NuFact 2022: The 23rd International Workshop on Neutrinos from Accelerators

Report of Contributions

https://indico.fnal.gov/e/nufact22

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

NA65(DsTau) experiment at CERN

Friday, August 5, 2022 2:50 PM (15 minutes)

The DsTau experiment at CERN-SPS has been proposed to measure an inclusive differential cross-section of a Ds production with a consecutive decay to tau lepton in p-A interactions. A precise measurement of the tau neutrino cross section would enable a search for new physics effects such as testing the Lepton Universality (LU) of Standard Model in neutrino interactions. The detector is based on nuclear emulsion providing a sub-micron spatial resolution for the detection of short length and small "kink" decays. Therefore, it is very suitable to search for peculiar decay topologies ("double kink") of Ds⟶τ⟶X. In 2021, the first physics run of the experiment was performed successfully. The collected data corresponds to 30% of the aimed total statistics. In this presentation, the status of data taking and analysis will be presented.

Attendance type

In-person presentation

Primary author: DSTAU COLLABORATION

Presenter: FIRU, Elena

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Recent MicroBooNE cross-section results: neutrino-induced baryon production

Friday, August 5, 2022 11:15 AM (20 minutes)

The MicroBooNE detector is a liquid argon time projection chamber (LArTPC) which recently finished recording neutrinos from both the Booster Neutrino Beam and the Neutrinos at the Main Injector beam at Fermilab. One of the primary physics goals of MicroBooNE is to make detailed measurements of neutrino-argon scattering cross sections, which are critical for the success of future neutrino oscillation experiments. At neutrino energies relevant for the Short-Baseline Neutrino program, the most plentiful event topology involves mesonless final states containing one or more protons. A low reconstruction threshold enabled by LArTPC technology has allowed MicroBooNE to pursue a number of analyses studying neutrino-induced proton production. In this talk, we present several recent cross-section measurements of this reaction mode for both muon and electron neutrinos. The results include MicroBooNE's first measurements of differential cross sections involving transverse kinematic imbalance and two-proton final states. A first look at lambda baryon production in neutrino-argon scattering is also presented.

Attendance type

In-person presentation

Presenter: PAPADOPOULOU, Afroditi (MIT)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Recent MicroBooNE cross-section results: inclusive channels and pion production

Friday, August 5, 2022 11:35 AM (20 minutes)

One of the main physics goals of the MicroBooNE experiment at Fermilab is to perform high-statistics measurements of neutrino-argon interaction cross sections. These measurements will be essential for future neutrino oscillation experiments, including the Short-Baseline Neutrino program and the Deep Underground Neutrino Experiment (DUNE), to achieve an unprecedented level of precision. Inclusive cross-section data provide an important overall benchmark for the interaction modeling needed for these future efforts, and exclusive measurements of neutrino-induced pion production provide insight into the dominant reaction mode at the neutrino energies relevant for DUNE. In this talk, we present some of the latest neutrino-argon cross-section measurements in MicroBooNE, including new results for charged-current inclusive neutrino cross sections and pion-containing final states.

Attendance type

In-person presentation

Presenter: GRAMELLINI, Elena (Fermilab)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Muon acceleration for the muon g-2/EDM experiment at J-PARC

Friday, August 5, 2022 11:15 AM (25 minutes)

The muon anomalous magnetic moment (g-2) measurement by the Fermilab National Accelerator Laboratory (FNAL-E989) is consistent with a previous experiment by the Brookhaven National Laboratory (BNL-E821), with a deviation from the SM prediction of 4.2 standard deviations. This discrepancy could lead to the discovery of unknown particles, and a completely different approach from previous experiments is needed for further verification. The J-PARC experiment aims to measure muon g-2 and the electric dipole moment (EDM) with high precision using a new method with a low-emittance muon beam generated by RF linear acceleration. This paper describes the development of the world's first linear accelerator dedicated to muons.

Attendance type

Virtual presentation

Primary author: NAKAZAWA, Yuga (Ibaraki University)

Co-authors: Dr CICEK, Ersin (KEK); Dr EGO, Hiroyasu (KEK); Dr FUKAO, Yoshinori (KEK); Dr FUTATSUKAWA, Kenta (KEK); Dr HASEGAWA, Kazuo (QST); IIJIMA, Toru (Nagoya); Dr IINUMA, Hiromi (Ibaraki University); Dr INAMI, Kenji (Nagoya University); Dr ISHIDA, Katsuhiko (RIKEN); KAWAMURA, Naritoshi (KEK/J-PARC); Dr KITAMURA, Ryo (JAEA); Dr KONDO, Yasuhiro (JAEA); MIBE, Tsutomu (KEK); Dr MIYAKE, Yasuhiro (KEK); Dr MORISHITA, Takatoshi (JAEA); OTANI, Masashi (KEK); Dr SAITO, Naohito (KEK); Dr SHIMOMURA, Koichiro (KEK); Dr SUE, Yuki (Nagoya University); Dr SUMI, Kazumichi (Nagoya University); Dr SUZUKI, Kazuhito (Nagoya University); Dr TAKAYANAGI, Tomohiro (JAEA); Dr TAKEUCHI, Yusuke (Kyushu University); TOJO, Junji (Kyushu University); YAMAZAKI, Takayuki (KEK); Dr YASUDA, Hiromasa (University of Tokyo); Dr YOTSUZUKA, Mai (Nagoya University)

Presenter: NAKAZAWA, Yuga (Ibaraki University)

Session Classification: Joint Session

Track Classification: WG3: Accelerator Physics

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

Advanced Materials Studies for High Intensity Proton Production Targets and Windows

Thursday, August 4, 2022 4:40 PM (30 minutes)

A high-power target system is a key beam element to complete future High Energy Physics (HEP) experiments but in the recent past, major accelerator facilities have been limited in beam power not by their accelerators, but by the beam intercepting device survivability. The target must then endure high power pulsed beam, leading to high cycle thermal stresses/pressures and thermal shocks. The increased beam power will also create significant challenges such as corrosion and radiation damage that can cause harmful effects on the material and degrade their mechanical and thermal properties during irradiation. This can eventually lead to the failure of the material and drastically reduce the lifetime of targets and beam intercepting devices.
The Long-Baseline Neutrino Facility (LBNF), under design at FNAL, plans to use Graphite for the production target, Titanium alloy as the target beam window and Be as the primary beam window. However, relatively little is known about the behavior of such materials when impacted by high energy proton beam and very limited engineering data is available to support the design and material choice for bam intercepting devices

In order to operate reliable beam-intercepting devices in the framework of energy and intensity increase projects of the future, it is essential to develop a strong R&D for robust target and beam window. The international RaDIATE collaboration, established in 2012, connects expertise in nuclear material and accelerate targets to generate useful materials data for application within the accelerator and fission/fusion communities.
After presenting the high power targetry challenges facing next generation multi-MW accelerators, I will give an overview of the most recent recent activities within the frame work of the RaDIATE collaboration in support of High Power Targetry development.

Attendance type

Virtual presentation

Presenter: PELLEMOINE, Frederique (Fermilab)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

First result of the high repetition operation in J-PARC MR

Tuesday, August 2, 2022 4:00 PM (30 minutes)

The main ring synchrotron (MR) of Japan Proton Accelerator Research Complex (J-PARC) has provided world-leading-intensity protons for the long-baseline neutrino oscillation experiment (T2K). We launched the upgrade plan to increase the beam power for realizing higher precision physics experiments. The beam power for T2K was 515 kW before the upgrade, and we aim at 1.3 MW by 2028. One of the most important upgrades is shortening the repetition period from 2.48 s to 1.32 s by reconstructing the magnet power supplies. We replaced all the power supplies in the long shutdown in JFY2021 and restarted the beam operation in 2022. In this presentation, we will describe the first results of the beam studies with faster cycling. We will also state the further strategy to achieve the new beam power target.

Attendance type

Virtual presentation

Primary author: YASUI, Takaaki (KEK)

Co-authors: Prof. IGARASHI, Susumu (KEK); Prof. SATO, Yoichi (KEK); Prof. HOTCHI, Hideaki (KEK)

Presenter: YASUI, Takaaki (KEK)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

Design, construction, and vertical slice performance tests of the Mu2e straw tracker

Friday, August 5, 2022 4:10 PM (30 minutes)

The Mu2e experiment will search for charge-lepton flavor violating (CLFV) muon to electron conversion. The signal for this process is a monoenergetic electron, and so a precise momentum measurement of the outgoing electron is required in order to reach the target 90% C.L. sensitivity of 8x10^-17. This is achieved in Mu2e using a low-mass cylindrical straw tracker operated in vacuum, consisting of 21,000 thin-wall mylar straws held at tension. The Mu2e tracker is now in production and will be completed by 2024. We will discuss the design and construction status, and show results from the first 576 straw 'plane' that has been under test since the beginning of 2021.

Attendance type

In-person presentation

Primary author: BONVENTRE, Richard (Lawrence Berkeley National Lab)

Presenter: BONVENTRE, Richard (Lawrence Berkeley National Lab)

Session Classification: Joint Session

Track Classification: WG4: Muon Physics

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

Status of the Short-Baseline Near Detector at Fermilab

Tuesday, August 2, 2022 5:00 PM (18 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 in 2023. SBND is characterized 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 characterization 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.

Attendance type

In-person presentation

Primary authors: NEBOT-GUINOT, Miquel; Dr PANDEY, Vishvas (University of Florida)

Presenter: NEBOT-GUINOT, Miquel

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

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

Evolution of Lepton Number for Neutrinos

Friday, August 5, 2022 12:20 PM (25 minutes)

We study the evolution of the lepton number for a $SU(2)$ doublet consisting of a massive neutrino and a charged lepton. By choosing a specific initial lepton family for a neutrino we can compute the evolution of all lepton family numbers. Our framework results in additional oscillation phases that are important for nonrelativisitc neutrinos. We study the phenomenology of relativistic and nonrelativistic neutrino physics under this framework. The nonrelativistic region is of particular interest due to the Cosmic Neutrino Background (CνB) predicted from big bang models. Furthermore, we include important damping effects on the oscillations for the nonrelativistic region by considering a lepton number density. This is based on the works of arXiv:2101.07751 [hep-ph] and arXiv:2106.02783 [hep-ph].

Attendance type

Virtual presentation

Primary authors: Dr ADAM, Apriadi Salim (National Research and Innovation Agency (BRIN)); BENOIT, Nicholas (Hiroshima University); Prof. MOROZUMI, Takuya (Hiroshima University); Dr SHIMIZU, Yusuke (Hiroshima University)

Co-authors: Dr MATSUO, Yamato (Hiroshima University); Dr KAWAMURA, Yuta (Hiroshima University)

Presenter: BENOIT, Nicholas (Hiroshima University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

ESS linac overall status and normal-conducting linac commissioning

Tuesday, August 2, 2022 3:00 PM (30 minutes)

The European Spallation Source (ESS), currently under construction in Lund, Sweden, will be the brightest spallation neutron source in the world, when its driving superconducting proton linac achieves the design power of 5 MW at 2 GeV. Such a high power linac requires production, efficient acceleration, and almost no-loss transport of a high current beam (62.5 mA), thus making its design and beam commissioning challenging. Beam commissioning for the normal-conducting part of the linac is ongoing in stages. In 2022, the beam was accelerated up to the first tank of the five-tank drift-tube linac. This presentation provides a brief summary of the ESS linac project and presents highlights from ongoing beam commissioning.

Attendance type

Virtual presentation

Primary authors: MILAS, Natalia (European Spallation Source); Dr MIYAMOTO, Ryoichi (ESS)

Presenter: Dr MIYAMOTO, Ryoichi (ESS)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

Fermilab's Muon Campus: Status, Experiments, and Future

Friday, August 5, 2022 12:05 PM (25 minutes)

The Fermilab Muon Campus, repurposed Tevatron-era Antiproton Source facilities, is currently the home to the g-2 and Mu2e muon experiments. Collecting data since 2017, the g-2 experiment is currently running and will switch to a mu-minus mode before the Muon Campus transitions to Mu2e operation. Currently in the commissioning process, the Mu2e experiment is expected to begin calibration and data collection in fiscal year 2024. A majority of the Muon Campus is shared between the two experiments, however the modes of operation for each are significantly different. An 8 GeV primary proton beam strikes a target to produce a 3.1 GeV/c secondary muon beam for g-2, while the Mu2e experiment uses the Delivery Ring, formerly the Antiproton Accumulator Ring, for a pulsed, resonantly extracted, 8 kW, 8 GeV proton beam incident on a target in the experiment's target hall to produce a muon beam for the experiment. The current state of the Muon Campus, the current and future plans of the g-2 and Mu2e experiments, including the transition between operating modes, and the challenges associated with Mu2e operation will be presented.

Attendance type

In-person presentation

Primary author: BOI, Steven

Presenter: BOI, Steven

Session Classification: Joint Session

Track Classification: WG4: Muon Physics

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

Pion-production target for Mu2e-II: simulation design and prototype

Friday, August 5, 2022 12:30 PM (25 minutes)

Mu2e-II will probe new physics mass scales up to 105 TeV by utilizing an 800-MeV 100-kW proton beam with an upgraded Mu2e beamline and detector, to obtain a sensitivity of ~10-17 in measurements of mu to electron conversion. This sensitivity is enabled by the PIP-II SRF Linac, which can accelerate a 2-mA proton beam to a kinetic energy of 800 MeV (1.6 MW of beam power); Mu2e-II will use a fraction of that potential. The higher beam intensity will require a substantially more advanced target design. In this talk, we will discuss our recent advances in design R&D for a Mu2e-II target station, based on energy deposition and radiation damage simulations (using MARS15, G4beamline, and FLUKA), as well as thermal and mechanical ANSYS analyses to estimate the survivability of the system. We considered rotated targets, fixed granular targets and a novel conveyor target with tungsten or carbon spherical elements that are circulated through the beam path. The motion of the spheres can be ensured either mechanically or both mechanically and by a He-gas flow. The simulations identified the conveyor target as the preferred approach, and that approach has been developed into a prototype. We describe this first prototype for the Mu2e-II target and report on its mechanical tests performed at Fermilab that indicate the feasibility of the design, discuss its weaknesses as well as suggested the directions of its further improvement.

Attendance type

In-person presentation

Primary author: NEUFFER, David (Fermilab)

Co-authors: LIU, Ao (Euclid Techlabs); PUSHKA, Dave (Fermilab); POPP, James (York College of The City Univeristy of Nnew York); LYNCH, Kevin (York College/CUNY); PRONSKIKH, Vitaly (Fermilab)

Presenter: NEUFFER, David (Fermilab)

Session Classification: Joint Session

Track Classification: WG4: Muon Physics

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

NA61/SHINE proton-carbon hadron production measurements for neutrino oscillation experiments

Friday, August 5, 2022 3:32 PM (18 minutes)

Hadron production measurements are crucial for helping long-baseline neutrino oscillation experiments constrain their beam flux uncertainties and improve oscillation measurements. The proton-carbon reaction is of particular importance, as it serves as the primary neutrino-creating reaction for the T2K and NOvA experiments. The NA61/SHINE experiment has made hadron production measurements for 31 GeV/c, 60 GeV/c, and 120 GeV/c protons on carbon targets. This talk will present recent analysis results of 120 GeV/c protons on a carbon target, which is the reaction foreseen to create the neutrino beam for DUNE. More thin and replica target measurements are planned at NA61/SHINE after CERN's Long Shutdown 2.

Attendance type

In-person presentation

Primary author: RUMBERGER, Brant (University of Colorado Boulder)

Presenter: RUMBERGER, Brant (University of Colorado Boulder)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

Improved constraints on Heavy Neutral Leptons and Heavy QCD Axions from the ArgoNeuT Experiment

Thursday, August 4, 2022 3:20 PM (30 minutes)

ArgoNeuT was a 0.24 ton Liquid Argon Time Projection Chamber detector at Fermilab running from 2009 to 2010. It was located along the NuMI neutrino beam and collected six months of data in anti-neutrino beam mode. ArgoNeuT's data-set has been used to perform numerous first neutrino cross-section measurements on argon. It can also be used to probe physics beyond the standard model resulting from high-energy proton fixed-target collisions in the NuMI beam. Searches for two such models have been performed using the ArgoNeuT experiment: Heavy Neutral Leptons produced via decays of tau leptons, and Heavy QCD Axions produced via mixing with standard model mesons. The resulting particles can then propagate along the NuMI beamline and then decay producing a di-muon signature observable in ArgoNeuT. This talk will present the results of these searches, along with the new constraints that can be applied on the Heavy Neutral Lepton and Heavy QCD Axion parameter spaces.

Attendance type

In-person presentation

Primary author: GREEN, Patrick

Presenter: GREEN, Patrick

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Energy Reconstruction and Calibration of the MicroBooNE LArTPC

Friday, August 5, 2022 2:56 PM (18 minutes)

The Liquid Argon Time Projection Chamber (LArTPC) is increasingly becoming the chosen technology for current and future precision neutrino oscillation experiments due to its superior capability in particle tracking and energy calorimetry. In LArTPCs, calorimetric information is critical for particle identification, which is the foundation for the neutrino cross-section and oscillation measurements as well as searches for beyond standard model physics. One of the primary challenges in employing LArTPC technology is characterizing its performance and quantifying the associated systematic uncertainties. MicroBooNE, the longest operating LArTPC to date, has performed numerous such measurements, including studies of detector physics and electromagnetic shower reconstruction. Here we present results on the operation and performance of the detector during its data taking, highlighting accomplishments toward calorimetric reconstruction, calibration, and detector physics.

Attendance type

In-person presentation

Primary authors: WOSPAKRIK, Marianette (Fermi National Accelerator Laboratory); Dr WU, Wanwei (Fermi National Accelerator Laboratory)

Presenter: Dr WU, Wanwei (Fermi National Accelerator Laboratory)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

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

Status of the NINJA experiment

Friday, August 5, 2022 4:30 PM (20 minutes)

Uncertainty of the neutrino-nucleus interaction models is one of the major sources of systematic uncertainty for neutrino oscillation experiments. The NINJA experiment aims to measure the neutrino-nucleus interactions precisely using a nuclear emulsion detector called Emulsion Cloud Chamber (ECC). The sub-micron spatial resolution and a high sampling rate of the ECC allow us to detect short tracks of low-momentum charged particles such as protons (The momentum threshold for protons is down to 200 MeV/c).
So far, we have measured the kinematics of charged particles emitted from neutrino interactions on water or iron in J-PARC using the T2K high-intensity neutrino beam. Multiplicity, angle, and momentum distribution of the charged particles from the neutrino interactions have been compared to the prediction by the Monte Carlo simulation.
From November 2019 to February 2020, the NINJA experiment conducted its first physics run in J-PARC. The 75 kg water-target ECC was exposed to the neutrino beam corresponding to 4.8×10^{20} protons on target. In this presentation. we report the latest result of the pilot runs and the current status of neutrino interaction analysis of the physics run. In addition, expected outcomes from and prospects of the NINJA experiment will be discussed in this talk.

Attendance type

In-person presentation

Primary author: ODAGAWA, Takahiro (Kyoto University)

Presenter: ODAGAWA, Takahiro (Kyoto University)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Overview of physics results with coherent elastic neutrino-nucleus scattering data

Friday, August 5, 2022 2:35 PM (15 minutes)

The detection of **Coherent Elastic Neutrino-Nucleus Scattering (CEvNS)** performed in 2017 and 2021 with cesium iodide and in 2020 with liquid argon by the COHERENT collaboration has paved the way for precision phenomenological measurements of many diverse physical phenomena.
CEvNS is a neutral current process induced by the exchange of a Z boson that permits to put interesting constraints on **nuclear physics**, **neutrino electromagnetic properties** but it also represents a sensitive probe for **non-standard interactions (NSI)** that are not included in the SM, induced by yet to be discovered neutral vector and scalar bosons.
Recently, CEvNS has also been observed for the first time using antineutrinos from reactors at the Dresden-II site with a germanium detector called NCC-1701, allowing to obtain more stringent and complementary constraints.

In this talk, I will present an **overview of the physics reach of CEvNS**, presenting, in particular, the state of the art of the constraints on neutrino charge radii, milli-charges, and magnetic moments as well as new limits on NSI and different new physics models involving **light vector Z' mediators**. Complementarity of CEvNS constraints with nuclear physics with the recent PREX and CREX neutron-skin determinations will also be discussed, highlighting the interplay with the weak-mixing angle determination.
I will compare all the results obtained with the limits derived from other oscillation and scattering experiments and provide prospects for the future, given the large amount of CEvNS experiments that are currently being proposed or under construction.

Attendance type

In-person presentation

Primary author: CADEDDU, Matteo (INFN)

Presenter: CADEDDU, Matteo (INFN)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Search for an Anomalous Excess of Electron Neutrino Interactions in MicroBooNE and New Constraints on eV-Scale Sterile Neutrinos

Tuesday, August 2, 2022 4:00 PM (30 minutes)

The MicroBooNE collaboration recently released a series of measurements aimed at investigating the nature of the excess of low energy electromagnetic interactions observed by the MiniBooNE collaboration. In the talk, we will present the results on the search for an anomalous excess of electron neutrino events. This search was performed leveraging three independent analyses which target different charged current electron neutrino final-state topologies. The talk will include details on event selection, background estimation, systematic analysis and cross-checks. We additionally will highlight new results that use these well understood charged-current electron neutrino and muon neutrino event selections to perform a search of an eV scale sterile neutrino in the full 3+1 oscillation framework. Constraints will be presented for regions of sterile neutrino parameter space relevant to the Gallium ν_e disappearance anomaly and LSND/MiniBooNE ν_e appearance anomalies.

Attendance type

In-person presentation

Primary authors: JI, Xiangpan (BNL); WEI, Hanyu (brookhaven national laboratory)

Co-author: ROSS-LONERGAN, Mark (IPPP Durham University)

Presenter: JI, Xiangpan (BNL)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

MicroBooNE's Search for Anomalous Single-Photon Production in Neutrino Scattering

Friday, August 5, 2022 4:10 PM (29 minutes)

We report the results from MicroBooNE's search for a single-photon excess in the Booster Neutrino Beam at Fermilab, a potential interpretation to the long-standing MiniBooNE low-energy excess anomaly. We highlight recent results targeting neutrino-induced neutral current resonant Δ(1232) baryon production followed by Δ radiative decay. Data corresponding to MicroBooNE's first three years of operations (6.80×10^20 protons on target) were used to search for single-photon events with the backgrounds constrained via an in-situ high-purity measurement of NC π0 events. This provided the world's most sensitive search for NC Δ⟶Nγ below 1 GeV and disfavors the hypothesis that anomalously large Δ radiative decay is the origin of the MiniBooNE low-energy excess. Additional cross-checks to this analysis utilizing a separate reconstruction framework are presented, along with plans and progress towards both a model-independent inclusive photon search, and new model-dependent search targeting NC coherent-like single-photon production.

Attendance type

In-person presentation

Primary author: SUTTON, Kathryn (Caltech)

Co-author: ROSS-LONERGAN, Mark (IPPP Durham University)

Presenter: SUTTON, Kathryn (Caltech)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Beyond the Standard Model Searches with the Short Baseline Near Detector (SBND)

Tuesday, August 2, 2022 5:36 PM (18 minutes)

SBND is a 112-ton liquid argon time projection chamber located on the Booster Neutrino Beam at Fermi National Accelerator Laboratory, and is the near detector of the Short-Baseline Neutrino program. The primary goals of SBND are to provide flux constraints for sterile neutrino searches, conduct world-leading neutrino cross section measurements on argon, and perform beyond the Standard Model (BSM) physics searches with its high-precision particle identification capabilities. In this talk, I will discuss SBND's prospects and tools for detecting a variety of BSM phenomena produced in a neutrino beam, such as sub-GeV dark matter, dark neutrinos, millicharged particles, and others.

