1 to 15 GeV they naturally become long-lived particles. The search focuses on HNL production in W boson decays followed by a displaced decay of the HNL within the tracker volume of CMS. It uses advanced vertex reconstruction techniques and machine learning to perform the signal extraction. The obtained exclusion limits are the best available to date within the targeted mass range.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: VERMASSEN, Basile (Ghent University (BE))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **239** Type: **Parallel session talk**

Measurements of the Higgs Yukawa couplings with Run 2 data collected by the CMS experiment

Tuesday, January 11, 2022 4:30 PM (20 minutes)

With the oncoming start of Run 3 approaching, it is interesting to look at the current status of Higgs Yukawa coupling measurements. Run 2 marked the first observation of Higgs couplings to all third-generation charged fermions. This talk reviews these measurements together with their properties under CP symmetry. The ongoing research of coupling to second-generation fermions is also discussed.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: RAMON ALVAREZ, Clara (Universidad de Oviedo (ES))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **240** Type: **Parallel session talk**

Measurements of Higgs boson couplings and differential cross-sections

Tuesday, January 11, 2022 5:06 PM (16 minutes)

With Run-3 of the LHC fast approaching, the analyses of the full Run-2 dataset for Higgs precision couplings and differential cross-sections are being completed. The talk will cover the 4l, diphoton, WW, di-tau and bb channels, as well as dedicated measurements in ttH and VH production. These measurements provide the greatest global constraints on our knowledge of Higgs boson properties to date from CMS.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: SAHA, Prafulla (National Institute of Science Education and Research (IN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **241** Type: **Parallel session talk**

Searches for extended Higgs sectors and BSM decays of the Higgs boson

Tuesday, January 11, 2022 2:20 PM (20 minutes)

with the full Run-2 dataset in hand, BSM Higgs scenarios are being more tightly squeezed than ever before. Using complimentary approaches for searches for additional Higgs bosons and non-SM decays of the Higgs bosons, BSM scenarios with extended Higgs sectors can be probed. The talk will cover searches for extended higgs sectors (additional scalars and (N)MSSM scenarios) and BSM decays of the Higgs boson ((semi)invisible and light pseudoscalars).

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: MAJUMDER, Devdatta (Rudjer Boskovic Institute (HR))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **242** Type: **Parallel session talk**

Searches for double Higgs production

Tuesday, January 11, 2022 5:38 PM (16 minutes)

Double Higgs boson production is extremely rare at the LHC. By searching over a wide variety of final states, searches for double Higgs production can provide key insights into the nature of the Higgs self-coupling and the Higgs potential, as well as providing constraints on BSM models that allow for resonant decays of new particles into Higgs bosons. The talk will cover searches for resonant and non-resonant Higgs boson pair production, and constraints on the Higgs boson self-coupling.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: ZUOLO, Davide (Universita & INFN, Milano-Bicocca (IT))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **243** Type: **Poster**

Recent results in the H-> WW channel with full LHC Run-II data collected by the CMS experiment

Monday, January 10, 2022 4:22 PM (1 minute)

In 2012, the observation of the Higgs Boson was announced by the CMS and ATLAS experiments at CERN. Since the discovery, work has continued to measure the Higgs boson couplings and quantum numbers with greater precision. There are several production channels of the Higgs boson and we are searching for the production of the Higgs boson in association with a vector boson in the H⟶WW decay channel with the CMS experiment at the LHC. This measurement provides a direct probe of the Higgs boson coupling to vector bosons. The latest CMS results on the Higgs boson decay to a W boson pair are presented. The focus of the poster will be on the inclusive and STXS measurements performed for the VH leptonic channel with full Run 2 data which corresponds to an integrated luminosity of 137.1 fb-1, collected by the CMS detector at LHC , as well as the constraints on the Higgs boson couplings to fermions and vector bosons arising from the simultaneous measurement of different production mechanisms.

Primary authors: CMS; GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR))

Presenter: KAUR, Amandeep (Panjab University (IN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **244** Type: **Poster**

The Higgs through the looking glass

Monday, January 10, 2022 4:21 PM (1 minute)

The LHC Run 2 data-taking period marked the first measurement of the CP structure of Higgs Yukawa coupling to tau leptons. This measurement is complementary to the ones performed in Higgs production mechanisms improving the understanding of CP violation in the Higgs sector. The amount of CP-admixture in the Yukawa coupling introduces a correlation between the transverse spin of the two tau leptons, which was investigated by measuring the angle between their decay planes. The measured mixing angle excludes a pure CP-odd hypothesis with a 99.7% confidence level and is consistent with the Standard Model prediction of a pure CP-even coupling.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: CARDINI, Andrea (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **245** Type: **Parallel session talk**

Multiboson measurements at CMS

Wednesday, January 12, 2022 11:40 AM (20 minutes)

This talk reviews recent measurements of multiboson production using CMS data. Inclusive and differential cross sections are measured using several kinematic observables. This talk also discussed recent vector boson scattering measurements.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: HAKIMI, Alexandre (Centre National de la Recherche Scientifique (FR))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **246** Type: **Parallel session talk**

Vector boson associated with jets in CMS [Postponed]

Wednesday, January 12, 2022 12:40 PM (20 minutes)

[Talk will not happen live, recording to be uploaded on Friday]
The study of the associated production of vector bosons and jets constitutes an excellent enviroment to check numerous QCD predictions. Total and differential cross sections of vector bosons produced in association with jets have been studied in pp collisions using CMS data. Differential distributions as function of a broad range of kinematical observables are measured and compared with theoretical predictions. The talk will discuss both inclusive jet analyses, and analyses targeting heavy flavor production.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: MEENA, Meena (Panjab University (IN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **247** Type: **Parallel session talk**

Jet measurements in CMS

Wednesday, January 12, 2022 9:00 AM (20 minutes)

Measurements of jet cross sections in proton collisions with the CMS experiment are presented. Measurements are performed as a function of the jet transverse momentum pT and jet rapidity. Jets are reconstructed using the anti-kT clustering algorithm with different size parameters in a wide phase space region in jet pT and jet rapidity. The measured jet cross sections are corrected for detector effects and compared with the predictions from perturbative QCD.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenters: SAVOIU, Daniel (KIT - Karlsruhe Institute of Technology (DE)); SAVOIU, Daniel (KIT)

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **248** Type: **Poster**

Search for top squark pair production with the CMS experiment

Monday, January 10, 2022 4:20 PM (1 minute)

Searches for the supersymmetric partner of the top quark with the CMS experiment at the LHC are presented. This poster includes the combination of three general-purpose analyses and a targeted one. The latter specifically probes a region of the parameter space where the kinematics of top squark pair production and top quark pair production are very similar, because the mass difference between the top squark and the neutralino is close to the top quark mass. All analyses are performed with the full Run 2 data set of proton-proton collisions at a centre-of-mass energy of 13 TeV.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: TRAPOTE FERNANDEZ, Andrea (Universidad de Oviedo (ES))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **250** Type: **Parallel session talk**

Searches for supersymmetry in hadronic final states with the CMS experiment

Tuesday, January 11, 2022 3:00 PM (20 minutes)

The latest results of searches for supersymmetry in hadronic final states with the CMS experiment will be presented. The analyses are based on the full dataset of proton-proton collisions collected during the Run 2 of the LHC at a center-of-mass energy of 13 TeV.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: WILSON, Jon (Baylor University (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **251** Type: **Parallel session talk**

Searches for supersymmetry in leptonic final states with the CMS experiment

Tuesday, January 11, 2022 3:40 PM (20 minutes)

The latest results of searches for supersymmetry in leptonic final states with the CMS experiment will be presented. The analyses are based on the full dataset of proton-proton collisions collected during the Run 2 of the LHC at a center-of-mass energy of 13 TeV.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: HELLER, Ryan (Fermi National Accelerator Lab. (US))

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **252** Type: **Parallel session talk**

Astroparticle and Beyond the Standard Model Capabilities and Results from MicroBooNE

Wednesday, January 12, 2022 12:40 PM (20 minutes)

MicroBooNE is an 85-ton active mass liquid argon time projection chamber (LArTPC) at Fermilab. Its excellent calorimetry and resolution (both spatial and energy), along with its exposure to two neutrino beamlines make it a powerful detector not just for neutrino physics, but also for Beyond the Standard Model (BSM) physics and astroparticle physics. The experiment has competitive sensitivity to heavy neutral leptons possibly present in the leptonic decay modes of kaons, and also to scalar bosons that could be produced in kaon decays in association with pions. In addition, MicroBooNE serves as a platform for prototyping searches for rare events in the future Deep Underground Neutrino Experiment (DUNE). This talk will explore the capabilities of LArTPCs for BSM physics and astroparticle physics and highlight some recent results from MicroBooNE.

Primary author: LEPETIC, Ivan (Rutgers University)

Presenter: NAVRER-AGASSON, Anyssa (University of Manchester)

Session Classification: Beyond the Standard Model

Track Classification: Beyond the Standard Model

Contribution ID: **253** Type: **Parallel session talk**

Recent neutrino cross-section results from MicroBooNE

Tuesday, January 11, 2022 5:10 PM (20 minutes)

MicroBooNE is a liquid argon time projection chamber that operates in the Booster Neutrino Beam at Fermilab. The detector provides high-resolution imaging of neutrino interactions with a low threshold and full angular coverage. Thanks to a high event rate and several years of continuous operation, the MicroBooNE collaboration has obtained the world's largest dataset of neutrino-argon scattering events. A detailed understanding of these interactions, especially the impact of nuclear physics effects, will be critical to the success of future precision neutrino oscillation efforts, particularly the argon-based Deep Underground Neutrino Experiment (DUNE) and the Short-Baseline Neutrino (SBN) program. This talk presents the latest neutrino-argon cross-section measurements from MicroBooNE, including new measurements of inclusive electron neutrino and muon neutrino interactions, as well as exclusive final states containing one or more protons and zero pions.

Primary author: GARDINER, Steven (Fermi National Accelerator Laboratory)

Presenters: GU, Wenqiang (Brookhaven Natoinal Laboratory); GU, Wenqiang (Brookhaven National Laboratory (US))

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **254** Type: **Parallel session talk**

First results from the MicroBooNE search for a low energy excess

Tuesday, January 11, 2022 5:50 PM (20 minutes)

The MicroBooNE experiment is performing a series of measurements to address the nature of the excess of low energy electromagnetic interactions observed by the MiniBooNE collaboration. One analysis looks for neutrino-induced neutral current (NC) resonant Delta(1232) baryon production followed by Delta radiative decay from the Fermilab Booster neutrino beam, while three others look for electron neutrino interactions from the Fermilab Booster neutrino beam. In the talk, we will present the latest results on the searches for (1) neutral current resonant Delta−>N(gamma) decay and (2) an anomalous excess of electron neutrino events in multiple single electron final states. The talk will include details on event selection, background estimation, systematic analysis and cross-checks to demonstrate the robustness of analysis.

Primary author: TBD (MicroBooNE)

Presenter: KAMP, Nicholas (Massachusetts Institute of Technology)

Session Classification: Neutrino physics

Track Classification: Neutrinos

Contribution ID: **256** Type: **Parallel session talk**

Outreach at LHCb

Wednesday, January 12, 2022 10:20 AM (20 minutes)

Since March 2020, the landscape of science communication has radically changed to adapt to a situation of limited mobility and exploding internet usage. Following this trend, the LHCb collaboration has increased its online presence through a wide communication around its latest results, and has built experience in organising virtual visits of the experiment, while pursuing its efforts to strengthen its previous outreach activities.
This talk will include an overview of the coverage of recent LHCb results in social and internet-based media. We will also discuss our experience and future plans for virtual tours of the detector, and cover updates of the LHCb Masterclass aimed at improving the students experience.
In parallel with this, the collaboration is preparing for the future. As part of this process, we are designing and preparing a brand new physical exhibit at the LHCb site at CERN. We will present the current status and plans for this exhibit.