Attendance type

In-person presentation

Primary author: BALASUBRAMANIAN, Supraja

Presenter: BALASUBRAMANIAN, Supraja

Session Classification: Joint Session

Track Classification: WG5: Beyond PMNS

Contribution ID: **23** Type: **Poster**

Measurement of the Λ Baryon Production Cross Section in Neutrino Interactions with MicroBooNE

Monday, August 1, 2022 6:20 PM (40 minutes)

The MicroBooNE detector is a liquid argon time projection chamber (LArTPC) with an 85 ton active mass that receives flux from the Booster Neutrino and the Neutrinos from the Main Injector (NuMI) beams, providing excellent spatial resolution of the reconstructed final state particles. Since 2015 MicroBooNE has accumulated many neutrino and anti-neutrino scattering events with argon nuclei enabling searches for rare interaction channels.

The Cabibbo suppressed production of hyperons in anti-neutrino-nucleus interactions provides sensitivity to a range of effects, including second class currents, SU(3) symmetry violations and reinteractions between the hyperon and the nuclear remnant. This channel exclusively involves anti-neutrinos, offering an unambiguous constraint on wrong sign contamination. The effects of nucleon structure and final state interactions are distinct from those affecting the quasielastic channel and modify the Λ and Σ production cross sections in different ways, providing new information that could help to break their degeneracy. Few measurements of this channel have been made, primarily in older experiments such as Gargamelle [1,2].

We present the measurement of the cross section for direct (Cabibbo suppressed) Λ production in muon anti-neutrino interactions with argon nuclei in the MicroBooNE detector, using neutrinos from the off-axis NuMI beam. The event selection and treatment of systematic uncertainties will also be described.

[1] O. Erriquez et al., Nucl. Phys. B140, 123 (1978)

[2] O. Erriquez et al., Phys. Lett. B 70, 383 (1977)

Attendance type

In-person presentation

Primary author: THORPE, Christopher (Lancaster University)

Presenter: THORPE, Christopher (Lancaster University)

Session Classification: Reception & Poster Session

Track Classification: WG2: Neutrino Scattering Physics

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

SBND Trigger System: General status and the configuration of the Analog Master Trigger Card

Thursday, August 4, 2022 4:50 PM (20 minutes)

We present a brief description of the Short-Baseline Near Detector (SBND) hardware trigger system. The SBND experiment is a liquid argon neutrino detector that sits on the central axis of the Booster Neutrino Beam (BNB), located at Fermilab. The detector is currently being assembled and is expected to start operating in 2023. Neutrinos delivered by the BNB will interact with liquid argon inside the SBND, producing charge and scintillation light that will be collected, respectively, by the charge collection wires and the photon detection system. SBND will record over a million neutrino interaction events per year while simultaneously being exposed to a large flux of cosmic ray interactions. Thus it is imperative to determine which events in the detector are of interest for analysis. This is the work of the SBND trigger system which receives several prompt inputs, discriminates these inputs and qualifies them to form a so-called "trigger decision". In this work, we will focus on the general overview of the trigger system for SBND and, specifically, we describe the configuration of the Analog Master Trigger Card used in the photon detection trigger.

Attendance type

In-person presentation

Primary author: VITTI STENICO, Gabriela (State University of Campinas (UNICAMP))

Presenter: VITTI STENICO, Gabriela (State University of Campinas (UNICAMP))

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

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

INVOLVING THE NEW GENERATIONS IN FERMILAB ENDEAVOURS

Friday, August 5, 2022 11:55 AM (20 minutes)

Since 1984 the Italian groups of the Istituto Nazionale di Fisica Nucleare (INFN) and Italian Universities, collaborating with Fermilab 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 successful and the engineering students have been well accepted by the Technical, Accelerator and Scientific Computing Division groups. This program has proven to be the most effective way to engage new students in Fermilab endeavours. Many students have extended their collaboration with Fermilab with their Master Thesis and PhD.
Since 2004 the program has been supported in part by DOE in the frame of an exchange agreement with INFN. The program has involved more than 500 Italian students from more than 20 Italian Universities. A handful of students of European and non-European Universities were also accepted in the years.
Each intern is supervised by a Fermilab Mentor. Training programs spanned from Tevatron, CMS, Muon (g-2), Mu2e and SBN (MicroBooNE, ICARUS, SBND) and DUNE design and experimental data analysis, development of particle detectors, 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.
In 2015 the University of Pisa included the program within its own educational programs. 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.
After two years of suspension, we are resuming the Program. The students' are showing great interest.
Information on students' recruiting methods, training programs and final students' evaluation process awill be given.

Attendance type

Virtual presentation

Primary authors: DONATI, Simone (Istituto Nazionale di Fisica Nucleare); BELLETTINI, Giorgio (University and INFN, Pisa); PASCIUTO, Daniele (University of Pisa - INFN); BARZI, Emanuela (Fermilab)

Presenter: DONATI, Simone (Istituto Nazionale di Fisica Nucleare)

Session Classification: WG7: IDEEO

Track Classification: WG7: IDEEO

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

The ENUBET monitored neutrino beam for high precision cross section measurements

Tuesday, August 2, 2022 5:00 PM (20 minutes)

The main source of systematic uncertainty on neutrino cross section measurements at the GeV scale originates from the poor knowledge of the initial flux. The goal of cutting down this uncertainty to 1% can be achieved through the monitoring of charged leptons produced in association with neutrinos, by properly instrumenting the decay region of a conventional narrow-band neutrino beam. Large angle muons and positrons from kaons are measured by a sampling calorimeter on the decay tunnel walls, while muon stations after the hadron dump can be used to monitor the neutrino component from pion decays. This instrumentation can provide a full control on both the muon and electron neutrino fluxes at all energies. Furthermore, the narrow momentum width (<10%) of the beam provides a 0(10%) measurement of the neutrino energy on an event by event basis, thanks to its correlation with the radial position of the interaction at the neutrino detector. The ENUBET project has been funded by the ERC in 2016 to prove the feasibility of such a monitored neutrino beam and, since 2019, ENUBET is a CERN neutrino platform experiment (NP06/ENUBET). In this talk we will present the final results of the ERC project, together with the complete assessment of the feasibility of its concept. The breakthrough the project achieved is the design of a horn-less beamline that allows for a 1% measurement of ν_e and ν_μ cross sections in about 3 years of data taking at CERN-SPS using ProtoDUNE as far detector. Thanks to the replacement of the horn with a static focusing system (2 s proton extraction) we reduce the pile up by two orders of magnitude, and we can monitor leptons from pion and kaon decays with a signal/background >2. We will hence discuss the implementation of a monitored neutrino beam at CERN and FNAL, its performance and perspectives for a new generation of cross section experiments to study neutrino-nucleus interactions and improve the physics reach of DUNE and Hyper-Kamiokande.

Attendance type

In-person presentation

Primary author: PUPILLI, Fabio (INFN-Padova)

Presenter: DELOGU, Claudia Caterina (Padova University)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

New muon monitor for J-PARC neutrino experiment

Thursday, August 4, 2022 3:20 PM (30 minutes)

The T2K experiment is a neutrino oscillation experiment running at J-PARC. In order to increase the statistics of neutrino data and improve the sensitivity to CP violation, upgrade of the neutrino beam is currently ongoing. The repetition cycle will be shortened from 2.48s to 1.16s and the number of protons in each pulse will be increased. With these upgrades, the beam intensity will be increased from 510 kW to 1.3MW. In the T2K experiment, the beam direction and profile are monitored by detecting muons produced simultaneously with neutrinos. Si PIN photodiodes and ionization chambers have been used as muon monitors, but these monitors need to be updated after the beam upgrade due to radiation damage or non-linearity at high intensity. Therefore, we are studying Electron Multiplier Tube (EMT) as a new detector candidate. It was shown by the previous study that EMTs have superior radiation tolerance than Si detectors. However, it was also shown that the gain drops for initial radiation and then further decreases after certain amount of radiation, corresponds to more than 100 days of 1.3 MW beam exposure. In order to improve the radiation tolerance of EMT, further studies are ongoing to address initial instability and to extend the life of the EMT. For these purposes, beam tests were conducted at ELPH in Tohoku University. In this beam test, the variation of the gain was confirmed with further radiation and the cause of the variation was investigated by changing the conditions of radiation for each component. Another study indicates the cause of the initial instability is due to the temperature dependence. We report the results of these studies.

Attendance type

In-person presentation

Primary author: HONJO, Takashi (Osaka City Univ.)

Co-authors: Dr FRIND, Megan; Dr ICHIKAWA, Atsuko; Ms NAKAMURA, Hina; Dr NAKAMURA, Kiseki; Dr SEIYA, Yoshihiro; Ms IZUMI, Nao; Dr ISHITSUKA, Masaki; Dr KIKAWA, Tatsuya; Mr KASAMA, Sohei; Dr MATSUBARA, Tsunayuki; Mr TAKIFUJI, Kouichi; Dr YAMAMOTO, Kazuhiro; Mr YAMAMOTO, Tatsuya; Mr YASUTOME, Kenji

Presenter: HONJO, Takashi (Osaka City Univ.)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

Recent results from Belle II

Thursday, August 4, 2022 3:10 PM (25 minutes)

The Belle II experiment at the SuperKEKB energy-asymmetric e+e− collider is a substantial upgrade of the B factory facility at the Japanese KEK laboratory. The design luminosity of the machine is 6×1035 cm−2s−1 and the Belle II experiment aims to ultimately record 50 ab−1 of data, a factor of 50 more than its predecessor. With this data set, Belle II will be able to measure the Cabibbo-Kobayashi-Maskawa (CKM) matrix, the matrix elements and their phases, with unprecedented precision and explore flavor physics with B and charmed mesons, and τ leptons. Belle II has also a unique capability to search for low mass dark matter and low mass mediators. In this presentation, we will review the latest results from Belle II, with emphasis on those related to lepton flavour violation.

Attendance type

In-person presentation

Primary authors: ADAMCZYK, Karol; JIM, Libby (Indian Institute of Technology Madras)

Presenter: ADAMCZYK, Karol

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **29** Type: **Talk**

DeeMe –muon-electron conversion search experiment–

Tuesday, August 2, 2022 5:30 PM (30 minutes)

The one of an experiment to search for the charged lepton flavor violating process, muon-electron conversion in a nuclear field , DeeMe, is being prepared at the J-PARC MLF H-line in Japan. This experiment utilizes a pulsed proton beam from the Rapid Cycle Synchrotron (RCS). A graphite target is bombarded with a pulsed proton beam and negative pion production and pion-in-flight-decay to negative muon, then creation of muonic atoms are caused in the same pion production target. And a converted electron is expected to emit about after 1~2 micro second delayed timing due to muon atom binding. Also two body reaction of the new process μ + (A,Z) $\longrightarrow$ e + (A,Z) results in 105 MeV monoenergetic electron. Therefore, 1~2 micro second delayed 105MeV monoenergetic electron is a searched signal. Electrons around 100 MeV are transported by the H-Line and analyzed by the dipole magnet (0.4T) and four MWPCs (two upstream of the dipole magnet and two downstream of the dipole magnet).
However, the burst pulse reaching to 10^8 charged particles/pulse attributable to the RCS pulse makes large dead time for the MWPC. So, HV switching scheme is introduced where at the burst time the voltages between anode wires and potential wires set the same so as to lower the gas gain to be O(1) while at the delayed timing the voltages between them set ~1500V so as to increase the gas gain to be O(10^4) rapidly. The signal is recorded by the flash ADC and the single electron signal was obtained successfully. The target single event sensitivity is 10^{-13}. At the present moment, all the magnet components of the H-line have been connected with the vacuum pipe, and the commissioning is going on in a good shape. In this talk, the experimental basis, the commissioning status of the H-Line and the DeeMe experiment are presented.

Attendance type

Virtual presentation

Primary author: YAMAMOTO, Kazuhiro (Osaka Metropolitan University)

Presenter: YAMAMOTO, Kazuhiro (Osaka Metropolitan University)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **30** Type: **Talk**

The MUonE experiment proposal, status and plans

Thursday, August 4, 2022 11:50 AM (30 minutes)

The MUonE experiment aims at an independent and competitive determination of the leading hadronic contribution to the muon anomalous magnetic moment $a_\mu = (g_\mu - 2)/2$, based on an alternative method, complementary to the existing ones. It relies on the measurement of the shape of the μe elastic scattering cross section, with unprecedented precision, which can be obtained at CERN by exploiting the available 160 GeV muon beam in fixed target collisions.
MUonE could have a crucial role to clarify the comparison of the a_μ measurement with the Standard Model, given the recent Fermilab result, and the tension between the accepted theory prediction and a new Lattice QCD calculation.
A Test Run with a reduced detector is planned to validate the proposal. The status of the experiment and the future plans will be presented.

Attendance type

In-person presentation

Primary authors: ABBIENDI, Giovanni (INFN - Bologna); CAPRIOTTI:, Lorenzo; MARCONI, Umberto (INFN - Bologna)

Presenter: CAPRIOTTI:, Lorenzo

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **31** Type: **Talk**

New sensitivties for eV-scale Sterile Neutrino Searches with IceCube

Tuesday, August 2, 2022 5:54 PM (18 minutes)

Various short-baseline neutrino oscillation experiments have yielded unexpected results, which hint at the existence of light sterile neutrinos. IceCube has performed a unique search for sterile neutrinos by exploiting matter-enhanced resonant oscillations, which can be probed using atmospheric and astrophysical neutrinos in the TeV energy regime. The analysis uses the world's largest sample of Earth-crossing muon neutrino events from eight years of IceCube data with a purity above 99.9%. We present new sensitivities in this analysis using both new event selection and energy reconstruction based on machine learning techniques.

Attendance type

In-person presentation

Primary authors: GARCIA SOTO, Alfonso Andres (Harvard University); ARGÜELLES DELGADO, Carlos (Harvard University)

Presenter: GARCIA SOTO, Alfonso Andres (Harvard University)

Session Classification: Joint Session

Track Classification: WG5: Beyond PMNS

Contribution ID: **32** Type: **not specified**

WG1 Introduction

Monday, August 1, 2022 8:40 AM (20 minutes)

Attendance type

In-person presentation

Primary author: AURISANO, Adam (University of Cincinnati)

Presenter: AURISANO, Adam (University of Cincinnati)

Session Classification: Plenary: WG Introductions

Contribution ID: **33** Type: **Talk**

SBND-PRISM: Sampling Multiple Off-Axis Neutrino Fluxes with the Same Detector

Thursday, August 4, 2022 11:38 AM (18 minutes)

The Short Baseline Near Detector (SBND), a 112-ton liquid argon time projection chamber, is the near detector of the Short Baseline Neutrino program at Fermilab. SBND has the characteristic of being remarkably close (110 m) to the neutrino source and not perfectly aligned with the neutrino beamline, in such a way that the detector is traversed by neutrinos coming from different angles with respect to the beam axis. This is known as the PRISM feature of SBND, which allows sampling of multiple neutrino fluxes using the same SBND detector. SBND-PRISM, which will start taking data in 2023, can be utilized to improve neutrino-oscillation sensitivities and study distinctive neutrino-nucleus interactions and exotic physics signals.

Attendance type

In-person presentation

Primary author: DEL TUTTO, Marco (Fermilab)

Presenter: DEL TUTTO, Marco (Fermilab)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **34** Type: **Talk**

Tests of neutrino mass models at CMS

Friday, August 5, 2022 3:20 PM (30 minutes)

The latest results and prospects of searches for heavy neutrinos at the CMS experiment will be presented.

Attendance type

Virtual presentation

Primary authors: CMS, Collaboration; QIAN, Sitian; QIAN, Sitian (Peking University)

Presenters: CMS, Collaboration; QIAN, Sitian; QIAN, Sitian (Peking University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **35** Type: **Talk**

Recent results from the NA62 experiment at CERN

Thursday, August 4, 2022 2:20 PM (25 minutes)

The NA62 experiment at CERN collected world's largest dataset of charged kaon decays in 2016-2018, leading to the first observation of the ultra-rare K+ –> pi+ nu nu decay based on 20 candidates. Dedicated trigger lines were employed for collection of di-lepton final states, which allowed establishing stringent upper limits on the rates lepton flavor and lepton number violating kaon decays. The dataset is also exploited to search for production of light feebly interacting particles (such as heavy neutral leptons) in kaon decays. Recent NA62 results based on the 2016-2018 dataset, and the prospects of the NA62 experiment, are presented.

Attendance type

In-person presentation

Primary author: GOUDZOVSKI, Evgueni (University of Birmingham)

Presenter: GOUDZOVSKI, Evgueni (University of Birmingham)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **36** Type: **Talk**

Favourable Conditions for Majorana Phase Appearance in Neutrino Oscillation Probabilities

Thursday, August 4, 2022 5:00 PM (25 minutes)

The nature of neutrinos, whether they are Dirac or Majorana particles, has been an open question for long time. In the case of two flavour mixing, the transition matrix is real in the case of Dirac neutrinos but it contains a phase ϕ in the case of Majorana neutrinos. This phase does not appear in neutrino oscillation probabilities for vacuum oscillations as well as for matter modified oscillations. However, it was shown by Benatti et al. 2001, that for some special forms of quantum decoherence effects in neutrino evolution, this ϕ-phase appears in oscillation probabilities. In this work, we ask the question: For what other forms of neutrino evolution equation does the Majorana phase appear in the oscillation probabilities? We show that, in the case of neutrino decay, the Majorana phase appears in the oscillation probabilities if the decay eigenstates are not the same as the mass eigenstates. The forms of appearance of Majorana phase in our work and that in [Benatti et al. 2001] can be distinguished from each other by their CPT properties.

Attendance type

Virtual presentation

Primary author: Dr DIXIT, Khushboo (IIT Bombay)

Co-authors: PRADHAN, Akhil Kumar (IIT Bombay); Prof. SANKAR, S. Uma (IIT Bombay)

Presenter: Dr DIXIT, Khushboo (IIT Bombay)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **37** Type: **Talk**

Ability of DUNE to establish Deviation from Maximal θ_{23}

Friday, August 5, 2022 4:32 PM (22 minutes)

The present global analyses of the available oscillation data still allow $\sin^2\theta_{23} = 0.5$ at 3σ confidence level while, the current best-fit of θ_{23} strongly suggests $\sin^2\theta_{23} \neq 0.5$.Thus, it is imperative to question at what significance maximal 2-3 mixing can be ruled out. We study in great detail the performance of DUNE to establish the deviation from maximality in the 2-3 sector. We also discuss the impact of $\sin^2\theta_{23} - \Delta m^2_{31}$ degeneracy in establishing non-maximal θ_{23} and show how this degeneracy can be broken by exploiting the spectral shape information in ν and $\bar{\nu}$ disappearance events. We find that a 3σ (5σ) determination of non-maximal θ_{23} is possible in DUNE with an exposure of 336 kt·MW·years if the true value of $\sin^2\theta_{23} \leq 0.465\ (0.450)$ or $\sin^2\theta_{23} \geq 0.554\ (0.572)$ for any value of true $\delta_{\rm CP}$ and true NMO. We also study the individual contributions from appearance and disappearance channels, the impact of systematic uncertainties and marginalization over oscillation parameters, the importance of spectral analysis, and the data from both ν and $\bar{\nu}$ runs, while analyzing DUNE's sensitivity to discover non-maximal θ_{23}.

Attendance type

Virtual presentation

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

Presenter: SINGH, Masoom (Utkal University and Institute of Physics, Bhubaneswar)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **38** Type: **Talk**

Coherent neutrino scattering and the quenching factor measurement

Thursday, August 4, 2022 4:10 PM (25 minutes)

The recent evidence for coherent elastic neutrino-nucleus scattering (CE\nuνNS) in the NCC-1701 germanium detector using antineutrinos from the Dresden-II nuclear reactor is in good agreement with standard model expectations. However, we show that a 2σ improvement in the fit to the data can be achieved if the quenching factor is described by a modified Lindhard model with a negative value of q, which is also consistent with the direct quenching factor measurements. We also place constraints on the parameter space of a light vector or scalar mediator that couples to neutrinos and quarks, and on a neutrino magnetic moment. We demonstrate that the constraints are quite sensitive to the quenching factor at low recoil energies by comparing constraints for the standard Lindhard model with those by marginalizing over the two parameters of the modified Lindhard model.

Attendance type

Virtual presentation

Primary authors: MARFATIA, Danny (University of Hawaii); LIU, Hongkai; LIAO, Jiajun (Sun Yat-sen University)

Presenter: LIAO, Jiajun (Sun Yat-sen University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **39** Type: **Talk**

Calibration strategy for the JUNO experiment

Friday, August 5, 2022 3:14 PM (18 minutes)

Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kton liquid scintillator based neutrino experiment, being built in the Guangdong province in Southern China. Its construction is expected to be completed in 2023. The experimental hall is located underground, below a 700 meter rock over-burden, to reduce backgrounds from cosmic rays. JUNO will act as a multipurpose observatory for neutrinos produced by artificial and natural sources. Its primary goal consists in the determination of the neutrino mass ordering (NMO), which 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. Moreover, it will be able to the determine $\sin^2\theta_{12}$, Δm^2_{12}, Δm^2_{13} with unprecedented precision, to perform precision solar neutrino spectroscopy, to measure atmospheric neutrino and geo-neutrinos fluxes, to detect supernova neutrinos, etc.
The detector calibration is a crucial and challenging tile for the success of the JUNO rich physics programme. The calibration strategy is based on the periodical deployment of radioactive sources within the liquid scintillator. The hardware design consists of several independent and low-background subsystems able to deploy the sources in multiple positions, to optimize the energy resolution and to provide a detailed assessment of the detector energy response.
By exploiting this comprehensive calibration program, along with a dual calorimetry technique based on two independent photosensor system, the JUNO central detector will be able to achieve a better than 1% energy linearity and a 3% effective energy resolution, which are crucial requirements for the NMO determination.
This talk is dedicated to the explanation of JUNO calibration strategy and requirements, along with the system hardware design and to the simulation results.

Attendance type

In-person presentation

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

Presenter: Dr BASILICO, Davide (University of Milan / INFN)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **40** Type: **Talk**

The design of the ENUBET beamline

Friday, August 5, 2022 3:20 PM (30 minutes)

The ENUBET project aims at reducing to 1% the flux related systematics on a narrow band neutrino beam through the monitoring of the associated charged leptons in an instrumented decay tunnel. A key element of the project is the design of a meson transfer line with conventional magnets that maximizes the yield of K^+ and π^+, while minimizing the total length to reduce meson decays in the not instrumented region. In order to limit particle rates on the tunnel instrumentation, a high level of beam collimation is needed, thus allowing undecayed mesons to reach the end of the tunnel. At the same time a fine tuning of the shielding and the collimators is required to minimize any beam induced background in the decay region. The magnetic lattice is optimized with TRANSPORT: the focusing of mesons from the target is performed with a static (quadrupole-based) system that, coupled with a slow proton extraction scheme, allows for a significant pile-up reduction at the tunnel instrumentation while retaining a particle yield large enough for a high precision neutrino cross section measurement on a 3 year time scale. Charge and momentum selection in a 8.5 GeV$\pm$10% momenum bite is performed by a double dipole system. Shielding elements are optimized with a full simulation of the facility in Geant4. In particular a powerful genetic algorithm is used to scan automatically the parameter space of the collimators in order to find a configuration that minimizes the halo background in the decay tunnel while preserving a large meson yield.
This contribution will report the results of the optimization studies and the final design of the ENUBET beamline, together with doses estimation through a FLUKA simulation. The design of an alternative secondary beamline with a broad momentum range (4, 6, 8.5 GeV/c), that could enhance the physics reach of the facility, is discussed in addition.