Primary author: NEUBERT, Sebastian (University of Bonn (DE))

Presenter: NICOLINI, Janina (Technische Universitaet Dortmund (DE))

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **257** Type: **Poster**

Study of GEM detectors and their applications to Imaging

Monday, January 10, 2022 4:18 PM (1 minute)

The Gas Electron Multiplier (GEM) Detector is being used extensively to handle a fairly large flux environment in high energy and other related experiments. Due to the ease of operation with environment friendly gases, this detector can be deployed to wider range of experiments as well as in applications to developing the instruments for humanitarian aid purposes. In this talk, we will present results from one such effort. We collaborated with the industry to produce the GEM foils of various specifications and then made an effort to use GEMs as an imaging detector for medical as well as security purposes. The key component of a GEM detector is the GEM foil which has very dense go-through holes on a 50μm highly insulating foil (Kapton/Apical) coated on both sides with 5μm layers of copper. Before these GEM foils can be used for assembling the GEM detector the foils electrical and optical properties have to be tested to find defects and correct it. We report on the development of techniques used to study the GEM foils electrically and optically. The polarisation and charging up effects of these foils will also be discussed along with the ways to better handle these effects . A feasibility study to utilize GEM detectors for imaging objects with varying densities with x-rays were carried out. The reconstructed images shows a good distinction between materials of different densities, which opens the possibility to further explore the applications of GEM detectors to medical imaging or cargo imaging.

Primary author: Dr NAIMUDDIN, Mohammad (University of Delhi)

Co-authors: Dr KUMAR, Ashok (University of Delhi); Dr GOLA, Mohit (University of Delhi)

Presenter: AHMED, Asar (University of Delhi (IN))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **258** Type: **Parallel session talk**

LUXE: A new experiment to study non-perturbative QED in electron-LASER and photon-LASER collisions

Wednesday, January 12, 2022 12:40 PM (20 minutes)

The LUXE experiment (LASER Und XFEL Experiment) is a new experiment in planning at DESY Hamburg using the electron beam of the European XFEL. LUXE is intended to study collisions between a high-intensity optical laser and 16.5 GeV electrons from the XFEL electron beam, as well as collisions between the optical LASER and high-energy secondary photons. The physics objective of LUXE are processes of Quantum Electrodynamics (QED) at the strong-field frontier, where the electromagnetic field of the laser is above the Schwinger limit. In this regime, QED is non-perturbative. This manifests itself in the creation of physical electron-positron pairs from the QED vacuum, similar to Hawking radiation from black holes. LUXE intends to measure the positron production rate in an unprecedented LASER intensity regime. An overview of the LUXE experimental setup and its challenges will be given, followed by a discussion of the expected physics reach in the context of testing QED in the non-perturbative regime.

Primary author: LIST, Jenny (Deutsches Elektronen-Synchrotron (DE))

Presenter: JACOBS, Ruth Magdalena (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **259** Type: **Parallel session talk**

Probing new physics at the LUXE experiment

Tuesday, January 11, 2022 5:30 PM (20 minutes)

The proposed LUXE experiment (LASER Und XFEL Experiment) at DESY, Hamburg, using the electron beam from the European XFEL, aims to probe QED in the non-perturbative regime created in collisions between high-intensity laser pulses and high-energy electron or photon beams. This setup also provides a unique opportunity to probe physics beyond the standard model. In this talk we show that by leveraging the large photon flux generated at LUXE, one can probe axion-like-particles (ALPs) up to a mass of 350 MeV and with photon coupling of 3x10^{-6} GeV^{-1}. This reach is comparable to FASER2 and NA62. In addition, we will discuss other probes of new physics such as ALPs-electron coupling.

Primary author: LIST, Jenny (Deutsches Elektronen-Synchrotron (DE))

Presenter: MA, Teng

Session Classification: Dark Matter

Track Classification: Dark Matter

Contribution ID: **260** Type: **Poster**

Detector Challenges of the strong-field QED experiment LUXE at the European XFEL

Monday, January 10, 2022 4:17 PM (1 minute)

The LUXE experiment aims at studying high-field QED in electron-laser and photon-laser interactions, with the 16.5 GeV electron beam of the European XFEL and a laser beam with power of up to 350 TW. The experiment will measure the spectra of electrons and photons in non-linear Compton scattering where production rates in excess of 10^9 are expected per 1 Hz bunch crossing. At the same time positrons from pair creation in either the two-step trident process or the Breit-Wheeler process will be measured, where the expected rates range from 10^-3 to 10^3 per bunch crossing, depending on the laser power and focus. These measurements have to be performed in the presence of low-energy high radiation-background. To meet these challenges, for high-rate electron and photon fluxes, the experiment will use Cherenkov radiation detectors, scintillator screens, sapphire sensors as well as lead-glass monitors for backscattering off the beam-dump. A four-layer silicon-pixel tracker and a compact electromagnetic tungsten calorimeter with GaAs sensors will be used to measure the positron spectra. The layout of the experiment and the expected performance under the harsh radiation conditions will be presented.