Attendance type

In-person presentation

Primary author: PUPILLI, Fabio (INFN-Padova)

Presenter: PAROZZI, Elisabetta Giulia (CERN)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **41** Type: **Talk**

Suppression of quasielastic electron scattering cross sections at small q and extraction of the Coulomb Sum Rule

Thursday, August 4, 2022 2:20 PM (20 minutes)

We report on a phenomenological analysis of all available electron scattering data on carbon (about 8000 differential cross section measurements) and oxygen at all values of q. The QE cross section is modeled within the framework of the superscaling model (including Pauli blocking). In addition to the expected enhancement of the transverse QE response function we find that at low values of q there is "Extra Suppression" of the QE longitudinal response function beyond the expected suppression from Pauli blocking. We extract q dependent parameterizations that can be used to determine the "Extra Suppression" factor for any nucleon momentum distribution for use in electron and neutrino Monte Carlo generators. We obtain the best measurement of the Coulomb Sum Rule (CSR) as function of q. For carbon, the CSR and low q suppression are in good agreement with the Lavato 2000 "First Principle" Green's Function MC. The extracted CSR and low q suppression values for Carbon are in good agreement with the "first principle Green's function MC" calculation of Lavato et al. Phys. Rev. Lett. 117, 082501 (2016). The extracted CSR values for Oxygen are in agreement with the Coupled Custer calculation of J. E. Sobczyk et al. .Phys. ReV. C 102, 064312 (2020). The contribution of nuclear excitations to the Coulomb Sum Rule is significant (up to 29%). Consequently we also provide parameterizations of the form factors for the nuclear excitations in carbon$ and oxygen}

Attendance type

Virtual presentation

Primary authors: BODEK, Arie (University of Rochester); Dr CHRISTY, M. Eric (Jefferson Laboratory)

Presenter: BODEK, Arie (University of Rochester)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **42** Type: **Talk**

IceCube & SWGO Photodetectors

Tuesday, August 2, 2022 4:00 PM (20 minutes)

We look at the PMTs, bases, and digitizers for the IceCube Observatory: the original installed IceCube Gen1 modules, the under-construction IceCube Upgrade modules, and the proposed IceCube Gen2 modules. Will also look at the proposed solutions for the Southern Wide-field Gamma-ray Observatory (SWGO). Of particular interest is the customization of tubes at the factory, and a powerful micro-controller-centered active base design.

Attendance type

In-person presentation

Primary authors: ICECUBE COLLABORATION; DUVERNOIS, Michael (University of Wisconsin--Madison); SWGO COLLABORATION

Presenter: DUVERNOIS, Michael (University of Wisconsin-Madison)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **43** Type: **Talk**

Machine Learning Methods for Solar Neutrino Classification

Thursday, August 4, 2022 3:04 PM (22 minutes)

Super-Kamiokande has observed boron-8 solar neutrino recoil electrons at kinetic energies as low as 3.49 MeV to study neutrino flavor conversion within the sun. At SK-observable energies, these conversions are dominated by the Mikheyev–Smirnov–Wolfenstein effect. An upturn in the electron survival probability in which vacuum neutrino oscillations become dominant is predicted to occur at lower energies, but radioactive background increases exponentially with decreasing energy. New machine learning approaches provide substantial background reduction in the 2.49 MeV - 3.49 MeV energy region such that statistical extraction of solar neutrino interactions becomes feasible. An overview of machine learning methods in use for water Cherenkov detectors including convolutional neural networks trained on event display images and boosted decision trees trained on reconstructed variables will be presented followed by solar angle distributions of events selected for this analysis.

Attendance type

In-person presentation

Primary author: YANKELEVICH, Alejandro (University of California, Irvine)

Presenter: YANKELEVICH, Alejandro (University of California, Irvine)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **44** Type: **Talk**

Online machine learning based event selection for COMET Phase-I

Friday, August 5, 2022 5:10 PM (30 minutes)

The COMET experiment aims to search for a muon to electron conversion with a single event sensitivity of 3×10^{-15} in its Phase-I in order to explore new physics beyond the Standard Model. In the experiment, a high multiplicity environment is expected around the detector. Many accidental hits may cause a high fake trigger rate that cannot meet the DAQ capability, less than 13 kHz.
To overcome this issue, we are developing the machine learning algorithms implemented onto Field Programmable Gate Arrays (FPGAs) to efficiently select signal like events within an order of a microsecond. We have developed the hardware electronics to meet the timing requirement and confirmed that the simple machine learning algorithms could be populated inside the commercially available FPGAs. In this presentation, we will report the current status of the development and future prospects.

Attendance type

In-person presentation

Primary author: FUJII, Yuki (Monash University)

Co-authors: Dr YOSHIDA, Hisataka (Osaka University); Dr UENO, Kazuki (Osaka University); PINCH-BECK, Liam (Monash University); Mr MIYATAKI, Masaki (Osaka University); Dr LEE, MyeongJae (Sungkyunkwan University); Dr NAKAZAWA, Yu (High Energy Accelerator Research Organization)

Presenter: FUJII, Yuki (Monash University)

Session Classification: Joint Session

Track Classification: WG6: Detectors

Contribution ID: **45** Type: **Talk**

NuMI Beam Monitoring Simulation and Data Analysis

Thursday, August 4, 2022 2:50 PM (30 minutes)

With the Main Injector Neutrino Oscillation Search (MINOS) experiment decommissioned, muon and hadron monitors became an important diagnostic tool for the NuMI Off-axis ν_e Appearance (NOvA) experiment at Fermilab to monitor the Neutrinos at the Main Injector (NuMI) beam. The goal of this study is to maintain the quality of the monitor signals and to establish correlations with the neutrino beam profile. And with the muon monitor simulation, we carry out a systematic study of the response of the muon monitors to the changes in the parameters of the proton beam and lattice parameters. By combining individual pixel information from muon monitors and pattern recognition algorithms, we use simulation resluts and measurement data to build a machine learning-based predictions of the muon monitor response and neutrino flux.

Attendance type

In-person presentation

Primary authors: WICKREMASINGHE, Don Athula (Fermilab); OSSORIO, Eduardo; YONEHARA, Katsuya (Fermilab); SNOPOK, Pavel (IIT/Fermilab); GANGULY, Sudeshna (Fermilab); YU, Yiding; SZTUC, Artur; Prof. THOMAS, Jennifer; CARROLL, Thomas (University of Wisconsin - Madison)

Presenter: YU, Yiding

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **46** Type: **Talk**

Short-Baseline neutrino oscillation searches with the ICARUS detector

Tuesday, August 2, 2022 5:18 PM (18 minutes)

The ICARUS collaboration employed the 760-ton T600 detector in a successful three-year physics run at the underground LNGS laboratories studying neutrino oscillations with the CNGS neutrino beam from CERN, and searching for atmospheric neutrino interactions. ICARUS performed a sensitive search for LSND-like anomalous νe appearance in the CNGS beam, which contributed to the constraints on the allowed parameters to a narrow region around 1 eV^2, where all the experimental results can be coherently accommodated at 90% C.L. After a significant overhaul at CERN, the T600 detector has been installed at Fermilab. In 2020 cryogenic commissioning began with detector cool down, liquid Argon filling and recirculation. ICARUS has started operations and is presently in its commissioning phase, collecting the first neutrino events from the Booster Neutrino Beam and the NuMI off-axis. The main goal of the first year of ICARUS data taking will then be the definitive verification of the recent claim by NEUTRINO-4 short baseline reactor experiment both in the ν_μ channel with the BNB and in the ν_e with NuMI. After the first year of operations, ICARUS will commence its search for evidence of a sterile neutrino jointly with the SBND near detector, within the Short Baseline Neutrino (SBN) program. The ICARUS exposure to the NuMI beam will also give the possibility for other physics studies such as light dark matter searches and neutrino-Argon cross section measurements. The proposed contribution will address ICARUS achievements, its status and plans for the new run at Fermilab and the ongoing developments of the analysis tools needed to fulfill its physics program.

Attendance type

In-person presentation

Primary authors: MENEGOLLI, Alessandro; BEHERA, Biswaranjan (Colorado State University)

Presenters: MENEGOLLI, Alessandro; BEHERA, Biswaranjan (Colorado State University)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **47** Type: **Talk**

Searching for Muon to Electron with the COMET Experiment

Tuesday, August 2, 2022 6:00 PM (30 minutes)

Muon to electron conversion, an example of charged lepton flavour violation (CLFV), provides a clear experimental probe into new physics beyond the Standard Model. The COMET experiment at J-PARC will use the highest intensity muon beam to search for muon to electron conversion using a staged approach, with sensitivity levels in reach of many new physics models. With a single event sensitivity of 3×10^{-15} in Phase-I and 3×10^{-15} in Phase-II, COMET will provide about x100 and x10000 improvement on current muon to electron conversion bounds respectively. In addition, an initial stage called Phase-α is being prepared to measure extinction protons and provide more precise muon and pion production rates for these upcoming physics runs. Construction of Phase-I is in progress with physics runs expected to start in 2024. This talk will provide an overview of the physics motivations for COMET and the current status of Phase-α, Phase-I and Phase-II development.

Attendance type

In-person presentation

Primary author: DEKKERS, Sam (Monash University)

Presenter: DEKKERS, Sam (Monash University)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **48** Type: **Talk**

MELODY at CSNS-II

Thursday, August 4, 2022 5:10 PM (30 minutes)

MELODY at the China Neutron Spallation Source (CSNS) is the first muon beam that will be built in China for muon science. It will take part at the second phase of CSNS (II) and utilize 20 kW out of 500 kW of the proton beam at CSNS. Since 2021, the various components of the muon beam are under design. In this talk, a brief introduction of the overall design of MELODY at the high energy proton area (HEPEA) will be given, focusing on the primary proton target station and the muon beamlines.

Attendance type

Virtual presentation

Primary authors: VASSILOPOULOS, Nikolaos (IHEP, Beijing); Dr BAO, Yu (IHEP, CSNS)

Co-author: Mr CHEN, Cong (IHEP, CSNS)

Presenters: VASSILOPOULOS, Nikolaos (IHEP, Beijing); Dr BAO, Yu (IHEP, CSNS); Mr CHEN, Cong (IHEP, CSNS)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **49** Type: **Talk**

Detection of high-energy neutrinos at LHC with SND@LHC

Friday, August 5, 2022 2:20 PM (15 minutes)

SND@LHC is a compact and stand-alone experiment to perform measurements with neutrinos produced at the LHC in a hitherto unexplored pseudo-rapidity region of 7.2 < 𝜂 < 8.4, complementary to all the other experiments at the LHC. The experiment is to be located 480 m downstream of IP1 in the unused TI18 tunnel. The detector is composed of a hybrid system based on an 800 kg target mass of tungsten plates, interleaved with emulsion and electronic trackers, followed downstream by a calorimeter and a muon system. The configuration allows efficiently distinguishing between all three neutrino flavours, opening a unique opportunity to probe physics of heavy flavour production at the LHC in the region that is not accessible to ATLAS, CMS and LHCb. This region is of particular interest also for future circular colliders and for predictions of very high-energy atmospheric neutrinos. The detector concept is also well suited to searching for Feebly Interacting Particles via signatures of scattering in the detector target. The first phase aims at operating the detector throughout LHC Run 3 to collect a total of 150 fb−1. A new era of collider neutrino physics is just starting.

Attendance type

In-person presentation

Primary authors: SND@LHC COLL.; GULER, Ali Murat (METU); KOMATSU, Masahiro (CERN)

Presenter: KOMATSU, Masahiro (CERN)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Mass test setup for DUNE SiPMs characterization

Tuesday, August 2, 2022 5:00 PM (15 minutes)

The Deep Underground Neutrino Experiment (DUNE) is an upcoming neutrino physics experiment that will answer some of the most compelling questions in particle physics and cosmology. The DUNE Far Detector (FD) exploits silicon photomultipliers (SiPMs) to detect scintillation photons produced by the interaction of charged particles in the liquid Argon time projection chamber (LArTPC).
The SiPMs are photosensors consisting of a matrix of single-photon avalanche diodes (SPAD) operating in the Geiger-Mueller region. Their high sensitivity and dynamic range, as well as the possibility to fill large surfaces with high-granularity sensors, makes them an ideal choice for the DUNE FD photodetection system.
An international consortium of research groups is currently engaged in systematic quality assurance tests of all the sensors that will be installed in the FD to control their specifications. A custom set-up, CACTUS (Cryogenic Apparatus for Continuous Tests Upon SiPMs), has been developed at Ferrara and Bologna Universities-INFN sites to perform automatically the tests for a large number of sensors in parallel. This system can characterize up to 120 SiPM simultaneously both testing their mechanical and thermal resistance, and measuring the complete current-voltage curve for each sensor at room and cryogenic temperatures. These data allow to extrapolate the quenching resistor (R_q) and the breakdown voltage (V_bd), the key operating parameters of the SiPMs.
Furthermore, the CACTUS test facility allows to perform dark noise characterization through a custom-made fixed threshold
amplifier-discriminator system.

Attendance type

In-person presentation

Primary author: GUARISE, Marco (INFN Ferrara)

Presenter: GUARISE, Marco (INFN Ferrara)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **51** Type: **Talk**

Exploring new physics effects of scalar NSI at Long Baseline Experiments

Thursday, August 4, 2022 4:10 PM (22 minutes)

The discovery of the phenomena of neutrino oscillations have opened a new window to probe physics beyond Standard Model (SM). In this precision era of neutrino physics, experiments around the world are trying to measure the oscillations parameters with ever increasing accuracy. This makes the ongoing and proposed neutrino experiments sensitive to the subdominant effects of neutrinos like Non Standard Interactions (NSIs).The NSIs [1,2] often comes in various extensions of SM and can significantly impact the sensitivities of different neutrino experiments. In this work we have explored a new type of NSI which is mediated by a scalar termed as scalar NSI [3,4]. The effect of this kind of coupling appears as a medium dependent perturbation to the neutrino mass term, which makes it interesting to probe. Also the effect of scalar NSI scales linearly with matter density and hence it makes LBL experiments one of the suitable candidate to study its effects.

In this study, we have explored the effects of scalar NSI on the sensitivities of various Long Baseline experiments viz. DUNE [5], T2HK [6] and T2HKK [7]. We found that, the presence of scalar NSI poses various degeneracy is measurement of the δ CP phase apart from having significant impact on the oscillation probabilities. We have also performed a sensitivity analysis of these experiments towards finding these scalar NSI elements. Finally we have checked the effect of scalar NSI on the CPV sensitivity at these experiments.

Attendance type

Virtual presentation

Primary author: Mr MEDHI, Abinash (Tezpur University, Assam, India)

Co-authors: Dr DUTTA, Debajyoti (Assam Don Bosco University, Assam, INDIA); Dr DEVI, Moon Moon (Tezpur University, Assam, INDIA)

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

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **52** Type: **Talk**

Investigation of the MicroBooNE inclusive neutrino cross sections on Argon

Thursday, August 4, 2022 2:40 PM (20 minutes)

MicroBooNE data of charged current inclusive neutrino cross sections on argon as a function of different kinematical variables have recently appeared. We compare these data to our theoretical calculations after a brief review of our RPA model and of its successful predictions for the MiniBooNE and T2K cross sections on carbon. Overall we find an agreement with MicroBooNE data in spite of a tendency of underestimation in some specific regions. We also quantitatively compare our model to the ones employed in the MicroBooNE analyses. A new aspect is the availability of the data in terms of the energy transfer to the nucleus, which allows a better separation of the different reaction mechanisms. We focus especially on the results in terms of this transferred energy, for which our model is particularly efficient. We finally discuss the semi-inclusive CC0π1p and CC0πNp MicroBooNE results and the compatibility of our multinucleon emission channel with these data.

Attendance type

Virtual presentation

Primary author: MARTINI, Marco (Ghent University)

Co-authors: Prof. ERICSON, Magda (IP2I Lyon and CERN); Prof. CHANFRAY, Guy (IP2I Lyon)

Presenter: MARTINI, Marco (Ghent University)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **53** Type: **Talk**

Time generation and clock distribution for Hyper-Kamiokande

Tuesday, August 2, 2022 3:40 PM (20 minutes)

The construction of the next-generation far detector Hyper-Kamiokande (HK) has started. It will have ten times larger fiducial volume and increased detection performances. The data taking is planned for 2027. Time stability is crucial, as detecting physics events relies on reconstructing Cherenkov rings based on the coincidence between the photomultipliers. The above requires a timebase jitter smaller than 100 ps. In addition, since this detector will be used to detect neutrinos produced by the J-PARC accelerator in Tokai, each event needs to be timed with a precision of less than 100 ns with respect to UTC in order to be associated with a proton spill from J-PARC.
The HK collaboration is in an R&D phase and several groups are working in parallel, exploring various solutions for the electronics system. This talk will present the studies related to a novel design for the time synchronization system. We will discuss the clock generation, including the connection scheme between the GNSS receiver (Septentrio) and the atomic clock (free-running Rubidium), the precise calibration of atomic clock and algorithms to correct errors on satellites orbits, the redundancy of the system ; and a two-stage distribution system that sends the clock encoded in the data stream, using a custom protocol.

Attendance type

In-person presentation

Primary author: MELLET, Lucile (LPNHE, Paris, FRANCE)

Presenter: MELLET, Lucile (LPNHE, Paris, FRANCE)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **54** Type: **Talk**

Characterisation of the ERAM detectors for the High Angle TPC of the T2K ND upgrade

Friday, August 5, 2022 11:35 AM (20 minutes)

The High-Angle Time Projection Chambers (HA-TPCs) are a new set of detectors that will equip the off-axis near detector (ND280) of the T2K long-baseline neutrino oscillation experiment. These detectors will be installed below and above a new Super Fine-Grained Scintillator detector (FGD) in 2023 as part of the upgrade of ND280.

The HATPCs operate at atmospheric pressure with the "T2K gas" mixture contained in a Field Cage with a central cathode splitting the active volume (2.0×1.8×0.8 m3) into two halves (1m long in drift direction).
The thin wall (3cm) Field Cages are built by exploiting composite material techniques with lightweight and low-Z materials.

The readout is done with Resistive Micromegas readout modules (ERAM) that utilizes a resistive foil covering the reading pads, acting as a 2D RC network and allowing a better determination of the deposited charges position. A prototype of the Field Cage instrumented with one ERAM detector has been recently exposed at the DESY electron beam and spatial resolution better than 0.6 mm and dE/dx resolution In order to ensure that the HA-TPCs satisfy the required performances for the ND280 Upgrade (space point resolution better than 600 μm and dE/dx resolution smaller than 10%), the ERAM detectors have been characterized with X-rays sources and by exposing them to the DESY electron beam.
In addition, we have developed a detailed a simulation of the charge spreading phenomenon and of the electronic response, along with new reconstruction methods that exploit both charge and time information from the main and neighboring pads. In this talk we will present the physics associated with such novel technology, the status of simulation and reconstruction efforts, and the performances observed with the DESY Test beam.

Attendance type

Virtual presentation

Primary author: FELTRE, Matteo (University of Padua)

Presenters: FELTRE, Matteo (University of Padua); GIGANTI, Claudio (LPNHE Paris)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **55** Type: **Talk**

Machine learning applications to maintain the NuMI neutrino beam quality at Fermilab

Thursday, August 4, 2022 12:20 PM (30 minutes)

The NuMI target facility at Fermilab produces an intense muon neutrino beam for NOvA (NuMI Off-axis ν_e Appearance) long baseline neutrino experiment. Three arrays of muon monitors located in the downstream of the hadron absorber in the NuMI beamline provide the measurements of the primary beam and horn current quality. We have studied the response of muon monitors with the proton beam profile changes and focusing horn current variations. The responses of muon monitors are used to develop Machine Learning (ML) algorithms. We present the progress of the ML applications and the future plans. This effort is important for many future applications such as beam quality assurance, anomaly detections, neutrino beam systematics studies and neutrino beam quality assurance. Our results demonstrate the advantages of developing useful ML applications that can be leveraged for future beamlines such as LBNF.

Attendance type

Virtual presentation

Primary authors: WICKREMASINGHE, Don Athula (Fermilab); SNOPOK, Pavel (IIT/Fermilab); YU, Yiding; OSSORIO, Eduardo; YONEHARA, Katsuya (Fermilab); GANGULY, Sudeshna (Fermilab)

Presenter: WICKREMASINGHE, Don Athula (Fermilab)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **56** Type: **Talk**

A Demonstrator For Muon Ionisation Cooling

Friday, August 5, 2022 11:40 AM (25 minutes)

The muon collider is an excellent prospect as a multi-TeV lepton collider, with the possibility for high luminosity and reach to 10 TeV or more. In order to realise such luminosity, high beam brightness is required. Ionisation cooling, which was demonstrated recently by the Muon Ionization Cooling Experiment (MICE), is the technique proposed to realise sufficient brightness. MICE demonstrated transverse emittance reduction of incident beams having relatively high emittance and without beam reacceleration. The international Muon Collider Collaboration proposes a Demonstrator for Muon Cooling that will demonstrate six-dimensional emittance reduction over a number of cooling cells, operating at beam emittance close to the ultimate goal for the muon collider. Together with a full R&D programme this will pave the way for construction of a muon collider. In this paper, initial considerations and possible implementations for the demonstrator are discussed.

Attendance type

Virtual presentation

Primary author: ROGERS, Chris (Rutherford Lab)

Presenter: ROGERS, Chris (Rutherford Lab)

Session Classification: Joint Session

Track Classification: WG3: Accelerator Physics

Contribution ID: **57** Type: **Talk**

Characterisation of Cooling in the Muon Ionisation Cooling Experiment

Thursday, August 4, 2022 11:20 AM (30 minutes)

A high-energy muon collider could be the most powerful and cost-effective collider approach in the multi-TeV regime, and a neutrino source based on decay of an intense muon beam would be ideal for measurement of neutrino oscillation parameters. Muon beams may be created through the decay of pions produced in the interaction of a proton beam with a target. The muons are subsequently accelerated and injected into a storage ring where they decay producing a beam of neutrinos, or collide with counter-rotating antimuons. Cooling of the muon beam would enable more muons to be accelerated resulting in a more intense neutrino source and higher collider luminosity. Ionization cooling is the novel technique by which it is proposed to cool the beam. The Muon Ionization Cooling Experiment collaboration has constructed a section of an ionization cooling cell and used it to provide the first demonstration of ionization cooling. Here the observation of ionization cooling is described. The results of the further analysis of the data is presented, including studies in different magnet configurations and with more detailed understanding of the detector systematic uncertainty.

Attendance type

Virtual presentation

Primary author: ROGERS, Chris (Rutherford Lab)

Presenter: ROGERS, Chris (Rutherford Lab)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **58** Type: **Talk**

PMNS and the number of additional neutrino flavors

Tuesday, August 2, 2022 3:30 PM (30 minutes)

In accordance with the WG subject, we are concerned with the fundamental question of the number of neutrino species existing in nature. We report on a theoretical description of the mixing space based on singular values, contractions, and dilation procedures. With a bird's eye perspective, it provides an independent way of doing neutrino mixing analysis allowing for quantitative searches of extra neutrino states, establishing alternative limits on the "active-sterile" mixing, defining disjoint physical regions of the mixings among scenarios with a different number of sterile neutrinos. We give the pros and cons of the method. Concerning applications to phenomenological studies, going beyond PMNS, we try to understand the emergence of complete models with masses and mixings of heavy neutrino states and potential implications for collider and cosmological studies.

Attendance type

In-person presentation

Primary author: GLUZA, Janusz (U. Silesia)

Co-authors: FLIEGER, Wojciech (MPI Munich); KARMAKAR, Biswajit (U. of Silesia)

Presenter: GLUZA, Janusz (U. Silesia)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **59** Type: **Talk**

Calibrating for Precision Physics in LArTPCs at ICARUS

Friday, August 5, 2022 3:32 PM (18 minutes)

The Short-Baseline Neutrino (SBN) Program at Fermilab consists of multiple Liquid Argon Time Projection Chamber (LArTPC) detectors in a single neutrino beam. SBN will have a broad physics program that includes GeV-scale neutrino cross section measurements and Beyond Standard Model physics searches including a search for short-baseline neutrino oscillations. Especially for the oscillation program at SBN (and, looking ahead, at DUNE) it is imperative to have accurate and precise energy measurements that can be related to the true neutrino energy. In addition to GeV-scale accelerator neutrino physics, MeV-scale physics is also possible at SBN and DUNE such as in searches for millicharged particles, solar and supernova neutrino detection, and a proposed modification of DUNE to enable a search for neutrinoless double beta decay. These measurements will require further leveraging of the calorimetric information from ionization charge beyond the traditional needs of GeV-scale physics. In this talk, I will review the limits on calorimetric energy precision in a LArTPC. I will also discuss a path for calibrations to improve the accuracy of track-like energy measurements in a LArTPC to the sub-percent level. Two innovations are important here. First, diffusion plays a role in determining the energy scale in LArTPC calibration in a way unappreciated by previous experiments. Second, calibrating from digitized charge to energy directly instead of through a determination of the electronics gain can eliminate the otherwise irreducible systematic uncertainty from existing recombination measurements. We are implementing these techniques now at ICARUS, the far detector in SBN, which has already begun data collection. Looking forward, improved measurements of LAr properties are needed to unlock the best possible energy reconstruction at SBN and DUNE.

Attendance type

In-person presentation

Primary author: PUTNAM, Gray

Presenter: PUTNAM, Gray

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **60** Type: **Talk**

The Accelerator Neutrino Neutron Interaction Experiment

Friday, August 5, 2022 3:05 PM (15 minutes)

The Accelerator Neutrino Neutron Interaction Experiment (ANNIE) is a 26-ton Gadolinium-loaded water Cherenkov detector located at the Booster Neutrino Beamline at Fermilab. One of the primary physics goals is to measure the number of final-state neutrons from neutrino-nucleus interactions in water. This measurement will improve our understanding of these complex interactions and help reduce the associated systematic uncertainties, thus benefiting the next generation of long-baseline neutrino experiments. ANNIE will achieve its physics goals by using recently developed photodetectors, the Large Area Picosecond Photodetectors (LAPPDs), with better than 100 picosecond time resolution. This talk will present the status of the experiment, the deployment of LAPPDs, the event reconstruction techniques, and the analysis result of the most recent neutrino beam data. ANNIE's Future R&D opportunities demonstrating the use of Water-based Liquid Scintillators as a new neutrino detection medium will also be discussed.

Attendance type

In-person presentation

Presenter: WANG, Jingbo

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Probing BSM models at future high-precision long baseline experiments

Friday, August 5, 2022 11:55 AM (25 minutes)

Neutrino oscillations are a very well established phenomenon and in the last two decades we have been able to determine almost all the oscillation parameters with few percents precision.
However, there is still room for the possibility of the presence of new physics effects. In this context, long-baseline (LBL) accelerator experiments provide a great environment to probe BSM (Beyond Standard Model) models. These experiments can look at different oscillation channels at both short (near detectors) and long (far detectors) distances, working with well controlled focused neutrino beams. Two of the most promising future LBL experiments are DUNE in the USA and T2HK in Japan, which may be part of a bigger experiment (T2HKK) with a second detector in Korea. We studied the performances of these experiments in constraining different models.
For instance, we took into account the possible Non-Unitarity of the neutrino mixing matrix, searching for the best constraints on new physics parameters that DUNE and T2HKK could be able to set. Moreover, we considered how much the presence of non-standard phases may influence the δ_{CP} determination.
We also explored the capabilities of DUNE in searching for hints of the existence of Non-Standard-Interactions (NSI) in different benchmark scenarios. Regarding this, we studied the effects of vector and scalar NSI on neutrino oscillations, showing how DUNE will be able to differentiate the models.

Attendance type

In-person presentation

Primary author: GIARNETTI, Alessio (Roma Tre University & INFN)

Presenter: GIARNETTI, Alessio (Roma Tre University & INFN)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Neutrino Mass Ordering with IceCube DeepCore

Friday, August 5, 2022 11:37 AM (22 minutes)

The neutrino mass ordering (NMO) is one of the last unmeasured fundamental parameters in the neutrino sector of the Standard Model of Particle Physics. NMO studies aim to answer the question of whether the neutrino mass ordering is normal (m3>m2>m1) or inverted (m2>m1>m3). IceCube is an ice-Cherenkov neutrino detector deployed greater than 1.5 kilometers below the surface of the South Pole. Using the DeepCore subarray, the densely-instrumented region of IceCube, we conduct a study of the NMO using neutrino oscillations from atmospheric neutrinos. Matter effects distort the oscillation probabilities for neutrinos (normal ordering) and anti-neutrinos (inverted ordering) traversing the Earth's core with energies below about 15 GeV. Differences in the atmospheric flux and cross-section yield a higher rate of neutrinos than anti-neutrinos in DeepCore, resulting in differences between the normal and inverted orderings in the combined neutrino/anti-neutrino signal. In this talk, we show a study of the NMO sensitivity using nine years of IceCube DeepCore data where a new event selection, reconstruction method, particle identification, and systematic uncertainty modeling are used. The aim is to both provide a higher-energy complementary NMO study to those being conducted by long-baseline neutrino experiments as well as to serve as a preamble for an NMO study using the upcoming IceCube Upgrade, which should significantly improve IceCube's NMO sensitivity.

Attendance type

In-person presentation

Primary author: PRADO RODRIGUEZ, Maria (University of Wisconsin-Madison)

Presenter: PRADO RODRIGUEZ, Maria (University of Wisconsin-Madison)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

3D segmented scintillator neutrino detector SuperFGD for T2K experiment

Friday, August 5, 2022 11:15 AM (20 minutes)

The T2K neutrino experiment in Japan obtained a first indication of CP violation in neutrino oscillations. To obtain better sensitivity, T2K will accumulate more statistics with a higher intensity beam and an upgraded of-axis near detector (ND280). It will allow us to reduce systematic uncertainties in oscillation measurements. The upgraded detector will have the full polar angle coverage for muons produced in neutrino charged current interactions, a low threshold for proton detection and will be able to measure neutrons using time-of-flight due to a good timing performance. Thanks to these new capabilities, the upgrade of ND280 will measure the energy spectra of muon neutrinos and antineutrinos with an unprecedented level of accuracy, and the near-to-far detector extrapolation of systematics constrains will be much less model dependent and therefore more reliable.
A novel 3D highly granular scintillator detector called SuperFGD of a mass of about 2 tons was adopted as an upgraded ND280 fully-active neutrino target and a 4\pi detector of charged particles from neutrino interactions. It will consist of about two millions of small optically-isolated plastic scintillator cubes with a 1 cm side. Each cube is read out in the three orthogonal directions with wave-length shifting fibers coupled to compact photosensors, micro pixel photon counters (MPPCs). Several SuperFGD prototypes tested in beams with charged particles and neutrons demonstrated good performance. It is planned that SuperFGD installed into the ND280 magnet will be ready to accept the beam in the beginning of 2023. In this talk, the main detector parameters, performance of SuperFGD prototypes in beam tests, current status and plans will be reported.

Attendance type

In-person presentation

Primary authors: MAUGER, Christopher (University of Pennsylvania); Prof. KUDENKO, Yury (Institute for Nuclear Research, Moscow)

Presenter: MAUGER, Christopher (University of Pennsylvania)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **67** Type: **Talk**

Probing Light Mediators in the Radiative Emission of Neutrino Pair

Thursday, August 4, 2022 12:20 PM (30 minutes)

We propose a new possibility of using the coherently enhanced neutrino pair emission to probe light-mediator interactions between electron and neutrinos. With typical momentum transfer at the atomic $\mathcal{O}(1\,\text{eV})$ scale, this process is extremely sensitive for the mediator mass range $\mathcal{O}(10^{-3} \sim 10^{4})\,\text{eV}$. The sensitivity on the product of couplings with electron (g^e or y^e) and neutrinos (g^ν or y^ν) can touch down to $|y^e y^\nu| < 10^{-9} \sim 10^{-19}$ for a scalar mediator and $|g^e g^\nu| < 10^{-15} \sim 10^{-26}$ for a vector one, with orders of improvement from the existing constraints.

Attendance type

In-person presentation

Primary authors: PASQUINI, Pedro Simoni (Unicamp); GE, Shao-Feng (Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Presenter: PASQUINI, Pedro Simoni (Unicamp)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Electron-Nucleus Scattering Constraints For Neutrino Interactions And Oscillations

Tuesday, August 2, 2022 5:40 PM (20 minutes)

The ability of current and next generation accelerator-based neutrino-oscillation measurements to reach their desired sensitivity requires a detailed understanding of neutrino-nucleus interactions. These include precise knowledge of the relevant cross sections and of our ability to reconstruct the incident neutrino energy from the measured final state particles. Incomplete understanding of these interactions can skew the reconstructed neutrino spectrum and therefore bias the extraction of fundamental oscillation parameters. In this talk, I will present new wide phase-space electron-nucleus scattering data, collected using the decommissioned CLAS6 spectrometer at the Thomas Jefferson National Accelerator Facility (JLab), where we studied how well we can reconstruct the incident lepton energy from the measured final state particles. Disagreements with the commonly used GENIE event generator are observed, indicating a potential bias for future oscillation analyses and pointing the way for improving these event generators.

Attendance type

In-person presentation

Primary author: PAPADOPOULOU, Afroditi

Presenter: PAPADOPOULOU, Afroditi

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Total neutron cross section measurement on CH with a novel 3D-projection scintillator detector

Thursday, August 4, 2022 12:32 PM (18 minutes)

Long-baseline neutrino oscillation experiments rely on detailed models of neutrino interactions on nuclei. These models constitute an important source of systematic uncertainty, partially because detectors to date have been blind to final state neutrons. Three-dimensional projection scintillator trackers comprise components of the near detector of the next generation long-baseline neutrino experiments. Due to the good timing resolution and fine granularity, this technology is capable of measuring neutrons in neutrino interactions on an event-by-event basis and will provide valuable data for refining neutrino interaction models and ways to reconstruct neutrino energy. Two prototypes have been exposed to the neutron beamline at Los Alamos National Laboratory (LANL) in both 2019 and 2020 with neutron energies between 0 and 800 MeV. In order to demonstrate the capability of neutron detection, the total neutron-scintillator cross section is measured with one of the prototypes and compared to external measurements. The total neutron cross section in scintillator between 98 and 688 MeV was measured and will be presented in this talk.

Attendance type

In-person presentation

Primary author: RICCIO, Ciro (Stony Brook University (US))

Presenter: RICCIO, Ciro (Stony Brook University (US))

Session Classification: Joint Session

Track Classification: WG6: Detectors

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

Pion-argon inclusive cross-section measurement on ProtoDUNE-SP

Friday, August 5, 2022 11:55 AM (20 minutes)

Hadron cross-section measurement is crucial to understand the final-state interactions which accounts for a large source of systematic uncertainty in neutrino oscillation experiments. ProtoDUNE-SP with its charged particle beam data can provide such experimental constraints. This work shows the pion-argon inclusive cross-section measurement using ProtoDUNE-SP Run 1 1 GeV/c beam data. We further develop the slicing method proposed by the LArIAT collaboration and apply it to large scale LArTPC like ProtoDUNE-SP. The cross-sections of pion kinetic energy ranging from 350 MeV to 950 MeV are measured.

Attendance type

In-person presentation

Primary authors: YANG, Tingjun (Fermilab); LIU, Yinrui

Presenter: LIU, Yinrui

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Panoptic Segmentation for Particle Identification in ProtoDUNE-SP

Thursday, August 4, 2022 3:26 PM (22 minutes)

The ProtoDUNE-SP Liquid Argon Time Projection Chamber is the prototype for the first far detector module of the Deep Underground Neutrino Experiment (DUNE). Convolutional Neural Networks have been developed and employed in the analysis of scientific data from ProtoDUNE, which exploits the high-resolution images and the fine details that the detector can capture. Despite these advantages, the classification of the different types of particles and interactions is still a challenge. With this motivation. In this talk, I will present the details and the application of a multi-task reconstruction algorithm using Sparse Convolutional Neural Networks for the task of panoptic segmentation, which simultaneously generates a voxel-by-voxel particle ID and clusters voxels into objects.

Attendance type

In-person presentation

Primary authors: SARASTY, Carlos (University of Cincinnati); YANG, Tingjun (Fermilab)

Presenter: SARASTY, Carlos (University of Cincinnati)

Session Classification: Joint Session

Track Classification: WG2: Neutrino Scattering Physics

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

Photon Detection System (PDS) for DUNE low energy physics study and the demonstration of a few nanosecond timing resolution using ProtoDUNE-SP PDS

Thursday, August 4, 2022 4:30 PM (20 minutes)

Photon detection systems (PDS) are an integral part of liquid-argon neutrino detectors. Besides providing the timing information for an event, which is necessary for reconstructing the drift coordinate of ionizing particle tracks, photon detectors can be effectively used for other purposes including triggering events, background rejection, and calorimetric energy estimation. PDS in particular for the DUNE Far Detector Module 2 is designed to achieve a more extended optical coverage (—> ~4π) with new generation large size PD modules based on the ARAPUCA technology. This will provide enhanced opportunities for the study of low energy neutrino physics using PDS. The ARAPUCA technology was extensively tested within the ProtoDUNE-SP detector operated at the CERN neutrino platform. Here I present a study of the timing resolution of ARAPUCA detectors using light emitted from a sample of energetic cosmic ray muons traveling parallel to the PDS. An intrinsic timing resolution of the order of 3 ns is observed for the ARAPUCA detectors. An excellent timing resolution capability of PDS can be exploited for further enhancing physics study in the DUNE far detectors.

Attendance type

In-person presentation

Primary authors: PAUDEL, Ajib (Fermi National Accelerator Laboratory); YANG, Tingjun (Fermilab)

Presenter: PAUDEL, Ajib (Fermi National Accelerator Laboratory)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

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

Yields and Energy Spectra of Heavy Charged Particles After Nuclear Muon Capture with the AlCap Experiment

Tuesday, August 2, 2022 5:00 PM (30 minutes)

The AlCap experiment recently published its first results on the yields and energy spectra of heavy particles emitted after the nuclear muon capture process. These detailed measurements quantify an important hit background to the Mu2e and COMET experiments, which will search for charged lepton flavor violation. These results greatly expand the literature in this area with first measurements on Ti and of tritons, as well as improve the precision in the energy range relevant to the upcoming muon-to-electron conversion experiments. In this talk, I will describe the experiment and present the results.

Attendance type

Virtual presentation

Primary author: EDMONDS, Andrew (Boston University)

Presenter: EDMONDS, Andrew (Boston University)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

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

Forward Neutrinos from Charm at the LHC and Prompt Neutrinos at IceCube

Thursday, August 4, 2022 11:50 AM (30 minutes)

The Forward Physics Facility (FPF) at the LHC will detect neutrinos produced in proton collisions. In addition to neutrinos from pion and kaon decays, there will be significant contribution, particularly for ν_e and ν_τ flavors, from decay of charmed mesons. We present our predictions for the neutrino flux from charm decays as evaluated in different QCD approaches: the next-to-leading order collinear factorization (NLO), and the k_T-factorization approach. We use QCD parameters, such as the scales, the choice of parton distribution functions, and the fragmentation function, which were determined from fitting the LHCb data for D-meson production. We also calculate the neutrino energy distribution, for neutrinos of all flavors, that are produced from charmed meson decays. We show that FPF will be able to provide valuable information about the QCD, by measuring neutrino flux. We also present our results for the prompt neutrinos, which are decay products of charmed mesons produced in interactions of cosmic rays with the atmosphere, of relevance to IceCube.

Attendance type

In-person presentation

Primary author: Prof. SARCEVIC, Ina (University of Arizona)

Presenter: Prof. SARCEVIC, Ina (University of Arizona)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

The search for $0\nu\beta\beta$ with the NEXT time projection chamber

Friday, August 5, 2022 12:15 PM (20 minutes)

The Neutrino Experiment with a Xenon TPC (NEXT) is an international collaboration searching for the ultra-rare neutrinoless double beta decay process with the xenon-136 isotope. The experimental programme in NEXT consists of a series of high-pressure gaseous xenon time projection chambers with the most recent experiment (NEXT-White) running from 2016 - 2021 consisting of 5 kg of xenon and subsequently, NEXT-100, under commissioning in 2022 and scaling up to 100 kg of xenon. Crucial to the success of the NEXT programme is achieving excellent energy resolution FWHM and reducing backgrounds to negligible levels at the decay energy. This talk will cover the key aspects of the NEXT detectors which enable such goals, the status of the NEXT-100 project, and the extensive R&D efforts being carried out to tag the daughter barium ions from the decay to enable a near background-free neutrinoless double beta decay search.

Attendance type

In-person presentation

Primary author: MISTRY, Krishan (The University of Texas at Arlington)

Presenter: MISTRY, Krishan (The University of Texas at Arlington)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **77** Type: **Talk**

Investigating the Development of STEM-Positive Identities of Refugee Teens in a Physics Out-of-School Time Experience (INSPIRE)

Friday, August 5, 2022 11:35 AM (20 minutes)

Authors: T.Nyawelo, S.Braden, J.N.Matthews & J.Gerton

Refugee youth resettled in the United States experience two main barriers to long-term participation in STEM fields: (a) access to STEM skills and knowledge which is impacted by translocation and interrupted schooling, and (b) access to crafting positive learner identities in STEM as multilingual, multicultural, and multiracial youth. This presentation shares a model for engaging refugee teens in Cosmic Ray research through an NSF-funded project titled: Investigating the Development of STEM-Positive Identities of Refugee Teens in a Physics Out-of-School Time Experience (INSPIRE). The INSPIRE program is designed to address such barriers by offering students participation in three inter-related activities: (1) constructing scintillator cosmic ray detectors then learning how to collect and analyze data using those detectors; (2) creating digital stories (short video documentaries) to document their experience in the cosmic ray research; and (3) family and community science events where students share what they are learning with their families, and eventually, science teachers, researchers, and broader members of the scientific community.

Attendance type

In-person presentation

Primary author: NYAWELO, Tino (University of Utah)

Presenter: NYAWELO, Tino (University of Utah)

Session Classification: WG7: IDEEO

Track Classification: WG7: IDEEO

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

Measurement of Atmospheric Muon Neutrino Disappearance using CNN Reconstructions with IceCube

Thursday, August 4, 2022 2:42 PM (22 minutes)

The IceCube Neutrino Observatory is a Cherenkov detector deployed over a cubic kilometer deep within the South Pole ice. The DeepCore subdetector is built in the lower center of the array and more densely configured, improving the reconstruction performance of neutrinos at the GeV-scale, where atmospheric neutrino oscillations can be studied. Convolutional neural networks (CNN) are used to reconstruct neutrino interactions in and near the DeepCore detector, which achieve comparable direction and energy resolution to current Likelihood-based methods but with 3 orders of magnitude faster execution speeds. In this talk, I will present an ongoing study of atmospheric muon neutrino disappearance, which is established on the new reconstructions using CNNs, and compare it to the recent IceCube results.

Attendance type

In-person presentation

Primary author: YU, Shiqi (IIT/ANL)

Co-author: Ms MICALLEF, Jessie (MSU)

Presenter: YU, Shiqi (IIT/ANL)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

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

Oscillation and decay of neutrinos in matter: an analytic treatment

Thursday, August 4, 2022 4:32 PM (22 minutes)

We present compact analytic expressions for neutrino propagation probabilities in matter, with invisible neutrino decay effects included. These will be directly relevant for long-baseline and reactor experiments.

The inclusion of decay leads to a non-Hermitian effective Hamiltonian, with the Hermitian component corresponding to oscillation, and the anti-Hermitian component representing the invisible decay effects. Due to a possible mismatch between the effective mass eigenstates and the decay eigenstates of neutrinos, these two components need not commute. Even for the special case where the decay and mass eigenstates in vacuum are the same, in the presence of matter, the two components will invariably become non-commuting. We overcome this by employing the techniques of inverse Baker-Campbell-Hausdorff (BCH) expansion, and the Cayley-Hamilton theorem applied in the 3-flavor framework. We also point out the conditions under which the One Mass Scale Dominance (OMSD) would be a good approximation.

The analytic results obtained provide physical understanding into possible effects of neutrino decay as it propagates through Earth matter. We show that certain non-intuitive feature like decay increasing the value of $P_{\mu\mu}$ at its first and second dip may be explained using our analytic approximations.

Attendance type

Virtual presentation

Primary authors: Mr CHATTOPADHYAY, Dibya S. (Tata Institute of Fundamental Research, Mumbai); Dr CHAKRABORTY, Kaustav (Shanghai Jiao Tong University, Shanghai); Prof. DIGHE, Amol (Tata Institute of Fundamental Research, Mumbai); Prof. GOSWAMI, Srubabati (Physical Research Laboratory, Ahmedabad); Dr S MOHAN, Lakshmi (National Centre for Nuclear Research (NCBJ))

Presenter: Mr CHATTOPADHYAY, Dibya S. (Tata Institute of Fundamental Research, Mumbai)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **80** Type: **Talk**

Oscillation Physics Potential of JUNO

Friday, August 5, 2022 4:10 PM (22 minutes)

The Jiangmen Underground Neutrino Observatory is a 20 kton multi-purpose liquid scintillator detector located at a 700-m underground laboratory in South China (Jiangmen city, Guangdong province). The exceptional energy resolution and the massive volume of the JUNO detector offer great opportunities for addressing many essential topics in neutrino and astroparticle physics. JUNO's primary goals are to determine the neutrino mass ordering and precisely measure the related neutrino oscillation parameters. With reactor neutrino data, JUNO can determine the neutrino mass ordering with great significance and measure the neutrino oscillation parameters $\sin^2\theta_{12}$, Δm^2_{21}, and $\Delta m^2_{31}/\Delta m^2_{32}$ to the sub-percent precision level. In addition, the atmospheric and solar neutrino measurements at JUNO can also provide important information for oscillation physics. This talk will focus on the oscillation physics potential of JUNO, including the sensitivity analysis and results based on the recent understanding of the detector.

Attendance type

Virtual presentation

Primary author: ZHANG, Jinnan

Presenter: ZHANG, Jinnan

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

Machine Learning Techniques to Enhance Event Reconstruction in Water Cherenkov Detectors

Thursday, August 4, 2022 2:20 PM (22 minutes)

Hyper-Kamiokande (Hyper-K) is the next generation water-Cherenkov neutrino experiment, building on the success of its predecessor Super-Kamiokande. To match the increased precision and reduced statistical errors of the new detectors, improvements to event reconstruction and event selection are required to suppress backgrounds and minimise systematic errors. Machine learning has the potential to provide these enhancements, enabling the precision measurements that Hyper-K is aiming to perform. This talk provides an overview of the areas where machine learning is being explored for Hyper-K's water Cherenkov detectors. Results using various network architectures are presented, along with comparisons to traditional methods and discussion of the challenges and future plans for applying machine learning techniques.