Primary author: LIST, Jenny (Deutsches Elektronen-Synchrotron (DE))

Presenter: HALLFORD, John

Session Classification: R&D

Track Classification: R&D

Contribution ID: **261** Type: **Poster**

CMS Drift Tube (DT) upgrade at High-Luminosity LHC

Monday, January 10, 2022 4:16 PM (1 minute)

The High-Luminosity Large Hadron Collider (HL-LHC) project aims to boost the performance of the LHC in order to increase the potential for discoveries for LHC Run-4 and onwards. The upgrade aims at increasing the instantaneous luminosity of the machine. In order to cope with the expected increase of both radiation and rates, the electronics that host the first level of readout and trigger electronics of the Drift Chambers in CMS must be replaced with the new On-Board electronics for DT (OBDT). The time digitization (TDC) data will be streamed directly to the new backend electronics hosted in the service cavern, where event building and trigger primitive (TP) generation will be performed using the latest commercial FPGAs exploiting the ultimate DT cell resolution. In order to develop and test Phase-2 architecture, a parallel readout of Phase-2 and legacy electronics was set up through front-end splitting on a full DT sector in one external wheel. A series of tests aiming to optimize installation in LS3 were performed. In this report, the motivation for such an upgrade will be highlighted, and the status of the DT slice-test operation, as well as its performance assessed with cosmic-ray events, will be presented.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: KIANI, Muhammad Bilal (Universita e INFN Torino (IT))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **262** Type: **Poster**

Precision Timing with the CMS MIP Timing Detector for HL-LHC

Monday, January 10, 2022 4:15 PM (1 minute)

The Compact Muon Solenoid (CMS) detector at the CERN Large Hadron Collider (LHC) is undergoing an extensive Phase II upgrade program to prepare for the challenging conditions of the High-Luminosity LHC (HL-LHC). A new timing detector in CMS will measure minimum ionizing particles (MIPs) with a time resolution of 30-40 ps for MIP signals at a rate of 2.5 Mhit/s per channel at the beginning of HL-LHC operation. The precision time information from this MIP Timing Detector (MTD) will reduce the effects of the high levels of pileup expected at the HL-LHC, bringing new capabilities to the CMS detector. The MTD will be composed of an Endcap Timing Layer (ETL), instrumented with Low-Gain Avalanche Detectors, as well as a Barrel Timing Layer (BTL) based on LYSO:Ce crystals coupled to SiPMs. In this talk we will present overview of the MTD, focusing on recent prototyping results and R&D studies targeting enhanced timing performance and radiation tolerance.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: CARDWELL, Bryan (University of Virginia (US))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **263** Type: **Poster**

HEPScape: an escape room about high energy physics

Monday, January 10, 2022 4:22 PM (1 minute)

Escape rooms are more and more popular nowadays. They have the challenges of a treasure hunt and represent a pleasant way to encourage team building. In addition they are a fun way to discover a new subject, a key point that can be exploited for science outreach. In 2021 a team from INFN has built an escape room about high energy physics, called HEPScape. The visitors have the impression of visiting the Large Hadron Collider at CERN and of entering one of the experimental control rooms. It makes use of projectors and posters which replicate the control room environment. Through some clues, that are hidden in the room, the visitors discover the purpose of particle accelerators and high energy physics experiments. The games can be tuned to the age group, resulting in a fun experience for all. HEPScape is made of portable equipment that can be transported and assembled in less than two hours. This allows to use it in science fairs and exhibitions. In addition it can be brought on demand to high schools in remote provinces. The material and the format of the games are simple and it is possible to replicate and translate the games in other languages. Feedback and experience from two science fairs will be presented in the talk.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenters: DI MARCO, Emanuele (INFN, Roma 1 (IT)); CAVALLARI, Francesca (Sapienza Universita e INFN, Roma I (IT))

Session Classification: Science in Society

Track Classification: Public Engagement and Training

Contribution ID: **265** Type: **Poster**

Simulation studies for the ATLAS track counting luminosity measurement

Monday, January 10, 2022 4:30 PM (1 minute)

A precise measurement of the luminosity is a key component of the ATLAS physics programme. ATLAS uses several detectors and algorithms to determine the luminosity. The absolute calibration of these algorithms is carried out in LHC runs with special beam conditions at low luminosity. The track counting luminosity measurement is used to determine the calibration transfer from the low-luminosity regime to the high-luminosity conditions typical of standard physics data taking, and to monitor the long term stability of the default luminosity method.

The track counting method works by counting the number of reconstructed tracks from charged particles inside the Inner Detector. The average number of charged particles in randomly-triggered bunch crossings is proportional to the average number of inelastic collisions per bunch crossing and can therefore be used to compute the luminosity. This poster presents simulation studies for the ATLAS track counting luminosity measurement. A toy simulation model is used to study the underlying distribution of the number of tracks and to illustrate the linearity between the average number of tracks and the luminosity. Full ATLAS MC simulation is used to asses effects related to the reconstruction of the tracks and their effect on the linearity.

Primary author: ATLAS COLLABORATION

Presenter: RIPELLINO, Giulia (KTH Royal Institute of Technology (SE))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **268** Type: **Parallel session talk**

Upgrade of the CSC Muon System for the CMS Detector at the HL-LHC

Tuesday, January 11, 2022 3:20 PM (20 minutes)

The Large Hadron Collider (LHC) will be upgraded in several phases to significantly expand its physics program. After the current long shutdown from 2018-2021 (LS2) the accelerator luminosity will be increased to 2 – 3 * 10^34cm−2s−1 exceeding the design value of 1 * 10^34cm−2s−1 allowing the CMS experiment to collect approximately 100 fb−1/year. A subsequent upgrade will increase the luminosity up to 5 * 10^34cm−2s−1. The CMS muon system must be able to sustain a physics program after the LS2 shutdown that maintains sensitivity to electroweak scale physics and for TeV scale searches similar to what was achieved up to now For the Cathode Strip Chamber (CSC) muon detectors. The on chamber front-end readout electronics portion of the CSC electronics upgrade has now been completed. The design of the upgraded CSC electronics will be discussed as well as the status of the commissioning of the upgraded CSC system. In view of the operating conditions at HL-LHC, it is vital to asses the detector performance for high luminosity. Accelerated aging tests are being performed to study the behavior of the CSC detectors under conditions which are nearly an order of magnitude beyond the original design values. The status of this irradiation campaign and results will be presented.

Primary authors: CMS; GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR))

Presenter: BONILLA, Johan Sebastian (University of California Davis (US))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **271** Type: **Parallel session talk**

IoP Project Juno: A reflection of over a decade of equality and diversity work within the UK

Wednesday, January 12, 2022 9:40 AM (20 minutes)

The UK Institute of Physics established Project Juno in 2007 to address the under representation of women in physics. UK universities and now also national research institutes are invited to join the scheme and work towards achieving the three levels of award: supporter, practitioner and champion. The speaker has experience of implementing good practice at a University (over 10 years) and in assessing other Universities (6 years). The talk will reflect on the progress made in the past decade and look towards what Universities and individuals can do now to support and improve equality, diversity and inclusion.