Attendance type

In-person presentation

Primary author: PROUSE, Nick (TRIUMF)

Presenter: PROUSE, Nick (TRIUMF)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

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

Searching for Charged Lepton Flavour Violation with the Mu3e Experiment

Tuesday, August 2, 2022 3:30 PM (30 minutes)

Being an accidental symmetry in the Standard Model (SM), the conservation of lepton flavour is violated in many extensions of the SM. There is a global effort to search for lepton flavour violation (LFV) at high intensity muon sources to which the upcoming Mu3e experiment at the Paul Scherrer Institute (PSI) will contribute.

The Mu3e Collaboration aims to perform a background-free search for the LFV decay $\mu^+ \rightarrow e^+e^-e^+$ with an unprecedented sensitivity in the order of 10^{-15} in the first phase of operation, and 10^{-16} in the final phase - an improvement over the preceding SINDRUM experiment by four orders of magnitude. The innovative experimental concept is based on a tracking detector built from novel ultra-thin silicon pixel sensors and scintillating fibres and tiles. The momentum resolution is further improved by a dedicated track reconstruction for low-momentum electrons. The full detector information is read out continuously. The data rate is reduced by realtime online event reconstruction and filtering on a GPU-based filter farm. The experiment is operated with a continuous muon beam in the order of $10^8\mu^+/s$ in phase I at an existing beamline at PSI, and in excess of $10^9\mu^+/s$ in phase II at the future High Intensity Muon Beam facility.

The experimental concept including recent developments in the construction of the phase I experiment as well as physics opportunities will be presented.

Attendance type

In-person presentation

Primary author: PERREVOORT, Ann-Kathrin (KIT - Institute of Experimental Particle Physics)

Presenter: PERREVOORT, Ann-Kathrin (KIT - Institute of Experimental Particle Physics)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

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

Towards neutrinoless double beta decay in NEXT

Friday, August 5, 2022 2:20 PM (30 minutes)

NEXT (Neutrino Experiment with a Xenon TPC) is an international collaboration with the objective of searching for neutrinoless double beta decay in xenon. After an initial R&D phase in which the TPC technology was developed, it was able to successfully run a small (5 kg of xenon) detector, NEXT-White (2016-2021). The detector was hosted at Laboratorio Subterráneo de Canfranc, an underground facility in the Spanish Pyrenees in the border between Spain and France. During this period it demonstrated the essential features of a neutrinoless double beta experiment, to be discussed in this talk: excellent energy resolution, active background discrimination through the combination of both energy and tracking capabilities, and a reliable measurement of the double beta two neutrino mode half-life of Xe-136.

The current phase consists of the construction (ongoing) and operation of a larger (100 kg of x

Attendance type

In-person presentation

Primary author: DÍAZ, Gonzalo (University of Santiago de Compostela)

Presenter: DÍAZ, Gonzalo (University of Santiago de Compostela)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Final state interactions in semi-inclusive neutrino-nucleus scattering: Application to T2K and MINERvA experiments

Thursday, August 4, 2022 3:20 PM (20 minutes)

Nuclear effects in neutrino-nucleus scattering are one of the main sources of uncertainty in the analysis of neutrino oscillation experiments. Due to the extended neutrino energy distribution (flux), very different reaction mechanisms contribute to the cross section at the same time. Measurements of muon momentum in CC0π events are very important for experiments like T2K, where most of the information about the oscillation signal comes from detection of the final-state muons only. However, those inclusive measurements make difficult to distinguish the contributions of nuclear effects. For instance, they do not allow to separate between different nuclear models and are not sufficient to put constraints on the amount of two-body current contributions. This is the reason why there is a growing interest in measurements of more exclusive processes, for instance the detection in coincidence of a muon and an ejected proton in the final state. Interpretation of such reactions, usually called semi-inclusive reactions, is challenging as it requires realistic models of the initial nuclear state and an appropriate description of proton final-state interactions (FSI). In this talk we're going to present the theoretical predictions of semi-inclusive ν_μ-^{12}C obtained within an unfactorized approach based on the relativistic distorted wave impulse approximation (RDWIA) and compare them with T2K and MINERvA measurements and predictions of the inclusive SuSAv2-MEC model implemented in the neutrino event generator GENIE.

Attendance type

Virtual presentation

Primary author: Mr FRANCO-PATIÑO, Juan Manuel (University of Seville)

Co-authors: GONZÁLEZ JIMÉNEZ, Raul (Universidad Complutense de Madrid); DOLAN, Stephen (CERN); MEGIAS VAZQUEZ, Guillermo Daniel (University of Seville, Spain); BARBARO, Maria Benedetta (University of Turin, Italy); Prof. CABALLERO CARRETERO, Juan Antonio (University of Seville); Prof. UDÍAS, Jose Manuel (Universidad Complutense de Madrid)

Presenter: Mr FRANCO-PATIÑO, Juan Manuel (University of Seville)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Mu2e: The Search for Muon to Electron Conversion at Fermilab

Tuesday, August 2, 2022 4:00 PM (30 minutes)

The Mu2e experiment, currently under construction at Fermilab, will search for the neutrinoless conversion of a muon into an electron in the field of an aluminum nucleus. A clear signature of this charged lepton flavor violating two-body process is given by the monoenergetic conversion electron of 104.97 MeV produced in the final state. The experimental apparatus consists of an intense pulsed proton beam interacting on a tungsten target; a set of superconducting magnets that selects negative muons; a segmented aluminum target that stops the muons; and a set of detectors used to both identify conversion electrons and reject beam and cosmic backgrounds. The experiment will need 3-5 years of data-taking to achieve a factor of 10^4 improvement on the current best limit on the conversion rate. After an introduction to the physics of Mu2e, we will report on the status of the different components of the experimental apparatus. We conclude with our current estimate of the experiment's sensitivity and discovery potential.

Attendance type

In-person presentation

Primary author: GROUP, Craig (Virginia)

Presenter: GROUP, Craig (Virginia)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **86** Type: **Poster**

Fabrication of a Cosmic Ray Veto System for the Mu2e Experiment

Monday, August 1, 2022 6:20 PM (40 minutes)

The Mu2e experiment at Fermilab will search for the charged-lepton flavor-violating process of a neutrino-less muon-to-electron decay in the presence of a nucleus. The experiment expects a single-event sensitivity of 2.9*10−17, which is four orders of magnitude below the current strongest limits on this process. This requires all backgrounds to sum to fewer than one event over the lifetime of the experiment. One major background is due to cosmic-ray muons producing electrons that fake a signal inside of the Mu2e apparatus. The Mu2e Cosmic Ray Veto (CRV) has been designed to veto these cosmic-ray backgrounds with an efficiency of 99.99 percent, while causing a low dead time and operating in a high-intensity environment. The design and fabrication status of the CRV are discussed.

Attendance type

In-person presentation

Primary author: GROUP, Craig (Virginia)

Presenter: GROUP, Craig (Virginia)

Session Classification: Reception & Poster Session

Track Classification: WG4: Muon Physics

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

LDMX: The Light Dark Matter eXperiment

Thursday, August 4, 2022 5:10 PM (30 minutes)

The constituents of dark matter are still unknown, and the viable possibilities span a very large mass range. The 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. 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 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. Relevant to the NuFact muon working group is a proposal for a muon LDMX that would use a muon beam to probe the electron-phobic scenario. This contribution will give an overview of the theoretical motivation, the main experimental challenges and how they are addressed, the status of the LDMX experiment, as well as projected sensitivities in comparison to other experiments.

Attendance type

In-person presentation

Primary author: SOLT, Matthew (University of Virginia)

Presenter: SOLT, Matthew (University of Virginia)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **88** Type: **Poster**

LDMX: The Light Dark Matter eXperiment

Monday, August 1, 2022 7:00 PM (40 minutes)

The constituents of dark matter are still unknown, and the viable possibilities span a very large mass range. The 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. 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 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. Relevant to NuFact, LDMX is capable of measuring inclusive and semi-exclusive lepton scattering that can be used to inform interaction modeling for neutrinos in a way that is complementary to other neutrino and electron scattering experiments. Relevant to the muon working group is a proposal for a muon beam version of LDMX that would probe the electron-phobic scenario. This contribution will give an overview of the theoretical motivation, the main experimental challenges and how they are addressed, the status of the LDMX experiment, as well as projected sensitivities in comparison to other experiments.

Attendance type

In-person presentation

Primary author: SOLT, Matthew (University of Virginia)

Presenter: SOLT, Matthew (University of Virginia)

Session Classification: Reception & Poster Session

Track Classification: WG4: Muon Physics

Contribution ID: **89** Type: **Talk**

Proton Beam Monitor Upgrades for the J-PARC Neutrino Extraction Beamline

Thursday, August 4, 2022 2:20 PM (30 minutes)

As the J-PARC Main Ring accelerator undergoes upgrades to 1.3 MW, upgrades to proton beam monitors in the neutrino extraction beamline are also underway. These upgrades will allow for stable running of the beamline for the current T2K and future Hyper-K long-baseline neutrino oscillation experiments. Important upgrades include those towards improving monitor radiation hardness and minimizing induced beam losses, as well as those towards quick handling and remote exchange of spent monitors.

Attendance type

In-person presentation

Primary author: FRIEND, Megan (KEK)

Presenter: FRIEND, Megan (KEK)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

Electro-nuclear scattering measurements for neutrinos with LDMX

Tuesday, August 2, 2022 5:20 PM (20 minutes)

The Light Dark Matter eXperiment (LDMX) is a proposed small-scale accelerator experiment designed to search for dark matter using missing energy and momentum techniques from multi-GeV electro-nuclear interactions. In order to detect and veto against energy losses from standard electro-nuclear scattering processes, the detector design features charged particle tracking and hermetic calorimetry for both electromagnetic and hadronic activity in a region within 40 degrees of the incident electron beam. These same characteristics make the experiment capable of measuring inclusive and semi-exclusive lepton scattering that can be used to inform interaction modeling for neutrinos – particularly for the upcoming Deep Underground Neutrino Experiment (DUNE) – in a way that is complementary to other neutrino and electron scattering experiments. We present the capability of LDMX to conduct a rich physics program in electro-nuclear scattering measurements of high relevance to current and future neutrino experiments.

Attendance type

In-person presentation

Primary author: KETCHUM, Wesley (Fermi National Accelerator Laboratory)

Presenter: KETCHUM, Wesley (Fermi National Accelerator Laboratory)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Tension between the T2K and NOvA appearance data and hints to new physics

Friday, August 5, 2022 5:16 PM (22 minutes)

The tension between the T2K and NOvA long-baseline experiments arises mostly due to the mismatch in the $\nu_\mu \to \nu_e$ and $\bar{\nu}_\mu \to \bar{\nu}_e$ appearance data. Assuming vacuum oscillation as the reference point, with maximal θ_{23} and $\delta_{CP} = 0$, we compute the $\nu_e/\bar{\nu}_e$ appearance events for each of the experiments. T2K observes a large excess in the ν_e appearance event sample compared to the expected ν_e events at the reference point, whereas NOvA observes a moderate excess. The large excess in T2K dictates that δ_{CP} be anchored at -90° and that $\theta_{23} > \pi/4$ with a preference for normal hierarchy (NH). The moderate excess at NOvA leads to two degenerate solutions: (a) NH, $0 < \delta_{CP} < 180^\circ$, and $\theta_{23} > \pi/4$; (b) inverted hierarchy (IH) with $-180^\circ < \delta_{CP} < 0$, and $\theta_{23} > \pi/4$. This is the main cause of tension between the two experiments. We show that beyond the standard model (BSM) physics scenarios such as non-unitary neutrino mixing, Lorentz invariance violation, and non-standard neutrino interactions, may resolve the tension.

Attendance type

Virtual presentation

Primary authors: RAHAMAN, Ushak (University of Johannesburg); RAZZAQUE, Soebur (University of Johannesburg); UMASANKAR, Sankagiri (Indian Institute of Technology Bombay)

Presenter: RAHAMAN, Ushak (University of Johannesburg)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

Demonstration of a novel, ton-scale, pixel-readout LArTPC for the DUNE Near Detector

Friday, August 5, 2022 11:55 AM (20 minutes)

To cope with the high event pile-up, the liquid argon time projection chamber of the near detector complex of the Deep Underground Neutrino Experiment relies on an innovative modular design featuring an advanced high-coverage photon detection system, a true 3D pixelated charge readout, and a low-profile resistive-shell field cage. The capabilities of this detector, including the performance of the charge and light readout systems, the signal matching between the two, the detector purity, and the response uniformity, have been demonstrated with two ton-scale prototypes operated at the University of Bern that acquired large samples of cosmic ray data. The data have been compared to a microphysical detector simulation, performed with highly-parallelized GPU algorithms. The main results from the analysis of these data sets, as well as the overall status of the ND-LAr detector development, will be presented in this talk.

Attendance type

In-person presentation

Primary author: Dr WOLCOTT, Jeremy (Tufts University)

Co-authors: MASTBAUM, Andrew (Rutgers University); OCHOA, J. Pedro (University of California at Irvine)

Presenter: Dr WOLCOTT, Jeremy (Tufts University)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

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

First light detection with an optical Time Projection Chamber

Monday, August 1, 2022 6:20 PM (40 minutes)

An optical Time Projection Chamber (TPC) is proposed for future neutrino experiments. Its excellent particle detection momentum threshold, together with cost-effective scale-up prospects, make the TPC a strong candidate for reducing systematic errors due to neutrino-nucleus interactions.
In order to produce a high number of photons, the TPC is equipped with a thick gaseous electron multiplier (ThGEM). Per each electron produced in the ThGEM holes, thousands of photons are created. Next, the electrons created in the ThGEM are extracted and drifted further towards a mesh. Here, by applying a high enough electric field to excite the Argon atoms, but low enough in order not to ionise them, electroluminescence (EL) photons are produced. The photons, normally in the UV range, are shifted to visible using a PEN wavelength shifter.

The firsts tests of the chamber were carried with a photo-multiplier tube. Several methods, including drift velocity, and trigger rate studies confirm that the TPC works as expected.

For a second phase of tests, voltage was placed on the EL mesh too, and a light yield increase was observed, as expected due to the electroluminescence effect. Surprisingly, a yield increase was observed even for small electric fields. This can not be explained through EL but it is rather an effect of the electrons being forced out of the ThGEM holes; the more towards the exterior the photons are produced, the less they get absorbed by the walls of the ThGEM.

For a third, and final study of the TPC, a 256 SiPM array has been set up.
Simulations show that by using two simple bi-convex lenses, hundreds of photons can be detected per cosmic-ray crossing the detector. Moreover, magnitudes of up to 12 can be obtained. In other words, if a particle leaves a track of 12cm in the real detector, the projected image on the SiPM array is only 1cm.
Currently, the SiPM array is in its first analysis phase, being very close to its first full track reconstruction. Thank you!

Attendance type

In-person presentation

Primary authors: Mr ROE, Edward (University of Geneva); SANCHEZ, Federico (Universite de Genève); Mr AMARINEI, Robert (University of Geneva); Mr GIANESSI, Lorenzo (University of Geneva); BORDONI, Stefania (CERN); LUX, Thorsten (IFAE - BIST)

Presenter: Mr AMARINEI, Robert (University of Geneva)

Session Classification: Reception & Poster Session

Track Classification: WG6: Detectors

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

Heavy neutrino production at the FCC-ee: Dirac or Majorana?

Tuesday, August 2, 2022 3:00 PM (30 minutes)

Three mysteries stand after the discovery of the Higgs boson: (i) the origin of the masses of the neutrinos; (ii) the origin of the baryon asymmetry in the universe; and (iii) the nature of dark matter. The FCC-ee provides an exciting opportunity to resolve these mysteries with the discovery of heavy neutral leptons (HNLs), in particular using the large sample (5.10^12) Z bosons produced in early running at the Z resonance using the production process e+e- –> Z –> vN. The expected very small mixing between light and heavy neutrinos leads to very small mixing angles, resulting in very long lifetimes for the HNL and in spectacular signal topology. Although the final state in this reaction appears to be charge-insensitive, it is nevertheless possible to distinguish the Dirac vs Majorana nature of the neutrinos, by a variety of methods that will be discussed. A Majorana nature could have considerable implication for the generation of the Baryon Asymmetry of the Universe.

Attendance type

In-person presentation

Primary author: BLONDEL, Alain (DPNC Université de Genève)

Presenter: BLONDEL, Alain (DPNC Université de Genève)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Searches for dark matter in the Galactic Halo and extragalactic sources with IceCube

Friday, August 5, 2022 5:08 PM (27 minutes)

The abundance of dark matter in the Universe could be explained by heavy dark matter. Dark matter is expected to be accumulated near the center of massive astrophysical objects, and the decay of it could produce highly energetic neutrinos detectable at Earth with large neutrino telescopes. The IceCube Neutrino Observatory is a cubic kilometer-scale neutrino telescope located under 1.5 km of ice near the Amundsen-Scott South Pole Station. With the discovery of high-energy astrophysical neutrinos, IceCube has demonstrated the ability to observe neutrinos of extraterrestrial origin. The sources of these astrophysical neutrinos remain largely unknown, making searches for exotic origins very timely. We present an analysis that searches for dark matter decay in extragalactic sources, using nine years of IceCube data. The sources considered are galaxy clusters, dwarf galaxies, and the Andromeda galaxy. We focus on heavy decaying dark matter with masses from 10 TeV to 100 PeV and consider several benchmark decay channels into pairs of Standard Model particles. We use well-established neutrino event selection criteria for neutrino candidate events from the northern sky. In this contribution, we present the latest analysis status and sensitivities calculated using the individual sources and by stacking the sources within the same source class.

Attendance type

In-person presentation

Primary author: JEONG, Minjin (Sungkyunkwan University)

Presenter: JEONG, Minjin (Sungkyunkwan University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Status of the MEG II Experiment and Performance Results From the First Year's Data Taking

Tuesday, August 2, 2022 3:00 PM (30 minutes)

We report on the MEG II experiment, a search for the charged lepton flavor violating (CLFV) decay $\mu^+ \to e^+\gamma$. The experiment is designed to improve upon the previous most sensitive search, done by the MEG experiment, by an order of magnitude: a sensitivity of $4.2 \cdot 10^{-13} \to 6 \cdot 10^{-14}$ at the 90% confidence level. The positron and photon kinematic properties are measured in a magnetic spectrometer and a liquid xenon calorimeter respectively. MEG II implements a variety of upgrades to achieve better sensitivity including a new lightweight stereo drift chamber for improved e^+ kinematic resolution, a new array of 512 scintillator timing counter tiles for improved e^+ timing, a new set of 4092 silicon photo multipliers on the calorimeter's inner face for improved γ kinematic resolution, and a higher μ^+ beam rate. The experiment completed it's first year of data collection in 2021. We will discuss preliminary e^+ and γ data-driven kinematic resolution measurements and compare them to MEG results and the MEG II design expectation. Estimates of the first year and projected final single event sensitivity will also be given.

Attendance type

In-person presentation

Primary author: PALO, Dylan (University of California, Irvine)

Presenter: PALO, Dylan (University of California, Irvine)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

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

Muon antineutrino charged-current neutral pion production differential cross-section measurement in the NOvA near detector

Friday, August 5, 2022 5:10 PM (20 minutes)

NOvA is a long-baseline neutrino oscillation experiment primarily designed to measure the muon (anti)neutrino disappearance and electron (anti)neutrino appearance in the off-axis Fermilab NuMI beam. It uses two functionally identical liquid scintillator detectors separated by 810 km and a narrow band beam centered around 2 GeV. Energetic neutral pions produced in Δ resonance, deep-inelastic interactions or final state interactions are a significant background to the electron (anti)neutrino appearance measurement as the photons coming from neutral pion decay may be misidentified as electrons(positrons). The high statistics antineutrino mode data in the near detector can be used to perform a measurement of the differential cross section for the muon antineutrino charged-current neutral pion production. The analysis uses a convolutional neural network trained on individually simulated particles to identify neutral pions in the final state. A data-driven template fit approach is used to constrain backgrounds. The assessment of systematic uncertainties is also presented.

Attendance type

In-person presentation

Primary author: GAO, Fan (University of Pittsburgh)

Presenter: GAO, Fan (University of Pittsburgh)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Cross section measurements with MINERvA and prospects of cross section measurements with ICARUS

Thursday, August 4, 2022 4:30 PM (20 minutes)

Accurate neutrino cross-section measurements are required for precise measurements of neutrino oscillation physics such as CP-violation and the ordering of the neutrino masses. In this talk, I will give an overview of neutrino cross section measurements with NuMI neutrino beam, specifically neutrino cross sections from MINERvA experiment and prospects of neutrino-Argon cross-section measurements at ICARUS. MINERvA is located on axis and ICARUS, located on-axis in the SBN neutrino beam, is 103 mrad off-axis from the NuMI beam. The interactions at both experiments provide the basis for important neutrino cross-section measurements and tests of models in an energy range that overlaps both the SBN oscillation search and most of the DUNE spectrum.

Attendance type

In-person presentation

Primary author: BETANCOURT, Minerba (Fermilab)

Presenter: BETANCOURT, Minerba (Fermilab)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Physics potentials and accelerator challenges of Phase Rotated Intense Source of Muons (PRISM)

Thursday, August 4, 2022 4:10 PM (30 minutes)

Muon to electron conversion in a muonic atom is an excellent laboratory to search for charged lepton flavor violation (CLFV). Its discovery would be a clear signal of physics beyond the Standard Model (BSM). In order to further improve the experiments by an additional factor of 100 in sensitivity beyond the current generation ones and study potential signals, the use of a Fixed-Field Alternating gradient (FFA) ring has been proposed to create a Phase Rotated Intense Source of Muons (PRISM). PRISM will allow significant purification of the muon beam and suppression of a typically large momentum spread by the use of RF phase rotation in the ring, both reducing the backgrounds and increasing the number of stopped muons relative to other methods. PRISM requires a proton driver capable of producing short, intense proton bunches. New facilities, in particular PIP-II at Fermilab equipped with a dedicated accumulator ring, or upgrades of other accelerator facilities, such as J-PARC and ESS, offer promising opportunities for providing the required intensity and time structure of the proton beam. A new proposed complex at Fermilab, the Advanced Muon Facility, would use the PRISM concept to provide the world's most intense positive and negative muon beams by exploiting the full potential of PIP-II and the Booster upgrade. Progress in R&D studies on PRISM are discussed.

Attendance type

In-person presentation

Primary author: PASTERNAK, Jaroslaw (Imperial College/RAL-STFC)

Presenter: PASTERNAK, Jaroslaw (Imperial College/RAL-STFC)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

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

CEvNS at CSNS in China

Friday, August 5, 2022 3:20 PM (15 minutes)

The detection and cross section measurement of Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) is vital for particle physics, astrophysics and nuclear physics. In 2017 the COHERNET collaboration reported the first observation of CEvNS signal. A new CEvNS detection experiment is under our schedule. Four pure CsI crystals, weight 3kg and coupled with two Photon Multiplier Tubes (PMTs) each, will be cooled down to 77K and placed at China Spallation Neutron Source (CSNS) to detect the CEvNS signals produced by neutrinos from stopped pion decays happening within the Tungsten target of CSNS. Owing to the extremely high light yield of pure CsI at 77K (33.5PE/keVee), even though only having a neutrino flux 30% weaker than COHERENT, the detectable signal event rate is still expected to be 540 each year. Low radioactivity materials and devices will be used to construct the detector and strong shielding will be applied to reduce the radioactive background. Dual-PMT readout will be able to reject PMT-related background like Cherenkov light and PMT dark noise. With all the strategies above, we are hoping to reach a signal to background ratio exceeding 4.

We have been using two EJ301 liquid scintillator detectors to investigate the beam related and unrelated background at the location. Our main detector is scheduled to be placed there as soon as CSNS finish their upgrade this summer.