Primary author: BERRY, Tracey (University of London (GB))

Presenter: BERRY, Tracey (University of London (GB))

Session Classification: Science in Society

Track Classification: Equality, Diversity, and Inclusion

Contribution ID: **272** Type: **Parallel session talk**

Challenges and novel reconstruction techniques for the CMS High Granularity Calorimeter for HL-LHC

Tuesday, January 11, 2022 2:40 PM (20 minutes)

he Compact Muon Solenoid (CMS) detector at the CERN Large Hadron Collider (LHC) is undergoing an extensive Phase II upgrade program to prepare for the challenging conditions of the High-Luminosity LHC (HL-LHC). To sustain the harsh conditions foreseen in Phase II the CMS experiment has designed a novel endcap calorimeter that uses approx. 5.8M radiation-tolerant Silicon sensors. These sensors will sample the electromagnetic and hadronic particle showers using 47 layers with fine lateral granularity and providing 5D measurements of energy, position and timing. In regions of sufficiently low radiation, small scintillator tiles with individual SiPM readout are employed. Developing a reconstruction sequence that fully exploits the granularity to achieve optimal electromagnetic and hadron identification, as well as a good energy resolution, in the presence of pileup, is a challenging task. A modular iterative clustering framework (TICL) is being developed to cope with this task. The framework starts from input clusters of energy deposited in individual calorimeter layers delivered by an “imaging”, density-based, algorithm In view of the expected pressure on the computing capacity in the HL-LHC era, the algorithms and their data structures are being designed with GPUs in mind. In addition, machine learning techniques are being investigated and integrated into the reconstruction framework. This talk will describe the approaches being considered and discuss the first results.

Primary authors: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR)); CMS

Presenter: GHOSH, Shamik (Centre National de la Recherche Scientifique (FR))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **274** Type: **Parallel session talk**

Highlights of top quark measurements with the ATLAS experiment

Tuesday, January 11, 2022 2:00 PM (20 minutes)

The top quark is the heaviest known fundamental particle and has the largest coupling to the Higgs boson. As it is the only quark that decays before it hadronizes, this gives the unique opportunity to probe the properties of bare quarks. This contribution will provide an overview of recent measurements of top-quark production cross sections and its mass and properties in proton-proton collisions with the ATLAS detector at the Large Hadron Collider at a center-of-mass energy of 13 TeV. The inclusive and differential measurements of top-quark pair and single top-quark production have reached a few-% precision and explore an entirely new kinematic regime. These standard candle measurements are complemented by measurements in previously unobserved, rare associated production processes. These measurements probe the consistency of the standard theory of elementary particles and test our understanding of the fundamental laws of nature in the TeV regime.

Primary author: ATLAS COLLABORATION

Co-author: JINNOUCHI, Osamu (Tokyo Institute of Technology (JP))

Presenter: PEIXOTO, Ana (Centre National de la Recherche Scientifique (FR))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **275** Type: **Plenary talk**

Introduction and Housekeeping

Monday, January 10, 2022 8:15 AM (10 minutes)

Presenter: GERSABECK, Marco (University of Manchester (GB))

Session Classification: Social

Contribution ID: **276** Type: **Plenary talk**

Opening and welcome to the University

Monday, January 10, 2022 8:25 AM (5 minutes)

Presenter: Prof. SCHRÖDER, Martin (University of Manchester)

Session Classification: Social

Contribution ID: **278** Type: **Plenary talk**

Higgs physics : experimental overview

Monday, January 10, 2022 8:30 AM (30 minutes)

Presenter: DI MARCO, Emanuele (INFN, Roma 1 (IT))

Session Classification: Precision SM Measurements

Contribution ID: **279** Type: **Plenary talk**

Higgs and electroweak physics : theory

Monday, January 10, 2022 9:00 AM (30 minutes)

Presenter: VAJRAVELU, Ravindran (The Institute of Mathematical Sciences)

Session Classification: Precision SM Measurements

Contribution ID: **280** Type: **Plenary talk**

Electroweak physics : experimental overview

Monday, January 10, 2022 9:30 AM (30 minutes)

Presenter: KEPKA, Oldrich (Czech Academy of Sciences (CZ))

Session Classification: Precision SM Measurements

Contribution ID: **281** Type: **Plenary talk**

Top physics : experimental overview

Monday, January 10, 2022 10:30 AM (30 minutes)

Presenter: KNUE, Andrea Helen (Albert-Ludwigs-Universitaet Freiburg (DE))

Session Classification: Precision SM Measurements

Contribution ID: **282** Type: **Plenary talk**

QCD at high-pT : experimental overview

Monday, January 10, 2022 11:00 AM (30 minutes)

Presenter: CANDELISE, Vieri (Universita e INFN Trieste (IT))

Session Classification: Precision SM Measurements

Contribution ID: **283** Type: **Plenary talk**

Jet physics : theory overview

Monday, January 10, 2022 11:30 AM (30 minutes)

Presenter: SOYEZ, Gregory (IPhT, CEA Saclay)

Session Classification: Precision SM Measurements

Contribution ID: **284** Type: **Plenary talk**

B anomalies: semileptonic and rare b decays experimental summary

Monday, January 10, 2022 2:00 PM (30 minutes)

Presenter: GRILLO, Lucia (University of Manchester (GB))

Session Classification: Quark and charged lepton flavour

Contribution ID: **285** Type: **Plenary talk**

Flavour anomalies : theory

Monday, January 10, 2022 2:30 PM (30 minutes)

Presenter: VAN DYK, Danny

Session Classification: Quark and charged lepton flavour

Contribution ID: **286** Type: **Plenary talk**

Physics of muons : experimental summary

Monday, January 10, 2022 3:00 PM (30 minutes)

Presenter: LANCASTER, Mark (University of Manchester)

Session Classification: Quark and charged lepton flavour

Contribution ID: **287** Type: **Plenary talk**

Physics of muons : theory

Monday, January 10, 2022 3:30 PM (30 minutes)

Presenter: EL-KHADRA, Aida (UIUC)

Session Classification: Quark and charged lepton flavour

Contribution ID: **288** Type: **Plenary talk**

High pT searches for BSM physics

Monday, January 10, 2022 5:30 PM (30 minutes)

Presenter: EVERAERTS, Pieter (University of Wisconsin Madison (US))

Session Classification: Beyond the Standard Model

Contribution ID: **289** Type: **Plenary talk**

Searches for long lived particles

Monday, January 10, 2022 6:00 PM (30 minutes)

Presenter: REDI, Federico Leo (CERN)

Session Classification: Beyond the Standard Model

Contribution ID: **290** Type: **Plenary talk**

BSM Physics : theoretical overview

Monday, January 10, 2022 6:30 PM (30 minutes)

Presenter: AGRAWAL, Prateek (University of Oxford)

Session Classification: Beyond the Standard Model

Contribution ID: **291** Type: **Plenary talk**

Hadron physics : experimental review (spectroscopy and exotics)

Thursday, January 13, 2022 9:00 AM (30 minutes)

Presenter: TAMPONI, Umberto (INFN Torino (IT))

Session Classification: Precision SM Measurements

Contribution ID: **292** Type: **Plenary talk**

Hadron physics: theory

Thursday, January 13, 2022 9:30 AM (30 minutes)

Presenter: PRELOVSEK, Sasa

Session Classification: Precision SM Measurements

Contribution ID: **293** Type: **Plenary talk**

Heavy ion physics: experimental review

Thursday, January 13, 2022 10:00 AM (30 minutes)

Presenter: BRUNO, Giuseppe (Universita e INFN, Bari (IT))

Session Classification: Precision SM Measurements

Contribution ID: **294** Type: **Plenary talk**

Axion and ALP searches

Thursday, January 13, 2022 11:00 AM (30 minutes)

Presenter: SEMERTZIDIS, Yannis (IBS/CAPP and KAIST in Republic of Korea (South Korea))

Session Classification: Dark Matter

Contribution ID: **295** Type: **Plenary talk**

Long baseline experiments

Wednesday, January 12, 2022 5:45 PM (30 minutes)

Presenter: MAHN, Kendall (Michigan State University)

Session Classification: Neutrino physics

Contribution ID: **296** Type: **Plenary talk**

Short baseline neutrino experiments

Wednesday, January 12, 2022 6:15 PM (30 minutes)

Presenter: CARATELLI, David (UC Santa Barbara)

Session Classification: Neutrino physics

Contribution ID: **297** Type: **Plenary talk**

0n2b and neutrino mass measurements

Thursday, January 13, 2022 11:30 AM (30 minutes)

Presenter: MERTENS, Susanne

Session Classification: Neutrino physics

Contribution ID: **298** Type: **Plenary talk**

Observation of CNO cycle at Borexino

Thursday, January 13, 2022 12:00 PM (20 minutes)

Presenter: RE, Alessandra Carlotta (INFN)

Session Classification: Neutrino physics

Contribution ID: **299** Type: **Plenary talk**

Astro and atmospheric neutrinos

Thursday, January 13, 2022 3:00 PM (30 minutes)

Presenter: KLEIN, Spencer Robert (Lawrence Berkeley National Lab. (US))

Session Classification: Neutrino physics

Contribution ID: **300** Type: **Plenary talk**

Neutrino phenomenology

Thursday, January 13, 2022 3:30 PM (30 minutes)

Presenter: MACHADO, Pedro (Fermilab)

Session Classification: Neutrino physics

Contribution ID: **301** Type: **Plenary talk**

Neutrino theory

Thursday, January 13, 2022 4:00 PM (30 minutes)

Presenter: VALLE, Jose

Session Classification: Neutrino physics

Contribution ID: **302** Type: **Plenary talk**

Dark matter direct detection experiments

Thursday, January 13, 2022 5:00 PM (30 minutes)

Presenter: MARRODÁN UNDAGOITIA, Teresa (Max-Planck-Institut für Kernphysik)

Session Classification: Dark Matter

Contribution ID: **303** Type: **Plenary talk**

Dark matter collider searches

Thursday, January 13, 2022 5:30 PM (30 minutes)

Presenter: MELONI, Federico (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Dark Matter

Contribution ID: **304** Type: **Plenary talk**

Dark matter astrophysics

Thursday, January 13, 2022 6:00 PM (30 minutes)

Presenter: PEREZ, Kerstin

Session Classification: Dark Matter

Contribution ID: **305** Type: **Plenary talk**

Astroparticle physics overview

Thursday, January 13, 2022 6:30 PM (30 minutes)

Presenter: DELIGNY, Olivier (CNRS/IN2P3)

Session Classification: Gravitational waves and astroparticle physics

Contribution ID: **307** Type: **Plenary talk**

Gravitational Waves

Friday, January 14, 2022 8:30 AM (30 minutes)

Presenter: SCHMIDT, Patricia

Session Classification: Gravitational waves and astroparticle physics

Contribution ID: **308** Type: **Plenary talk**

Rare decays of strange, charm, and beauty hadrons

Tuesday, January 11, 2022 9:00 AM (30 minutes)

Presenter: LAZZERONI, Cristina (University of Birmingham (GB))

Session Classification: Quark and charged lepton flavour

Contribution ID: **309** Type: **Plenary talk**

Mixing and CP violation in beauty and charm hadrons

Tuesday, January 11, 2022 9:30 AM (30 minutes)

Presenter: JOHN, Malcolm (University of Oxford)

Session Classification: Quark and charged lepton flavour

Contribution ID: **310** Type: **Plenary talk**

Multi-messenger Detection

Friday, January 14, 2022 9:00 AM (30 minutes)