Attendance type

Virtual presentation

Primary author: LIU, qian (university of chinese academy of sciences)

Presenter: LIU, qian (university of chinese academy of sciences)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Progress of studies on the Neutrinos from Stored Muons, nuSTORM, facility

Friday, August 5, 2022 4:10 PM (30 minutes)

The Neutrinos from Stored Muons, nuSTORM, facility has been designed to deliver a definitive neutrino-nucleus scattering programme using neutrino beams from the decay of muons confined within a
storage ring. The facility is unique, it will be capable of storing muon beams of both charges with momentum of between 1 GeV/c and 6 GeV/c and a momentum spread of ±16%. The neutrino beams generated will span neutrino energies from approximately 300 MeV to 5.5 GeV allowing neutrino-scattering measurements to be made over the kinematic range of interest to the DUNE and Hyper-K. At nuSTORM, the flavour composition of the beam and the neutrino-energy spectrum are both precisely
known. The storage-ring instrumentation will allow the neutrino flux to be determined to a precision of 1% or better. nuSTORM will: serve the future long- and short-baseline neutrino-oscillation programmes by providing definitive measurements of scattering cross-sections with percent-level precision.
It will extend the search for light sterile neutrinos beyond the sensitivities that will
be provided by the FNAL Short Baseline Neutrino (SBN) programme and
create an essential test facility for the development of muon accelerators to serve as the basis of a multi-TeV lepton-antilepton collider and a Neutrino Factory. Recent progress of R&D studies on nuSTORM are presented.

Attendance type

In-person presentation

Primary authors: PASTERNAK, Jaroslaw (Imperial College/RAL-STFC); LONG, Kenneth (Imperial College London)

Presenter: PASTERNAK, Jaroslaw (Imperial College/RAL-STFC)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

The High-Efficiency Cosmic Ray Veto Detector for the Mu2e Experiment at Fermilab

Friday, August 5, 2022 4:40 PM (30 minutes)

The Mu2e experiment will search for the charged-lepton flavor violating neutrino-less conversion of a negative muon into an electron in the presence of a nucleus. The experiment's goal is to improve the previous upper limit by four orders of magnitude. Any observation of this process is a clear sign of new physics. The single 105-MeV electron that results from this process can be mimicked by electrons produced by cosmic-ray muons traversing the detector. An active veto detector surrounding the apparatus detects incoming cosmic-ray muons. To reduce the backgrounds to the required level, it must have an efficiency of about 99.99% and excellent coverage. The cosmic ray veto consists of four layers of scintillator counters, each with two embedded wavelength-shifting fibers, whose light is detected by silicon photomultipliers. The design and expected performance of the cosmic ray veto detector will be described. The potential use of very similar technologies in other experiments will be highlighted.

Attendance type

In-person presentation

Primary author: CORRODI, Simon

Presenter: CORRODI, Simon

Session Classification: Joint Session

Track Classification: WG4: Muon Physics

Contribution ID: **103** Type: **Poster**

A High Rate Readout System for a High-Efficiency Cosmic Ray Veto for the Mu2e Experiment

Monday, August 1, 2022 7:00 PM (40 minutes)

The Mu2e Cosmic Ray Veto must veto cosmic-ray muons over a large area with an efficiency of 99.99% in the presence of high background rates. It consists of over 5000 scintillator extrusions with embedded wavelength-shifting fibers coupled to 2×2 mm2 silicon photomultipliers. A custom readout system consists of: (1) small circuit board, the Counter Mother Board, which provides a temperature sensor, flasher LEDs, and passive SiPM pulse shaping; (2) a Front End Board which digitizes, zero-suppresses, and stores signals from up to 64 Counter Mother Boards, provides bias to the SiPMs, pulses to the LEDs, and a measurement of the SiPM currents; and (3) a Readout Controller which collects data from the Front End Boards via Cat6 cables, which also deliver 48V power to the Front End Boards using power over ethernet. The Readout Controller serves as the interface between the Front End Boards and the DAQ. This poster provides an overview of this high rate readout system for the Mu2e Cosmic Ray Veto.

Attendance type

In-person presentation

Primary author: CORRODI, Simon

Presenter: CORRODI, Simon

Session Classification: Reception & Poster Session

Track Classification: WG6: Detectors

Contribution ID: **104** Type: **Poster**

A Measurement of Neutrino Induced Charged Current Neutral Pion Production in the MicroBooNE Experiment

Monday, August 1, 2022 6:20 PM (40 minutes)

MicroBooNE is a 85 tonne active mass liquid argon time projection chamber on the Booster Neutrino Beam at Fermi National Accelerator Laboratory. Studying neutral pion production in the MicroBooNE detector provides an opportunity to better understand neutrino-argon interactions, and is crucial for future accelerator-based neutrino oscillation experiments. This analysis presents the progress towards the first measurement of the differential cross section for π^0 production in neutrino-argon interactions. Using a dataset corresponding to about 7×10^{20} protons on target, we present an analysis which aims to measure
the single differential cross sections as a function of the pion and muon kinematic variables such as the momentum and the scattering angle.

Attendance type

In-person presentation

Primary author: BHATTACHARYA, Meghna

Presenter: BHATTACHARYA, Meghna

Session Classification: Reception & Poster Session

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **105** Type: **Poster**

Influence of Lorentz Invariance Violation on ν-oscillation probabilities in LBL experiments

Neutrinos having non-zero mass provide compelling experimental evidence for physics beyond the Standard Model. Lorentz Invariance Violation (LIV) is a violation of space-time symmetry, implying that physical laws are no longer invariant under Lorentz transformations. The possibility of exploring LIV using neutrino oscillation probabilities is appealing. The LIV effect considered here is intrinsic in nature, and its effects will be present even in a vacuum. We use the Standard Model Extension (SME) framework to study LIV, which is treated as a perturbation to the standard Hamiltonian. And by using this Hamiltonian we study the effects of LIV on the neutrino oscillation probabilities in the presence of the LIV parameters.

In this work, we investigate how the presence of LIV terms impacts the neutrino oscillation probabilities and explore their impact in LBL experiments.

Attendance type

Virtual presentation

Primary authors: SARKER, Arnab (Department of Physics, Tezpur University, Assam, India); MEDHI, Abinash (Tezpur University, Assam, India); Ms BEZBORUAH, Dharitree (Department of Physics, Tezpur University, Assam, India); DEVI, Moon Moon (Tezpur University, Assam, INDIA)

Presenter: SARKER, Arnab (Department of Physics, Tezpur University, Assam, India)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **106** Type: **Talk**

nuSTORM; Neutrinos from Stored Muons

Friday, August 5, 2022 4:10 PM (20 minutes)

The nuSTORM facility will provide ν_e and ν_μ beams from the decay of low energy muons confined within a storage ring. The neutrino and anti-neutrino energy distributions will be precisely known. The precision goals of the oscillation program require a realistic modeling of neutrino-nucleus scattering dynamics. nuSTORM can contribute to this effort by providing the ultimate experimental program of scattering measurements. The cross section for the scattering on complex nuclei is sensitive to energy and momentum transfers. Data with both muons and electrons in the final state are therefore very valuable. Sensitivity to physics beyond the Standard Model (BSM) is provided by nuSTORM's unique features. This allows sensitive searches for short-baseline flavour transitions, light sterile neutrinos, nonstandard interactions, and non-unitarity. In synergy with the scattering program, new physics searches would also profit from measurements of exclusive final states, allowing for BSM neutrino interactions to be probed in neutrino-electron scattering and by searching for exotic final states. The status of the development of nuSTORM will be reviewed in the context of the renewed effort to develop high-brightness stored muon beams and as a route to very-high energy lepton-anti lepton collisions in the muon collider.

Attendance type

In-person presentation

Primary author: LONG, Kenneth (Imperial College London)

Presenter: SCOTT, Mark (Imperial College London)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

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

Status of the KDAR neutrino search with JSNS2 experiment

Thursday, August 4, 2022 5:16 PM (12 minutes)

Kaon Decay-At-Rest (KDAR) provides a neutrino signal with well-known neutrino energy, which is an important probe for measuring the neutrino cross-section in an energy range that is otherwise difficult to access experimentally. The J-PARC Sterile Neutrino Search at the J-PARC Spallation Neutron Source (JSNS2) experiment is in a unique place for measuring monoenergetic neutrinos at 236 MeV from charged Kaon decay-at-rest (KDAR). JSNS2 is located at the J-PARC's Material and Life Science Facility (MLF) where the world's most intense source of KDAR was created by a 3 GeV proton beam incident on a liquid mercury target. In this presentation, We will present the first result of the search for the KDAR neutrinos conducted with the JSNS2 experiment with the data during the JSNS2's first long-term physics run in 2021, consisting of more than 115 days of data and 1.45x10^22 POT.

Attendance type

Virtual presentation

Primary author: JEON, Hyoungku (SungKyunKwan University)

Presenter: JEON, Hyoungku (SungKyunKwan University)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

KM3NeT/ORCA calibration procedures and capabilities

Thursday, August 4, 2022 4:54 PM (22 minutes)

The cubic-kilometre neutrino telescope (KM3NeT) is a deep-sea infrastructure composed of two neutrino telescopes, consisting of large-scale 3D-arrays of photomultiplier tubes (PMTs) currently under construction on the Mediterranean seabed. The two telescopes are: ARCA, near Sicily in Italy, designed for neutrino astronomy and ORCA, near Toulon in France, designed for neutrino oscillations.

The ORCA telescope, having a neutrino energy threshold in the GeV range, has the measurement of the neutrino mass ordering and atmospheric neutrino oscillation parameters as its main research goal. We intend to discuss the accurate calibration procedures performed necessary to achieve these purposes.

Attendance type

In-person presentation

Primary author: DE BENEDITTIS, Antonio (INFN - Napoli)

Presenter: DE BENEDITTIS, Antonio (INFN - Napoli)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

Phenomenology of Dark Sectors at the Short Baseline Neutrino Experiments

Thursday, August 4, 2022 2:20 PM (30 minutes)

I discuss predictions for signals of some dark sector models at the Fermilab Short Baseline Neutrino (SBN) experiments. I consider prospects for both inelastic dark matter models and Higgs portal mediator models. I demonstrate that new parameter space for both models can be probed in the near future. I discuss new simulation and analysis strategies, the latter including machine learning techniques, that will be required to realize such searches.

Attendance type

In-person presentation

Primary author: BERGER, Joshua (Colorado State University)

Co-authors: ISMAIL, Ahmed (Oklahoma State University); BATELL, Brian (University of Pittsburgh); DARMÉ, Luc (Institut de Physique des 2 Infinis de Lyon); FRUGIUELE, Claudia (INFN MILANO); DYER, Jamie (Colorado State University)

Presenter: BERGER, Joshua (Colorado State University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **112** Type: **Poster**

Measurement of double-differential cross sections for mesonless charged-current neutrino scattering on argon with MicroBooNE

Monday, August 1, 2022 7:00 PM (40 minutes)

The MicroBooNE liquid argon time projection chamber (LArTPC) experiment is pursuing a broad range of neutrino physics measurements, including some of the first high-statistics results for neutrino-argon scattering cross sections. At the neutrino energies relevant for MicroBooNE and its companion experiments in the Fermilab Short-Baseline Neutrino program, the dominant event topology involves mesonless final states containing one or more protons. A complete description of these events requires modeling the contributions of quasielastic and two-particle two-hole neutrino interactions as well as more inelastic reaction modes in which final-state mesons are reabsorbed by the residual nucleus. Refinements to the current understanding of these processes, informed by new neutrino cross-section data, will enable a precise and reliable interpretation of future measurements of neutrino oscillations and searches for exotic physics processes involving neutrinos. This poster presents the first double-differential cross-section results from MicroBooNE for mesonless charged-current scattering of muon neutrinos on argon.

Attendance type

In-person presentation

Primary authors: BOOK, Julia (Harvard University); Prof. GUENETTE, Roxanne (Harvard University); GARDINER, Steven (Fermilab)

Presenter: BOOK, Julia (Harvard University)

Session Classification: Reception & Poster Session

Track Classification: WG2: Neutrino Scattering Physics

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

Structure Functions and Tau Neutrino Cross-Section at DUNE Far Detector

Tuesday, August 2, 2022 3:42 PM (22 minutes)

The high statistics and excellent resolution capabilities of DUNE's ^{40}Ar detector will allow us to make precise studies about phenomena that have, until now, seemed too complex to measure, like tau neutrinos (ν_τ) detection and therefore, provide a completion of the 3-flavor neutrino paradigm. Quasi-elastic scattering (QE), Δ resonance production (RES), and deep inelastic scattering (DIS) processes are known to give dominant contributions in the medium and high neutrino energy to the total cross-section of ν_τ(N) and $\bar{\nu}_\tau$(N) cross-sections. These cross-sections have large systematic uncertainties compared to the ones for ν_μ and ν_e. Studies point out that the reason for these difference is due to the model dependence of the ν_τ(N) cross-sections in treating the nuclear medium effects described by the nucleon structure functions, $F_{1N,\ldots,3N}(x, Q^2)$ for ν_μ and ν_e. These nucleon structure functions are used to calculate DIS cross-section by including kinematical corrections, but due to the addition of the τ-lepton mass another two additional nucleon structure functions become non-negligible, $F_{4N}(x, Q^2)$ and $F_{5N}(x, Q^2)$. There is a special interest in the DIS processes originated by charged leptons and (anti)neutrinos on nucleons and nuclear targets as they play an instrumental role in the quark-parton structure of the free nucleons and nucleons when they are bound in a nucleus. This talk will show the semi-theoretical and experimental approach to the estimation of the ν_τ(N) and $\bar{\nu}_\tau$(N) cross-sections in DUNE for the DIS region. We aim to look over changes in Q^2, and the contributions of the additional nucleon structure functions $F_{4N}(x, Q^2)$ and $F_{5N}(x, Q^2)$.

Attendance type

In-person presentation

Primary author: YAEGGY, Barbara (University of Cincinnati)

Presenter: YAEGGY, Barbara (University of Cincinnati)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

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

T2K oscillation analysis results: latest analysis improvements at the far detector

Friday, August 5, 2022 5:38 PM (22 minutes)

T2K is a long baseline neutrino experiment which exploits a neutrino and antineutrino beam produced at the Japan Particle Accelerator Research Centre (JPARC) to provide world-leading measurements of the parameters governing neutrino oscillation. Neutrino oscillations are measured by tuning the neutrino rates and spectra at a near detector complex, located at JPARC, and extrapolate them to the water-Cherenkov far detector, Super-Kamiokande, located 295 Km away, where oscillations are observed as modifications of such rates and spectra.

The latest T2K results include multiple analysis improvements, in particular a new sample is added at the far detector, requiring the presence of a pion in muon-neutrino interactions. It is the first time that a pion sample is included in the study of neutrino disappearance at T2K and, for the first time, a sample with more than one Cherenkov ring is exploited in the T2K oscillation analysis, opening the road for further samples with charged- and neutral-pion tagging. The inclusion of such sample enables proper control of the oscillated spectrum on a larger neutrino-energy range and on subleading neutrino-interaction processes. Finally, T2K is engaged with the Super-Kamiokande collaboration to combine T2K neutrino beam data and Super-Kamiokande atmospheric data to perform a joint fit to the oscillation parameters. Such combination allows the degeneracies between the measurement of the CP-violating phase δ_{CP} and the measurement of the ordering of the neutrino mass eigenstates to be lifted. Precise evaluation of the enhanced sensitivity of this joint fit will be presented.

Attendance type

Virtual presentation

Primary author: YASUTOME, Kenji (Kyoto University)

Presenter: YASUTOME, Kenji (Kyoto University)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

Latest results on T2K Near Detector constraints for neutrino oscillation measurements

Thursday, August 4, 2022 11:56 AM (18 minutes)

T2K is a long baseline neutrino experiment which exploits a neutrino and antineutrino beam at JPARC to perform precision measurements of atmospheric parameters Δm^2_{32}, $\sin^2(\theta_{23})$ and to provide 3σ exclusion for some intervals of the CP-violating phase δ_{CP}.

The latest results of the measurement of oscillation parameters will be presented, the main systematic uncertainties limiting the precision will be described, as well as the role of the near detector to constrain such systematic uncertainties. In particular, the latest analysis exploits a new nuclear model to describe neutrino-nucleus interactions, a new flux tuning based on an improved NA61/SHINE hadro-production measurement and new samples with proton and photon tagging at the near detector. All these novelties, designed to extract more robust constrains on the mentioned systematics uncertainties, will be described, together with the results of such improved analysis at the near detector. The future strategy to improve further the precision will be presented: the T2K beam will be upgraded with increased power and an upgrade of the ND280 near detector, located 2.5 degrees off-axis, is being assembled to exploit the increased statistics.

Attendance type

In-person presentation

Presenter: WILKINSON, Callum (Lawrence Berkeley National Laboratory)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

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

T2K improved neutrino-nucleus interaction model tuned to global data

Tuesday, August 2, 2022 3:00 PM (22 minutes)

In order to achieve the ambitious goal of characterising neutrino flavour oscillations with percent-level precision, it is critical for current and future long-baseline neutrino oscillation experiments to substantially reduce existing systematic uncertainties. The most challenging of such systematic uncertainties is related with the modelling few-GeV neutrino-nucleus interactions.

To improve our understanding, the T2K collaboration is engaged in a continuous effort to implement up-to-date theoretical models in T2K's Monte Carlo event generator (NEUT) and to define a suitable parametrisation of the model's uncertainties as an input for neutrino oscillation analyses. The new uncertainty model, developed for the latest T2K oscillation measurement, will be presented, as well as a comparison of the model to available global lepton- and hadron-scattering data. Among other improvements, the latest model includes: a parametrisation offering substantial freedom to the input Spectral Function for charged-current quasi-elastic (CCQE) interactions; a momentum transfer dependent correction to the nuclear removal energy for CCQE interactions based on inclusive electron scattering data; and an updated treatment of nuclear medium effects in resonant pion production interactions.

Attendance type

Virtual presentation

Presenter: DOLAN, Stephen (CERN)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **117** Type: **Talk**

T2K latest results on neutrino-nucleus cross sections

Friday, August 5, 2022 4:50 PM (20 minutes)

A detailed understanding of neutrino-nucleus interactions is essential for the precise measurement of neutrino oscillations at long baseline experiments, such as T2K. The T2K near detector complex, designed to constrain the T2K flux and cross section models, also provides a complementary program of neutrino interaction cross-section measurements. Through the use of multiple target materials (carbon, water, lead, iron), and the ability to sample different neutrino spectra (with detectors located on- and off-axis with respect to the beam direction), T2K is able to investigate atomic number and energy dependence of interaction cross sections in a single experiment. In particular, T2K has recently performed the first joint on/off-axis measurement of the Charged Current channel without pion in the final state. Also, dedicated efforts are devoted to investigate rare or poorly studied interaction channels. Indeed, an improved analysis of the coherent pion production cross section has been recently accomplished, including an antineutrino sample for the first time. Those results, together with an overview of the T2K measurement strategy, adopted to reduce the model dependence, will be presented in this talk.

Attendance type

In-person presentation

Primary author: SOLER, Paul (University of Glasgow)

Presenter: CUDD, Andrew (University of Colorado Boulder)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **118** Type: **Talk**

The T2K Near Detector upgrade

Thursday, August 4, 2022 12:14 PM (18 minutes)

Neutrino oscillation physics has now entered the precision era. In parallel with needing larger detectors to collect more data, future experiments further require a significant reduction of systematic uncertainties with respect to what is currently available. In the neutrino oscillation measurements from the T2K experiment, the systematic uncertainties related to neutrino interaction cross sections are currently dominant. To reduce this uncertainty, a significantly improved understanding of neutrino-nucleus interactions is required. In particular, it is crucial to better characterise the nuclear effects which can alter the final state topology and kinematics of neutrino interactions in such a way which can bias neutrino energy reconstruction and therefore bias measurements of neutrino oscillations.

The upgraded ND280 detector will consist of a totally active Super-Fine-Grained-Detector (Super-FGD) composed of 2 million 1 cm^3 scintillator cubes with three 2D readouts, two High Angle TPC (HA-TPC) instrumented with resistive MicroMegas modules, and six TOF planes. It will directly confront our knowledge of neutrino interactions thanks to its full polar angle acceptance and a much lower proton tracking threshold. Furthermore, neutron tagging capabilities, in addition to precision timing information, will allow the upgraded detector to estimate neutron kinematics from neutrino interactions. Such improvements permit access to a much larger kinematic phase space which correspondingly allows techniques such as the analysis of transverse kinematic imbalances, to offer remarkable constraints of the pertinent nuclear physics for T2K analyses.

New reconstruction algorithms are being developed to fully benefit from the improved capabilities of the Super-FGD and of the HA-TPC and will be described in this talk together with the expected performances of the ND280 upgrade.

Attendance type

In-person presentation

Primary author: EGUCHI, Aoi (The University of Tokyo)

Presenter: EGUCHI, Aoi (The University of Tokyo)

Session Classification: Joint Session

Track Classification: WG6: Detectors

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

The NOvA Test Beam Program

Friday, August 5, 2022 12:21 PM (22 minutes)

NOvA is a long-baseline neutrino oscillation experiment designed to study and measure a wide range of topics for neutrino physics, such as the neutrino mixing parameters, the neutrino mass hierarchy, and CP violation in the lepton sector. A key component of the success of the experiment is a robust understanding of the systematic uncertainties associated with detector response and calibration. To address this, NOvA has constructed a test beam experiment at the Fermilab Test Beam Facility, which has collected data from 2019 through July 2022.

The NOvA Test Beam experiment uses a scaled-down 30-ton detector to analyze tagged particles from a new tertiary beamline, which can select and identify electrons, muons, pions, kaons and protons with energies from 0.3 to 2 GeV. Using these data, the program will provide NOvA with a better understanding of the largest systematic uncertainties impacting NOvA's analyses, which include the detector response, calibration, and hadronic and electromagnetic energy resolution. In this talk, I will present the status and future plans for the NOvA Test Beam program, along with preliminary results.

Attendance type

In-person presentation

Primary author: WALLBANK, Michael (University of Cincinnati)

Presenter: WALLBANK, Michael (University of Cincinnati)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

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

Core-passing atmospheric neutrinos: a unique probe to discriminate between Lorentz violation and non-standard interactions

Thursday, August 4, 2022 2:50 PM (30 minutes)

Lorentz violation and non-standard interactions are two of the most popular scenarios beyond the Standard Model of particle physics, both of which can affect neutrino oscillations significantly. However, these effects can mimic each other, and it would be difficult to distinguish between them in any fixed-baseline neutrino experiment. We show that atmospheric neutrinos, having access to a wide range of baselines, can break this degeneracy. Observations of core-passing atmospheric neutrinos and antineutrinos would be a potent tool to discriminate between these two new-physics scenarios.

Attendance type

In-person presentation

Primary author: Prof. AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar)

Co-authors: Prof. DIGHE, Amol (Tata Institute of Fundamental Research, Mumbai, India); Mr KUMAR, Anil (Institute of Physics, Bhubaneswar, Odisha, India); Mr SAHOO, Sadashiv (Institute of Physics, Bhubaneswar, Odisha, India)

Presenter: Prof. AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

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

Thursday, August 4, 2022 5:25 PM (25 minutes)

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.