Presenter: Dr CUOCO, Elena (European Gravitational Observatory)

Session Classification: Gravitational waves and astroparticle physics

Contribution ID: **311** Type: **Plenary talk**

Theory of hadron CP violation and mixing

Tuesday, January 11, 2022 10:00 AM (30 minutes)

Presenter: LENZ, Alexander (Siegen University)

Session Classification: Quark and charged lepton flavour

Contribution ID: **312** Type: **Plenary talk**

Highlights in baryon decays

Tuesday, January 11, 2022 10:30 AM (30 minutes)

Presenter: SHEN, Xiaoyan (University of Science and Technology of China (CN))

Session Classification: Quark and charged lepton flavour

Contribution ID: **313** Type: **Plenary talk**

Accelerators R&D

Friday, January 14, 2022 10:30 AM (30 minutes)

Presenter: Dr ZIMMERMANN, Frank (CERN)

Session Classification: R&D

Contribution ID: **314** Type: **Plenary talk**

Detectors R&D

Friday, January 14, 2022 11:00 AM (30 minutes)

Presenter: Dr KUEHN, Susanne (CERN)

Session Classification: R&D

Contribution ID: **315** Type: **Plenary talk**

Panel discussion: Equality, diversity, and inclusion

Wednesday, January 12, 2022 4:00 PM (1 hour)

Presenters: Prof. JACKSON, Chris (University of Manchester); NELLIST, Clara (Radboud University Nijmegen and NIKHEF (NL)); STARK, Giordon Holtsberg (University of California,Santa Cruz (US))

Session Classification: Science in Society

Contribution ID: **316** Type: **Plenary talk**

Public engagement in HEP

Wednesday, January 12, 2022 5:00 PM (25 minutes)

Presenter: ABREU, Pedro (LIP Laboratorio de Instrumentacao e Fisica Experimental de Particulas (PT))

Session Classification: Science in Society

Contribution ID: **317** Type: **Plenary talk**

Software and computing R&D

Friday, January 14, 2022 11:30 AM (30 minutes)

Presenter: Dr STEWART, Graeme A (CERN)

Session Classification: R&D

Contribution ID: **318** Type: **Plenary talk**

Electron Ion collider

Friday, January 14, 2022 2:00 PM (20 minutes)

Presenter: GAO, Haiyan

Session Classification: Future experiments and facilities

Contribution ID: **319** Type: **Plenary talk**

Future high energy frontier experiments

Friday, January 14, 2022 2:20 PM (25 minutes)

Presenter: OHM, Christian (KTH Royal Institute of Technology (SE))

Session Classification: Future experiments and facilities

Contribution ID: **320** Type: **Plenary talk**

Future flavour experiments

Friday, January 14, 2022 2:45 PM (25 minutes)

Presenter: Dr PALUTAN, Matteo (INFN e Laboratori Nazionali di Frascati (IT))

Session Classification: Future experiments and facilities

Contribution ID: **321** Type: **Plenary talk**

Future neutrino experiments

Friday, January 14, 2022 3:10 PM (25 minutes)

Presenter: WORCESTER, Elizabeth Turner (Brookhaven National Laboratory (US))

Session Classification: Future experiments and facilities

Contribution ID: **322** Type: **Plenary talk**

Overview of underground facilities for HEP experiments

Presenter: Prof. PALING, Sean

Session Classification: Future experiments and facilities

Contribution ID: **323** Type: **Plenary talk**

Future muon iniciatives

Friday, January 14, 2022 3:35 PM (25 minutes)

Presenter: CHISLETT, Rebecca

Session Classification: Future experiments and facilities

Contribution ID: **324** Type: **Plenary talk**

C11 panel report

Friday, January 14, 2022 4:30 PM (20 minutes)

Presenter: CANELLI, Florencia (Universitaet Zuerich (CH))

Session Classification: Committee Reports

Contribution ID: **325** Type: **Plenary talk**

ICFA Report

Friday, January 14, 2022 4:50 PM (20 minutes)

Presenter: HENDERSON, Stuart

Session Classification: Committee Reports

Contribution ID: **326** Type: **Plenary talk**

Snowmass report

Friday, January 14, 2022 5:10 PM (20 minutes)

Presenter: BUTLER, Joel (Fermi National Accelerator Lab. (US))

Session Classification: Committee Reports

Contribution ID: **327** Type: **Plenary talk**

African Strategy

Friday, January 14, 2022 5:30 PM (20 minutes)

Presenter: ASSAMAGAN, Ketevi Adikle (Brookhaven National Laboratory (US))

Session Classification: Committee Reports

Contribution ID: **328** Type: **Plenary talk**

Poster prizes: First Prize Talk

Friday, January 14, 2022 9:30 AM (8 minutes)

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

Session Classification: Science in Society

Contribution ID: **329** Type: **Plenary talk**

Poster prizes: Second Prize Talk

Friday, January 14, 2022 9:38 AM (8 minutes)

Presenter: CAVALLARI, Francesca (Sapienza Universita e INFN, Roma I (IT))

Session Classification: Science in Society

Contribution ID: **330** Type: **Plenary talk**

Poster prizes: Third Prize Talk

Friday, January 14, 2022 9:46 AM (8 minutes)

Presenter: LIU, Dong

Session Classification: Science in Society

Contribution ID: **332** Type: **Poster**

First Results of the 2021 FASER Calorimeter Test Beam

Monday, January 10, 2022 4:33 PM (1 minute)

FASER, or the Forward Search Experiment, is a new experiment at CERN designed to complement the LHC's ongoing physics programme, extending its discovery potential to light and weakly-interacting particles that may be produced copiously at the LHC in the far-forward region. New physics particles targeted by FASER, such as long-lived dark photons or dark scalars, are characterised by a signature with two oppositely-charged tracks or two photons with very high energy (~TeV) that emanate from a common vertex inside the detector. A tracking-based technology, supplemented by a magnet, four scintillator stations and an electromagnetic calorimeter to allow for energy measurements are the key components of FASER. The full detector was successfully installed in TI12 in March 2021 and operations are planned during Run 3.
In 2021 a test beam campaign was carried out using one of the CERN beam lines to establish the calibration of the FASER calorimeter system. The relative calorimeter response to electrons of different energies (between 10 and 300 GeV) and high energy muons have been measured under various HV conditions and beam positions. Preliminary results are reported in this poster and compared to simulation.