Attendance type

In-person presentation

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, UW Madison and WIPAC, USA); Prof. DIGHE, Amol (TIFR, Mumbai)

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

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Neutrino oscillations in Earth: a unique tool to probe dark matter inside the Core

Thursday, August 4, 2022 4:35 PM (25 minutes)

The information about the Earth's interior structure comes from seismic studies and gravitational measurements. The Preliminary Reference Earth Model (PREM) of the density of the Earth is obtained by measuring the travel time of seismic waves. Here, the density distribution inside the Earth is estimated from the model-dependent empirical relations having assumptions based on temperature, pressure, composition, and elastic properties of the Earth, which give rise to uncertainties in the PREM profile.
Neutrinos may be used in a way complementary to seismic studies and gravitational measurements, thus starting an era of "multimessenger tomography" of Earth. Since neutrinos can peek into the deepest layers of Earth with their weak interactions, they can be used to sense the amount of baryonic matter present inside the core. If the baryonic matter observed by neutrinos is found to be less than the expected mass from gravitational measurement, we can attribute the difference to the presence of dark matter inside the core. Atmospheric neutrinos offer the possibility of probing dark matter inside the core of the Earth in a unique way through Earth matter effects in neutrino oscillations. We demonstrate that while the dark matter profile will be hard to identify, the baryonic matter profile inside the core can be probed in a manner complementary to the seismic measurements.

Attendance type

Virtual presentation

Primary authors: Mr UPADHYAY, ANUJ KUMAR (Aligarh Muslim University, Aligarh & Institute of Physics, Bhubaneswar, India); Mr KUMAR, Anil (Institute of Physics, Bhubaneswar, SINP, Kolkata, HBNI, Mumbai, India); Prof. AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar, HBNI, Mumbai, India, UW Madison & WIPAC, USA); Prof. DIGHE, Amol (TIFR, Mumbai, India); UPADHYAY, ANUJ KUMAR (Aligarh Muslim University)

Presenters: Mr UPADHYAY, ANUJ KUMAR (Aligarh Muslim University, Aligarh & Institute of Physics, Bhubaneswar, India); UPADHYAY, ANUJ KUMAR (Aligarh Muslim University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

Charged-meson-induced new physics in beam-focused neutrino experiments

Thursday, August 4, 2022 11:20 AM (30 minutes)

We point out that the production of new bosons by charged meson decays can greatly enhance the sensitivity of beam-focused accelerator-based experiments to new physics signals. This enhancement arises since the charged mesons are focused and their three-body decays do not suffer from helicity suppression in the same way as their usual two-body decays. As a realistic application, we attempt to explain the MiniBooNE low energy excess utilizing this overlooked mechanism, uniquely realizing dark-sector interpretations as plausible solutions to the excess. For illustration purposes, we consider two well-motivated classes of dark-sector models, models of vector-portal dark matter and models of long-lived (pseudo)scalar. We argue that the model parameter values to accommodate the excess are consistent with existing limits and that they can be tested at current and future accelerator-based neutrino experiments.

Attendance type

In-person presentation

Primary author: KIM, Doojin (Texas A&M University)

Co-authors: DUTTA, Bhaskar (Texas A&M University); VAN DE WATER, Richard (LANL); THOMPSON, Adrian (Texas A&M University); THORNTON, Remington

Presenter: KIM, Doojin (Texas A&M University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

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

ESSnuSB from source to target and plans for the future

Thursday, August 4, 2022 4:10 PM (30 minutes)

The European Spallation Source (ESS) will be the most powerful neutron source in the world. This facility offers a unique opportunity for studying fundamental physics, in particular the matter-antimatter asymmetry in the Universe thanks to the development of a very intense neutrino superbeam. The ESS neutrino Super-Beam project proposes an accelerator complex, complimentary to the existing facility, and an additional target station to produce such a neutrino beam. We will give an overview of the ESSnuSB project with details on the accelerator complex, from source to target. We will also present the proposed next steps for the ESSnuSB project.

Attendance type

Virtual presentation

Primary authors: MILAS, Natalia (European Spallation Source); MAJA, Olvegård

Presenter: MILAS, Natalia (European Spallation Source)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

Front-end electronics for the Mu2e tracker

Monday, August 1, 2022 7:00 PM (40 minutes)

The Mu2e experiment uses a cylindrical straw tube tracker operated in vacuum to provide a high precision momentum measurement of 105 MeV/c electrons that are the signal of charged lepton flavor violating (CLFV) muon to electron conversion. The tracker is instrumented with custom front-end electronics based on PolarFire FPGAs that sit at the outer radius of the tracker. Each straw is read out at both ends, and precise firmware TDCs allow for time-division based reconstruction of the hit position along the wire. The data is read out over optical fibers by the TDAQ system. The design, testing, and performance of the tracker electronics will be presented.

Attendance type

In-person presentation

Primary author: BONVENTRE, Richard (Lawrence Berkeley National Lab)

Presenter: BONVENTRE, Richard (Lawrence Berkeley National Lab)

Session Classification: Reception & Poster Session

Track Classification: WG4: Muon Physics

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

Muon Acceleration for Future Neutrino and Higgs Factory

Friday, August 5, 2022 4:40 PM (30 minutes)

Current machine concepts developed by Muon Accelerator Program (MAP) for a neutrino factory can be extended to reach the 63~GeV needed for s-channel production of the Higgs boson and beyond, by the addition of one or two RLAs, Envisioned staged approach, assumes a single-pass linac with a combination of 325 and 650 MHz superconducting RF, followed by a Recirculating Linear Accelerator(RLA) configured with 2.9~GeV/pass, 650 MHz superconducting linac based on quadrupole focusing, completed with four 'droplet' arcs, where the beam reaches 15 GeV in 4.5 recirculation passes. The chain can be further extended by a subsequent RLA based on Tesla cavities.
.

Attendance type

In-person presentation

Primary author: Dr BOGACZ, Alex (Jefferson Lab)

Presenter: Dr BOGACZ, Alex (Jefferson Lab)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **127** Type: **Talk**

Measuring solar neutrinos over gigayear timescales with paleo detectors

Friday, August 5, 2022 2:20 PM (18 minutes)

Measuring the solar neutrino flux over gigayear timescales could provide a new window to inform the solar standard model as well as studies of the Earth's long-term climate. We demonstrate the feasibility of measuring the time evolution of the B8 solar neutrino flux over gigayear timescales using paleo detectors, naturally occurring minerals which record neutrino-induced recoil tracks over geological times. We explore suitable minerals and identify track lengths of 15–30 nm to be a practical window to detect the B8 solar neutrino flux. A collection of ultraradiopure minerals of different ages, each some 0.1 kg by mass, can be used to probe the rise of the B8 solar neutrino flux over the recent gigayear of the Sun's evolution. We also show that the time-integrated tracks are sensitive to models of the Sun.

Attendance type

In-person presentation

Primary author: TAPIA, Natalia (Virginia Tech)

Presenters: TAPIA, Natalia (Virginia Tech); Prof. HORIUCHI, Shunsaku (Virginia Tech)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

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

Validating the Earth's Core using Atmospheric Neutrinos with ICAL at INO

Sunday, July 31, 2022 3:45 PM (25 minutes)

The Iron Calorimeter (ICAL) detector at the proposed India-based Neutrino Observatory (INO) aims to detect atmospheric neutrinos and antineutrinos separately in the multi-GeV range of energies and over a wide range of baselines. By utilizing its charge identification capability, ICAL can efficiently distinguish μ^- and μ^+ events. Atmospheric neutrinos passing long distances through Earth can be detected at ICAL with good resolution in energy and direction, which enables ICAL to see the density-dependent matter oscillations experienced by upward-going neutrinos in the multi-GeV range of energies. In this work, we explore the possibility of utilizing neutrino oscillations in the presence of matter to extract information about the internal structure of Earth complementary to seismic studies. Using good directional resolution, ICAL would be able to observe 331 μ^- and 146 μ^+ core-passing events with 500 kt·yr exposure. With this exposure, we show for the first time that the presence of Earth's core can be independently confirmed at ICAL with a median $\Delta\chi^2$ of 7.45 (4.83) assuming normal (inverted) mass ordering by ruling out the simple two-layered mantle-crust profile in theory while generating the prospective data with the PREM profile. We observe that in the absence of charge identification capability of ICAL, this sensitivity deteriorates significantly to 3.76 (1.59) for normal (inverted) mass ordering.

Attendance type

In-person presentation

Primary authors: Mr KUMAR, Anil (Insitute of Physics, Bhubaneswar. Homi Bhabha National Institute, Mumbai); Prof. AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar, HBNI, Mumbai, UW Madison and WIPAC, USA)

Presenter: Mr KUMAR, Anil (Insitute of Physics, Bhubaneswar. Homi Bhabha National Institute, Mumbai)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

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

The Camera System for the IceCube Upgrade

Friday, August 5, 2022 2:38 PM (18 minutes)

As part of a currently ongoing upgrade to the IceCube Neutrino Observatory, seven new strings will be deployed in the central region of the detector to enhance the capability to detect neutrinos in the GeV range. A main science objective of the IceCube Upgrade is to improve the calibration of the IceCube detector as a means of reducing systematic uncertainties related to the optical properties of the ice. A novel camera and illumination system, consisting of more than 1900 cameras installed in 700 newly developed optical modules of the IceCube Upgrade, has been developed. A combination of transmission and reflection photographic measurements will be used to measure the optical properties of bulk ice between strings and refrozen ice in the drill hole, to determine module positions, and to survey the local ice environments surrounding the sensor module. In this contribution, we present the production, acceptance testing, and the plan for post-deployment calibration measurements with this camera system.

Attendance type

In-person presentation

Primary author: KANG, Woosik (Sungkyunkwan University)

Co-authors: TOENNIS, Christoph (Sungkyunkwan University); RODAN, Steven (Sungkyunkwan University); LEE, Jiwoong (Sungkyunkwan University); ROTT, Carsten (University of Utah)

Presenter: KANG, Woosik (Sungkyunkwan University)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

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

An Upgrade Path for the Fermilab Accelerator Complex

Tuesday, August 2, 2022 3:30 PM (30 minutes)

The PIP-II and DUNE/LBNF projects will constitute a 1.2 MW long-baseline neutrino facility at Fermilab. The DUNE/LBNF Phase II calls for a 2.4 MW proton power upgrade, and this talk will outline one compelling path towards achieving that benchmark and also provides a robust experimental program at other energies. The proposed facility include a CW-capable 2GeV linac, a 2 GeV 0.5-2 MW pulsed proton ring, a 0.75-1 MW 8 GeV pulsed program, and a path to a 4 MW upgrade of DUNE/LBNF. Opportunities for neutrino and muon programs will be highlighted.

Attendance type

Virtual presentation

Primary author: ELDRED, Jeffrey (Fermilab)

Presenter: ELDRED, Jeffrey (Fermilab)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

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

WG2 Introduction

Monday, August 1, 2022 9:00 AM (20 minutes)

Presenter: KIKAWA, Tatsuya

Session Classification: Plenary: WG Introductions

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

WG3 Introduction

Monday, August 1, 2022 9:20 AM (20 minutes)

Attendance type

Presenter: YONEHARA, Katsuya (Fermilab)

Session Classification: Plenary: WG Introductions

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

WG4 Introduction

Monday, August 1, 2022 9:40 AM (20 minutes)

Attendance type

Presenter: OKSUZIAN, Yuri (Argonne)

Session Classification: Plenary: WG Introductions

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

WG5 Introduction

Monday, August 1, 2022 10:00 AM (20 minutes)

Presenter: RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

Session Classification: Plenary: WG Introductions

Contribution ID: **137** Type: **not specified**

WG6 Introduction

Monday, August 1, 2022 10:20 AM (20 minutes)

Presenter: NISHIMURA, Yasuhiro (Keio University)

Session Classification: Plenary: WG Introductions

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

WG7 Introduction

Monday, August 1, 2022 11:15 AM (20 minutes)

Presenter: BECHTOL, Ellen (UW Madison)

Session Classification: Plenary

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

NuFact 2022 conference logistics

Tuesday, August 2, 2022 9:30 AM (5 minutes)

Proceedings, Conference Tours, …

Presenters: ROTT, Carsten (University of Utah); SANDICK, Pearl (University of Utah); ZHAO, Yue (University of Utah)

Session Classification: Plenary

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

Welcome by the Dean of the College of Science

Monday, August 1, 2022 11:00 AM (15 minutes)

Presenter: TRAPA, Peter

Session Classification: Plenary

Contribution ID: **141** Type: **Talk**

Snowmass Status

Monday, August 1, 2022 11:35 AM (30 minutes)

Presenter: HAN, Tao (University of Pittsburgh)

Session Classification: Plenary

Contribution ID: **142** Type: **Talk**

Modular symmetries and the flavor problem

Thursday, August 4, 2022 11:50 AM (30 minutes)

The "flavor problem" represents one of the greatest challenges of particle model building since SM does not provide neither "a priori" explanation of the number of fermion generations nor on their mass and mixing patters, which appear to be very different in the lepton and quark sector. Discrete non-abelian symmetries have gathered a lot of attention as candidates for the solutions of the latter problems. In this talk, I will revise the latest results achieved by Modular Symmetries in the description of fermion masses and mixings, showing that this recently proposed framework is particularly suitable for a unified description of leptons and quarks.

Attendance type

Virtual presentation

Primary author: MELONI, Davide

Presenter: MELONI, Davide

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **143** Type: **Talk**

Non-accelerator neutrinos - neutrinos from natural sources

Friday, August 5, 2022 10:05 AM (30 minutes)

Presenter: WISSEL, Stephanie (Pennsylvania State University)

Session Classification: Plenary

Contribution ID: **144** Type: **Talk**

Status of T2K

Monday, August 1, 2022 2:20 PM (30 minutes)

Attendance type

Presenter: KORMOS, Laura (Lancaster University)

Session Classification: Plenary

Contribution ID: **145** Type: **not specified**

Status of NOvA

Monday, August 1, 2022 2:50 PM (30 minutes)

Attendance type

Presenter: WOLCOTT, Jeremy (Tufts University)

Session Classification: Plenary

Contribution ID: **146** Type: **not specified**

Status of IceCube

Monday, August 1, 2022 1:50 PM (30 minutes)

Attendance type

Presenter: LEONARD, Kayla (University of Wisconsin - Madison)

Session Classification: Plenary

Contribution ID: **147** Type: **Talk**

Status of DUNE

Monday, August 1, 2022 3:40 PM (30 minutes)

Presenter: GOLLAPINNI, Sowjanya (Los Alamos National Lab)

Session Classification: Plenary

Contribution ID: **148** Type: **Talk**

Status of Hyper-Kamiokande

Monday, August 1, 2022 4:10 PM (30 minutes)

Presenter: SMY, Michael (UCI)

Session Classification: Plenary

Contribution ID: **149** Type: **not specified**

Status of JUNO

Monday, August 1, 2022 4:40 PM (30 minutes)

Presenter: LUDHOVA, Livia

Session Classification: Plenary

Contribution ID: **150** Type: **Talk**

Status of ESSnuSB

Tuesday, August 2, 2022 11:30 AM (30 minutes)

Presenter: DRACOS, Marcos (IPHC-IN2P3/CNRS)

Session Classification: Plenary

Contribution ID: **151** Type: **Talk**

Latest results from COHERENT

Tuesday, August 2, 2022 9:35 AM (30 minutes)

Attendance type

Presenters: HEDGES, Samuel (Duke University); HEDGES, Samuel (LLNL)

Session Classification: Plenary

Contribution ID: **152** Type: **Talk**

Latest from Models and Generators

Tuesday, August 2, 2022 10:05 AM (30 minutes)

Presenters: ROCCO, Noemi; ROCCO, Noemi (Argonne National Laboratory - Fermilab)

Session Classification: Plenary

Contribution ID: **153** Type: **Talk**

Potential Constraints to Neutrino - Nuclei interaction based on electron scattering data

Tuesday, August 2, 2022 10:35 AM (30 minutes)

Presenter: PANDEY, Vishvas (University of Florida)

Session Classification: Plenary

Contribution ID: **154** Type: **Talk**

NuMI AIP and LBNF Neutrino Beam Progress

Wednesday, August 3, 2022 8:00 AM (30 minutes)

Attendance type

Presenter: LEE, Meredith (Fermilab)

Session Classification: Plenary

Contribution ID: **155** Type: **Talk**

J-PARC neutrino beam and upgrades

Wednesday, August 3, 2022 8:30 AM (30 minutes)

Presenters: FRIEND, Megan (KEK); NAKADAIRA, Takeshi (KEK)

Session Classification: Plenary

Contribution ID: **156** Type: **Talk**

ESS project status

Wednesday, August 3, 2022 9:00 AM (30 minutes)

Attendance type

Presenter: JONES, Kevin (ESS)

Session Classification: Plenary

Contribution ID: **157** Type: **Talk**

Muon Physics Review - Present Experiments

Wednesday, August 3, 2022 9:50 AM (30 minutes)

Presenter: PAPA, Angela (Paul Scherrer Institut)

Session Classification: Plenary

Contribution ID: **158** Type: **Talk**

Muon Physics Review - Future Experiments

Wednesday, August 3, 2022 10:20 AM (30 minutes)

Presenter: LYNCH, Kevin (York College/CUNY)

Session Classification: Plenary

Contribution ID: **159** Type: **Talk**

Overview of cLFV in the muon sector

Wednesday, August 3, 2022 10:50 AM (30 minutes)

Presenter: KRIEWALD, Jonathan (IN2P3)

Session Classification: Plenary

Contribution ID: **160** Type: **Talk**

Muon Collider

Wednesday, August 3, 2022 11:20 AM (30 minutes)

Presenter: SCHULTE, Daniel (CERN)

Session Classification: Plenary

Contribution ID: **161** Type: **Talk**

Searches for Exotic Particles

Thursday, August 4, 2022 9:00 AM (30 minutes)

Presenter: TABRIZI, Zahra (Northwestern University)

Session Classification: Plenary

Contribution ID: **162** Type: **Talk**

Gauged Seesaws outlook at Run III and HL-LHC

Session Classification: Plenary

Contribution ID: **163** Type: **Talk**

CP violation in neutrino mass models

Presenter: PETCOV, Serguey (SISSA/INFN, Trieste, Italy)

Session Classification: WG5: Beyond PMNS

Contribution ID: **164** Type: **Talk**

Short baseline experiments

Thursday, August 4, 2022 9:30 AM (30 minutes)

Attendance type

Presenter: ROSS-LONERGAN, Mark (IPPP Durham University)

Session Classification: Plenary

Contribution ID: **165** Type: **not specified**

Latest results from JSNS2 and status of JSNS2-II

Tuesday, August 2, 2022 12:00 PM (30 minutes)

Attendance type

Presenter: PARK, Jungsic (High Energy Accelerator Research Organization)

Session Classification: Plenary

Contribution ID: **166** Type: **Talk**

Neutrino event reconstruction and Machine Learning

Friday, August 5, 2022 8:35 AM (30 minutes)

Presenter: TERAO, Kazuhiro (SLAC National Accelerator Laboratory)

Session Classification: Plenary

Contribution ID: **167** Type: **Talk**

Scintillator detectors

Friday, August 5, 2022 9:05 AM (30 minutes)

Attendance type

Presenter: YEH, Minfang (Brookhaven National Laboratory)

Session Classification: Plenary

Contribution ID: **168** Type: **Talk**

Challenges in the construction of large neutrino detectors: the JUNO case

Friday, August 5, 2022 9:35 AM (30 minutes)

Attendance type

Primary author: MONTUSCHI, Michele (INFN - Sez di Ferrara)

Presenter: MONTUSCHI, Michele (INFN - Sez di Ferrara)

Session Classification: Plenary

Contribution ID: **169** Type: **Talk**

Multi-messenger Tomography of Earth (MMTE 2022) Summary

Thursday, August 4, 2022 10:00 AM (30 minutes)

Presenter: AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar)

Session Classification: Plenary

Contribution ID: **170** Type: **Talk**

Summary WG1 - Neutrino Oscillations

Saturday, August 6, 2022 8:40 AM (30 minutes)

Attendance type

Presenter: SCOTT, Mark (Imperial College London)

Session Classification: Plenary: WG Summary

Contribution ID: **171** Type: **not specified**

Summary WG2 - Neutrino Scattering

Saturday, August 6, 2022 9:10 AM (30 minutes)

Presenter: ASHKENAZI, Adi (Massachusetts Institute of Technology)

Session Classification: Plenary: WG Summary

Contribution ID: **172** Type: **not specified**

Summary WG3 - Accelerators

Saturday, August 6, 2022 10:10 AM (30 minutes)

Attendance type

Presenters: YONEHARA, Katsuya (Fermilab); MATSUBARA, Tsunayuki (KEK)

Session Classification: Plenary: WG Summary

Contribution ID: **173** Type: **Talk**

Summary WG4 - Muon Physics

Saturday, August 6, 2022 11:00 AM (30 minutes)

Attendance type

Presenter: OKSUZIAN, Yuri (Argonne)

Session Classification: Plenary: WG Summary

Contribution ID: **174** Type: **Talk**

Summary WG5 - Physics Beyond PMNS

Saturday, August 6, 2022 9:40 AM (30 minutes)

Presenter: RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

Session Classification: Plenary: WG Summary

Contribution ID: **175** Type: **not specified**

Summary WG6 - Detectors

Saturday, August 6, 2022 11:30 AM (30 minutes)

Presenter: NISHIMURA, Yasuhiro (Keio University)

Session Classification: Plenary: WG Summary

Contribution ID: **176** Type: **Talk**

Summary WG7 - Inclusion, Diversity, Equity, Education, & Outreach

Saturday, August 6, 2022 12:00 PM (30 minutes)

Presenter: HIROSHIMA, Nagisa (University of Toyama)

Session Classification: Plenary: WG Summary

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

Selected Posters

Friday, August 5, 2022 10:35 AM (15 minutes)

10x3min presentations by selected posters

Session Classification: Plenary

Contribution ID: **178** Type: **Talk**

Closing

Saturday, August 6, 2022 12:30 PM (30 minutes)

Presenters: ROTT, Carsten (University of Utah); SANDICK, Pearl (University of Utah)

Session Classification: Plenary: WG Summary

Contribution ID: **179** Type: **Talk**

PIP-II Accumulator Ring - PAR

Friday, August 5, 2022 2:50 PM (30 minutes)

The FNAL accelerator complex is poised to reach MW neutrino beams on target for the exploration of the dark sector physics and rare physics program spaces. Future operations of the complex will include the CW capable PIPII linac at beam intensities that have not been seen before [1, 2]. The ambitious beam program relies on multi-turn H– injection into the FNAL Booster and then extracted into delivery rings or the Booster Neutrino Beam (BNB) 8 GeV HEP program. These programs will utilize about 1.5% of the PIPII capabilities. Additionally, there are many accelerator engineering challenges that are already known and many that will be discovered. This proposal calls for an intermediate step that will both facilitate the operation of Booster in the PIP-II era, gain operational experience associated with high power injection rings and jump start FNAL beam based dark sector physics program. The PIP-II Accumulator Ring (PAR) is being designed to deliver several hundred kW beam power for a dark sector (DS) program with flexible bunch structures. This step includes the design, construction and installation of a 0.8 GeV accumulator ring (upgradeable to 1+ GeV) to be located in the PIP-II Booster Transfer Line (BTL). The PIP-II accumulator ring (PAR) may be primarily designed around permanent magnets or use standard iron core magnet technology with an aperture selected to accommodate the desired high intensity protons at 0.8 GeV.
PAR will leverage the power of PIPII and create and exciting DS program by the end of the decade.