Primary author: CAVANAGH, Charlotte (University of Liverpool (GB))

Presenter: CAVANAGH, Charlotte (University of Liverpool (GB))

Session Classification: R&D

Track Classification: R&D

Contribution ID: **334** Type: **Poster**

Electrons for the HL-LHC

Monday, January 10, 2022 4:38 PM (1 minute)

The Large Hadron-electron Collider is the opportunity for DIS at the TeV scale in the HL-LHC era. An energy recovery linac in racetrack configuration would provide 20-60 GeV electrons to collide with the HL-LHC hadron and nuclear beams, providing instantaneous luminosities around 10^{34} and $5 \cdot 10^{32}$ cm^{-2}s^{-1} per nucleon respectively. It would extend the kinematic $x - Q^2$ plane down in x and up in Q^2 by around two and four orders of magnitude in ep and eA respectively. A comprehensive physics programme on precision QCD, top, EW , Higgs, BSM and nuclear physics would be achievable with such machine. In this talk we will review accelerator, physics and detector aspects of the proposal, following the update 1 of the 2012 CDR 2. Besides, the studies on the recent proposal of a detector in IP2 able to study both ep/A and pp/pA/AA collision will be presented, including a new detector and IR design 3.

1 LHeC Collaboration and FCC-he Study Group, P. Agostini et al., e-Print: 2007.14491 [hep-ex], to appear in J. Phys. G.
2 LHeC Study Group, J.L. Abelleira Fernandez et al., J.Phys.G 39 (2012) 075001, e-Print: 1206.2913 [physics.acc-ph].
3 LHeC talks at Offshell-2021 — The virtual HEP conference on Run4@LHC (https://indico.cern.ch/event/968055/

Primary author: ARMESTO PEREZ, Nestor (Universidade de Santiago de Compostela (ES))

Presenter: SCHWANENBERGER, Christian (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Future experiments and facilities

Track Classification: Future experiments and facilities

Contribution ID: **335** Type: **Poster**

Search for CP violation in ttH and tH production in multilepton channels with CMS

Monday, January 10, 2022 4:33 PM (1 minute)

A measurement of the CP structure of the Yukawa interaction between the Higgs boson (H) and top quarks in event samples enriched in association of a H with one (tH) or two (tt H) top quarks, is presented. The measurement is based on data collected in proton-proton collisions at $\sqrt{s}$ = 13 TeV by the CMS experiment at the CERN LHC, corresponding to an integrated luminosity of 137 fb−1. The analysis targets events where the H decays via H $\longrightarrow$WW or H $\longrightarrow \tau\tau$ and the top quark(s) decay either leptonically or hadronically. Separation of CP-even from CP-odd scenarios is achieved by applying machine learning techniques to final states characterized by the presence of at least two leptons.

Primary author: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR))

Presenter: RAMON ALVAREZ, Clara (Universidad de Oviedo (ES))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **336** Type: **Poster**

Latest cross section measurements of the tW process at CMS

Monday, January 10, 2022 4:34 PM (1 minute)

Single top quark production is the subleading production process of top quarks at the LHC after the top quark pair production. The latest measurements of single top quark production (tW) cross sections are presented using data collected by the CMS detector at a center-of-mass energy of 13 TeV. The results are confronted with precise theory calculations.

Primary author: GOERLACH, Ulrich (Centre National de la Recherche Scientifique (FR))

Presenter: LEGGAT, Duncan (Fudan University (CN))

Session Classification: Precision SM Measurements

Track Classification: Standard Model

Contribution ID: **337** Type: **Parallel session talk**

FERS-5200: a distributed Front-End Readout System for multidetector arrays

Tuesday, January 11, 2022 1:50 PM (10 minutes)

Modern physics experiments usually rely on very big experimental setup where it is possible to find a wide variety of detectors: silicon microstrip trackers, plastic scintillator calorimeters, LAr cryostats readout by a Time Projection Chamber, spectrometers composed of several drift tubes and resistive plate chambers. Moreover, other large and medium scale setups for the search of neutrinos and astroparticles use thousands of scintillation detectors read out by photomultipliers or SiPMs. Nowadays, waveform digitizers and/or ASIC-based front-end cards are well-established readout electronics to build a reliable system hosting many readout channels.
The FERS-5200 is the new CAEN Front-End Readout System, answering the challenging requirement to provide flexibility and cost-effectiveness in the readout of huge detector arrays. FERS-5200 is a distributed and easy-scalable platform integrating the whole readout chain of the experiment, from detector front-end to DAQ. It is based on compact ASIC-based front-end cards integrating A/D conversion and data processing, which can be ideally spread over a large detector volume without drawbacks on the readout performance. Synchronization, event building and DAQ is managed by a single Concentrator board, capable of sustaining thousands of readout channels.
Using the appropriate Front-End, the solution perfectly fits a wide range of detectors such as SiPMs, multianode PMTs, GEMs, Silicon Strip detectors, Wire Chambers, Gas Tubes, etc, thus matching the requirements of different applications.

Primary authors: ABBA, Andrea (Nuclear Instruments Srls); VENTURINI, Yuri; TINTORI, Carlo (CAEN SpA); VENARUZZO, Massimo (CAEN SpA); PAOLI, Nicola (CAEN SpA)

Presenter: VENTURINI, Yuri

Session Classification: R&D

Track Classification: R&D

Contribution ID: **339** Type: **not specified**

Closing

Friday, January 14, 2022 5:50 PM (5 minutes)

Presenter: GERSABECK, Marco (University of Manchester (GB))

Session Classification: Committee Reports