Attendance type

In-person presentation

Primary author: PELLICO, William (FNAL)

Presenter: PELLICO, William (FNAL)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **180** Type: **Talk**

Benchmarking intra-nuclear cascade models for neutrino scattering with relativistic optical potentials

Thursday, August 4, 2022 3:00 PM (20 minutes)

The description of final-state interactions (FSI) in the large phase space probed in neutrino experiments poses a great challenge. In neutrino experiments, which operate under semi-inclusive conditions, cascade models are commonly used for this task, while under exclusive conditions FSI can be treated with relativistic optical potentials (ROP). We formulate conditions under which the ROP approach and cascade model can be directly compared. We feed the NEUT cascade with events from a relativistic distorted-wave impulse approximation calculation that uses the real part of an optical potential. Cuts on the missing energy of the resulting events are applied to define a set of events that can be directly compared to RDWIA calculations with the full optical potential. The NEUT cascade and ROP agree for proton kinetic energies Tp>150 MeV for carbon, oxygen and calcium nuclei when a realistic nuclear density is used to introduce events in the cascade. For Tp<100 MeV the ROP and NEUT cross sections differ in shape and differences in magnitude are larger than 50 \%. Single transverse variables allow to distinguish different approaches to FSI, but due to a large non-QE contribution the comparison to T2K data does not give an unambiguous view of FSI. We discuss electron scattering and argue that with a cut in missing energy FSI can be studied with minimal confounding factors in e.g. e4v. The agreement of the ROP and NEUT for T2K conditions lends confidence to these models as a tool in oscillation analyses for sufficiently large nucleon kinetic energies. These results urge for caution when a cascade model is applied for small nucleon energies. The assessment of model assumptions relevant to this region are strongly encouraged. This paper provides novel constraints on cascade models from proton-nucleus scattering that can be easily applied to other neutrino event generators.

Attendance type

In-person presentation

Primary authors: NIKOLAKOPOULOS, Alexis (FNAL); SANCHEZ, Federico (Universite de Genève); UDÍAS, Jose Manuel (Universidad Complutense de Madrid); NIEWCZAS, Kajetan (Ghent University); JACHOWICZ, Natalie (Ghent University); GONZÁLEZ JIMÉNEZ, Raul (Universidad Complutense de Madrid)

Presenter: NIKOLAKOPOULOS, Alexis (FNAL)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **181** Type: **Talk**

Search for secluded dark matter with 6 years of IceCube data

Friday, August 5, 2022 5:35 PM (25 minutes)

The IceCube neutrino observatory–installed in the Antarctic ice–is the largest neutrino telescope to date. It consists of 5,160 photomultiplier-tubes spread among 86 vertical strings making a total detector volume of more than a cubic kilometer. IceCube detects neutrinos via Cherenkov light emitted by charged relativistic particles produced when a neutrino interacts in or near the detector. The detector is particularly sensitive to high-energy neutrinos of due to its size and photosensor spacing. In this analysis we search for dark matter that annihilates into a metastable mediator that subsequently decays into Standard Model particles. These models yield an enhanced high-energy neutrino flux from dark matter annihilation inside the Sun compared to models without a mediator. Signals produceddirectly inside the solar plasma are subject to strong attenuation. Mediators produced by secluded dark matter can however escape the Sun and avoid any such attenuation. We present the results of an analysis of six years of IceCube data looking for dark matter in the Sun for dark matter masses ranging from 200 GeV to 75 TeV.

Attendance type

In-person presentation

Primary author: TOENNIS, Christoph (SKKU)

Presenter: TOENNIS, Christoph (SKKU)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **182** Type: **Talk**

IsoDAR@Yemilab – A definitive search for exotic neutrinos and other BSM physics

Friday, August 5, 2022 2:20 PM (30 minutes)

The IsoDAR neutrino source comprises a novel compact cyclotron capable of delivering 10 mA of 60 MeV protons in cw mode and a high-power neutrino production target. It has obtained preliminary approval to run at the new underground facility Yemilab in South Korea. IsoDAR will produce a very pure, isotropic $\bar{\nu}_e$ source, with peak neutrino energy around 6 MeV and endpoint around 15 MeV. Paired with a kton-scale detector like the planned Liquid Scintillator Counter (LSC) at Yemilab, IsoDAR can measure $\bar{\nu}_e$ disappearance through the inverse beta decay (IBD) channel. We expect about 1.67·106 IBD events, and ~7000 $\bar{\nu}_e - e^-$ elastic scatter events in the LSC in five years of running letting us distinguish many different models for sterile neutrinos and improving significantly on existing limits for non-standard interactions (NSI). Finally, IsoDAR@Yemilab is sensitive to new particles produced in the target (such as a light X boson, that decays to $\bar{\nu}_e\nu_e$). Beyond the physics applications, we describe the accelerator developments for IsoDAR that enable us to produce about a mole of neutrinos in five years of running. These include direct injection through a radiofrequency quadrupole, exploiting complex beam dynamics, and application of machine learning in accelerator design and optimization.

Attendance type

Virtual presentation

Primary author: WINKLEHNER, Daniel (Massachusetts Institute of Technology)

Presenter: WINKLEHNER, Daniel (Massachusetts Institute of Technology)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **183** Type: **Talk**

Neutrino oscillation measurement with KM3NeT/ORCA

Friday, August 5, 2022 11:15 AM (22 minutes)

KM3NeT/ORCA is an underwater neutrino telescope which is currently being deployed in the Mediterranean Sea. Its geometry has been optimized for the study of neutrino oscillations using atmospheric neutrinos. In particular this will allow to measure the neutrino mass ordering as well as θ_{23} and Δm^2_{31}. The performance of ORCA with a 6 string configuration and one year of exposure already allowed to exclude the non-oscillation hypothesis with more than $5\,\sigma$. In this contribution an update of these results will be presented and the sensitivity of a full ORCA detector will be discussed.

Attendance type

In-person presentation

Primary author: SCHUMANN, Johannes (Friedrich-Alexander-Universität Erlangen-Nürnberg)

Presenter: SCHUMANN, Johannes (Friedrich-Alexander-Universität Erlangen-Nürnberg)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **184** Type: **Talk**

Lepton flavor universality and lepton flavor violation tests at ATLAS

Thursday, August 4, 2022 2:45 PM (25 minutes)

The growing evidence of lepton-flavour-universality violation in B-meson decays is one of the most interesting hints for physics beyond the Standard Model that may be reachable at the Large Hadron Collider. In addition, the observation of lepton flavor violation (LVF) would be a smoking gun for the presence of physics beyond the Standard Model Consequently, a broad program of measurements and direct searches that test lepton-flavor universality and lepton-flavour violation in proton-proton collisions is underway at the ATLAS experiment. This talk will present the latest results using the full Run 2 dataset at a center-of-mass energy of 13 TeV, as well as discuss future prospects.

Attendance type

In-person presentation

Primary authors: LEONE, Sandra (INFN - Sezione di Pisa); ATLAS COLLABORATION, Speaker to be defined

Presenter: TAL HOD, Noam (Weizmann Institute of Science)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **185** Type: **Talk**

Tests of neutrino mass models at ATLAS

Friday, August 5, 2022 2:50 PM (30 minutes)

Multiple theories beyond the Standard Model predict the existence of heavy neutrinos, such as the Type I or Type III seesaw mechanisms which can explain the light neutrino masses, or left-right symmetric models which restore parity symmetry in weak interactions at higher energy scale and predict right-handed counterparts to the weak gauge bosons. Searches for such heavy Majorana or Dirac neutrinos with the ATLAS detector, which can also lead to boosted or also displaced signatures, will be presented using proton-proton data from the LHC at a center-of-mass energy of 13 TeV.

Attendance type

In-person presentation

Primary authors: LEONE, Sandra (INFN - Sezione di Pisa); ATLAS COLLABORATION, Speaker to be defined

Presenter: WYNNE, Ben

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **186** Type: **Talk**

A Muon Collider at Fermilab

Friday, August 5, 2022 5:10 PM (30 minutes)

The Fermilab site can accommodate a Muon Collider at up to 10 TeV center of mass energy. Parameters for Fermilab-based muon colliders are presented. Recent related research on rapid-cycling acceleration, muon cooling, proton sources and targetry is discussed. Compatibility with neutrino sources and neutrino factories is also discussed as well as directions for future research.

Attendance type

In-person presentation

Primary author: NEUFFER, David (Fermilab)

Presenter: NEUFFER, David (Fermilab)

Session Classification: WG3: Accelerator Physics

Track Classification: WG3: Accelerator Physics

Contribution ID: **187** Type: **Talk**

Status of the Muon g-2/EDM experiment at J-PARC

Friday, August 5, 2022 2:50 PM (30 minutes)

The muon g-2/EDM experiment at J-PARC (E34) aims to measure muon g-2 and EDM with a low-emittance muon beam realized by the acceleration of thermal muons. Together with other novel techniques, the experiment measures muon g-2 in a different approach from FNAL. The technical design of the experiment has been completed, and the budget is being requested to start the data taking in 2027. In the first phase, the measurement of g-2 with a precision of 0.45 ppm is expected in two years of data acquisition. The statistically limited accuracy of 0.1 ppm is the final goal. In this talk, developments and the current status of the experiment will be presented.

Attendance type

Virtual presentation

Primary authors: ZHANG, Ce (Peking University); E34 COLLABORATION

Presenter: ZHANG, Ce (Peking University)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **188** Type: **Talk**

Stimulate IDEEO in Neutrino Education through the IceCube Masterclass

Friday, August 5, 2022 11:15 AM (20 minutes)

The unique properties of neutrinos and the international efforts in the field of neutrino physics and neutrino astronomy have drawn significant public attention in recent years. How to successfully transform public interest into a driving force to promote Inclusion, Diversity, Equity, Education and Outreach (IDEEO) in fundamental science research relies on many tactical considerations. This report summarizes our outreach experience with engaging high school students in local communities in South Dakota and Wyoming through the IceCube Masterclass. Thoughts on promoting IDEEO in neutrino education jointly in EPSCoR jurisdictions will also be discussed.

Attendance type

In-person presentation

Primary author: BAI, Xinhua (South Dakota School of Mines and Technology)

Presenter: BAI, Xinhua (South Dakota School of Mines and Technology)

Session Classification: WG7: IDEEO

Track Classification: WG7: IDEEO

Contribution ID: **189** Type: **Talk**

WG5 TEST

THIS IS A TEST

Attendance type

In-person presentation

Primary author: RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

Presenter: RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **191** Type: **Talk**

Snowmass 2022: Connection between neutrino mass models and muon experiments

Friday, August 5, 2022 11:15 AM (40 minutes)

We explore the connection between neutrino mass models and muon experiments, esp. those looking for charged lepton flavor violation.

Attendance type

Virtual presentation

Primary author: HEECK, Julian (University of Virginia)

Presenter: HEECK, Julian (University of Virginia)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **192** Type: **Talk**

Current Understanding of the Earth's Core

Sunday, July 31, 2022 11:00 AM (25 minutes)

The Earth's core may be divided into two main regions: a solid inner core; and a liquid outer core. At the base of the outer core is a seismologically anomalous layer, likely denser than the liquid above. There may also be a low-density layer at the top of the outer core. The solid inner core is divided into two regions: a seismically anisotropic inner zone, and an isotropic layer on top. Although mainly composed of Fe, the core also contains ~5% Ni and one or more light elements. Light element candidates include C,S,Si,O and H. Of these, O is almost certainly present; S or Si are plausible; and C and H are considered less likely. The core may also contain small amounts of noble gases. Radioactive K in the core could affect its cooling history, but current estimates suggest a core K concentration of ~30ppm - too small to have a significant effect.

Attendance type

Virtual presentation

Primary author: NIMMO, Francis (UCSC)

Presenter: NIMMO, Francis (UCSC)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **193** Type: **Talk**

A coupled core-mantle evolution

Saturday, July 30, 2022 4:55 PM (25 minutes)

I would give a brief review on the topic concerning the core-mantle co-evolution in terms of thermal and chemical evolution of Earth's core constrained from the mantle dynamics of Earth. In this talk, several controversial aspects in current understandings of thermal and chemical evolution of the Earth's core will be introduced: 1. The age of inner core (greatly uncertain in between ~1 Ga to 3 Ga) and potential energy source for geodynamo operating over 4 billion years, 2. Emergence of stably stratified region at the uppermost outer core and its origin (thermal or chemical) and 3. possibility on the radiogenic heat source in Earth's core.

Attendance type

Virtual presentation

Primary author: NAKAGAWA, Takashi

Presenter: NAKAGAWA, Takashi

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **194** Type: **Talk**

The search for the muon EDM at the Fermilab $g-2$ experiment and beyond

Friday, August 5, 2022 2:20 PM (30 minutes)

The observation of a non-zero permanent electric dipole moment (EDM) of an elementary particle would break both parity and time-reversal symmetries, implying the violation of charge-parity (CP) symmetry under CPT invariance. The Standard Model (SM) predicts subatomic particle EDMs which are so small as to be out of reach of current experiments, such that any observation of a non-zero EDM would indicate a source of CP violation arising from new physics beyond the SM (BSM). Presently, a measurement of muon EDM at the Fermilab $g-2$ experiment is well underway, aiming to exceed the current upper limit – set by the Brookhaven $g-2$ experiment – by two orders of magnitude at $\sim 10^{-21}$ e·cm; providing a unique opportunity to investigate BSM sources of CP violation in the second generation of leptons. This talk will provide an overview of the muon EDM search at Fermilab, as well as future search experiments.

Attendance type

Virtual presentation

Primary author: GRANT, Samuel (University College London)

Presenter: GRANT, Samuel (University College London)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **195** Type: **Talk**

Overview of Light Sterile Neutrino Searches

TBD

Attendance type

In-person presentation

Primary authors: KARAGIORGI, Georgia (Columbia University); KARAGIORGI, Georgia (Columbia University)

Presenters: KARAGIORGI, Georgia (Columbia University); KARAGIORGI, Georgia (Columbia University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **196** Type: **Talk**

Nuclear PDFs with Neutrino DIS data - a compatibility analysis from nCTEQ

Thursday, August 4, 2022 4:10 PM (20 minutes)

We present a global analysis of neutrino DIS cross-sections in the framework of nuclear parton distribution functions (PDFs). In our previous analysis (circa 2011), we concluded that some neutrino DIS data, particularly from the NuTeV experiment, were incompatible with the remaining nuclear scattering data. We have now performed a follow-up analysis that improves the previous study in many respects. For example, we have included all available neutrino DIS cross-section data from CDHSW, CCFR, NuTeV, and Chorus experiments alongside the di-muon semi-inclusive data. We have also improved the treatment of correlated systematic errors, and above all, we have included numerous important updates to the nuclear parton distribution functions accumulated across the past 10 years. In this contribution, we discuss the new updated global analysis of nuclear PDFs, including the neutrino data, and examine the tensions between different data sets encountered in the course of the global analysis. Understanding the tensions between the neutrino and charged-lepton DIS data is essential not only for a better flavor separation in global analyses of nuclear and proton PDFs, but also for neutrino physics and the searches for physics beyond the Standard Model.

Attendance type

In-person presentation

Primary author: RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

Presenter: RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **197** Type: **Talk**

Superionic H-bearing iron alloys in the Earth's inner core

Sunday, July 31, 2022 4:10 PM (25 minutes)

Earth's core plays a fundamental role in the evolution and habitability of our planet. Understanding its composition is key to interpreting the history of Earth's accretion. The density model suggests that the Earth's core is predominantly composed of iron (or iron-nickel alloy) with several percent of light elements, such as Si, S, C, O, and H, but their abundances in the Earth's core remain highly debated.
Seismic observations may provide important constraints on the chemical compositions of Earth's core. It was revealed that Earth's inner core transmits shear waves at anomalously low velocity. Although considerable efforts have been devoted to understanding this phenomenon in the past two decades, there is no one solution model that can match all seismic observations and geochemical constraints. In this talk, I will introduce our recent findings on H-bearing alloys under inner-core conditions. The superionic state of the inner core can explain the observed density and velocities simultaneously. Our findings reveal that hydrogen is a fundamental light element in the Earth's core.

Attendance type

Virtual presentation

Primary author: WANG, Wenzhong (University College London)

Presenter: WANG, Wenzhong (University College London)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **198** Type: **Talk**

Cosmogenic Background Suppression at the ICARUS

Friday, August 5, 2022 4:39 PM (29 minutes)

The ICARUS detector will search for LSND-like neutrino oscillations exposed at shallow depth to the FNAL BNB beam as the far detector in the Short-Baseline Neutrino (SBN) program. Cosmic backgrounds rejection is particularly important for the ICARUS detector due to its larger size and distance from neutrino production compared to the near detector SBND. In ICARUS the neutrino signal over cosmic background ratio is 40 times more unfavorable compared to SBND, in addition a greater than 3 times larger out-of-spill comics rate. On this poster, I will illustrate techniques for reducing cosmogenic backgrounds in the ICARUS detector.

Attendance type

In-person presentation

Primary author: BEHERA, Biswaranjan (Colorado State University)

Presenter: BEHERA, Biswaranjan (Colorado State University)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **199** Type: **Talk**

ARIADNE+: Large Scale Demonstration of Fast Optical Readout for Dual Phase LArTPCs at the CERN Neutrino Platform

Thursday, August 4, 2022 5:10 PM (20 minutes)

Optical readout of large scale dual-phase liquid Argon TPCs is an attractive and cost effective alternative to charge readout. Following the successful demonstration of 3D optical readout with the ARIADNE 1-ton detector, the ARIADNE+ experiment was recently deployed using the proto-DUNE "cold box" at the CERN neutrino platform imaging a much larger active region of 2m x 2m. ARIADNE+ uses 4 Timepix3 cameras imaging the S2 light produced by 16 novel, patent pending, glass THGEMs. ARIADNE+ takes advantage of the raw Timepix3 data coming natively 3D and zero suppressed with a 1.6 ns timing resolution. Three of the four THGEM quadrants were visible readout with the fourth featuring a VUV light image intensifier, thus removing the need for
wavelength shifting altogether. Cosmic muon events were recorded successfully at stable conditions providing the first demonstration for its use in kton scale experiments such as DUNE.

In my talk I will be discussing in detail the innovative ideas that make ARIADNE+ unique and the benefits that come with these technologies. These include, but is not limited too, TPX3Cams, the PEN wavelength shifting, a chemically etched stainless steel extraction grid, Invar support structure and a new way to manufacture glass THGEMs. I will also be presenting a gallery of cosmic muon events along with a breakdown of our mechanisms for analysis allowing us to arrive at an energy calibration and resolution.

Attendance type

In-person presentation

Primary author: LOWE, Adam (University of Liverpool)

Presenter: LOWE, Adam (University of Liverpool)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **200** Type: **Talk**

Long-Baseline Neutrino Oscillation Physics Sensitivities of the Hyper-Kamiokande Experiment

Friday, August 5, 2022 2:56 PM (18 minutes)

The Hyper-Kamiokande experiment has a rich long-baseline neutrino program, as well as a variety of other physics goals. The long-baseline program will utilize a world-class neutrino beam produced at the high-intensity J-PARC accelerator constrained by a suite of near detectors. The Hyper-Kamiokande detector is a ~185 kton fiducial volume water Cherenkov detector, located 295 km from the beam neutrino source. Hyper-Kamiokande long-baseline measurements will be sensitive to the leptonic CP violating phase, delta_CP, as well as the atmospheric oscillation parameters, sin^2theta_23 and Delta m^2_32. Combining the long-baseline and atmospheric neutrino measurements at the Hyper-Kamiokande detector will also allow for enhanced sensitivities, and in particular will help to resolve the neutrino mass ordering.

Attendance type

In-person presentation

Primary author: FRIEND, Megan (KEK)

Presenter: FRIEND, Megan (KEK)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **201** Type: **Talk**

Tau Neutrino Studies at ICAL Detector in INO

Friday, August 5, 2022 4:54 PM (22 minutes)

We present our results of tau neutrino events analysis at the Iron Calorimeter (ICAL) detector in India-based Neutrino Observatory (INO). We calculate the tau neutrino interaction with the detector via charged current(CC) interaction over background neutral current (NC) events of neutrinos of all flavors. We find that the presence of tau neutrinos with 10 years exposure at ICAL can be detected with nearly 4 sigma confidence. We show that the tau neutrino events are sensitive to the neutrino oscillation parameters θ_{23} and Δm^2. By performing combined analysis of tau neutrino events and muon neutrino events, we show the significant improvement in oscillation parameter θ_{23} and its octant measurement and moderate improvement in Δm^2 measurement.

Attendance type

Virtual presentation

Primary authors: Mr R, Thiru Senthil (The Institute of Mathematical Sciences, Taramani, Chennai 600113 India and Homi Bhabha National Institute, Anushaktinagar, Mumbai 400094 India); Prof. D, Indumathi (The Institute of Mathematical Sciences, Taramani, Chennai 600113 India and Homi Bhabha National Institute, Anushaktinagar, Mumbai 400094 India)

Presenter: Mr R, Thiru Senthil (The Institute of Mathematical Sciences, Taramani, Chennai 600113 India and Homi Bhabha National Institute, Anushaktinagar, Mumbai 400094 India)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **202** Type: **not specified**

Outcome of the ESSvSB design study 2018-2022

Sunday, July 31, 2022 2:05 PM (25 minutes)

Attendance type

Presenter: EKELÖF, Tord

Session Classification: Workshop

Contribution ID: **203** Type: **not specified**

Programme for the new design study ESSvSB+ 2023-2026

Sunday, July 31, 2022 2:30 PM (25 minutes)

Presenter: DRACOS, Marcos (IPHC-IN2P3/CNRS)

Session Classification: Workshop

Contribution ID: **204** Type: **Talk**

Target station and pion extraction system

Sunday, July 31, 2022 2:55 PM (20 minutes)

Attendance type

In-person presentation

Presenter: TOLBA, Tamer (Institut für Experimentalphysik, Universität Hamburg)

Session Classification: Workshop

Contribution ID: **205** Type: **Talk**

A Low Energy nuSTORM facility at ESS

Sunday, July 31, 2022 3:30 PM (20 minutes)

Attendance type

Presenter: OLVEGARD, Maja

Session Classification: Workshop

Contribution ID: **206** Type: **Talk**

The Low Energy ENUBET-like Monitored Neutrino Beam

Sunday, July 31, 2022 3:50 PM (25 minutes)

Attendance type

Virtual presentation

Presenter: TERRANOVA, Francesco (Univ. of Milano-Bicocca and INFN)

Session Classification: Workshop

Contribution ID: **207** Type: **Talk**

Detectors and physics performance of ESSvSB+

Sunday, July 31, 2022 4:15 PM (20 minutes)

Attendance type

Presenter: FANOURAKIS, George

Session Classification: Workshop

Contribution ID: **208** Type: **Talk**

Current status and future prospects of geoneutrino detection

Starting from the mid-twentieth century, the electron antineutrinos originating from the radioactive β⁻ emitters inside our planet, geoneutrinos, were proposed as a precious tool for exploring the inner Earth. While decaying, ⁴⁰K and the radioisotopes belonging to ²³⁸U and ²³²Th decay chains release geoneutrinos and energy in a well-fixed ratio. The energy released in these radioactive decays together with the secular cooling of our planet represents one of the main heat sources powering the internal dynamic processes of the Earth. Because of their weak interaction with matter, geoneutrinos can pass through our planet almost without interacting, bringing to surface useful information about Earth's interior.
The latest results from KamLAND (Japan) and Borexino (Italy) experiments give us an unprecedented opportunity to investigate the inner Earth. For almost 20 years these experiments have been collecting the feeble signal coming from ²³⁸U and ²³²Th geoneutrinos. The combination of experimental results and geochemical/geophysical modeling permits to estimate the U and Th content of our planet's mantle and in turn to derive its radiogenic heat production. The obtained results can be framed in the puzzle of the diverse proposed Earth's compositional models, analyzing their implications on planetary heat budget and composition.
The promising potential of geoneutrinos in investigating deep Earth radioactivity confer them a prestigious role in the comprehension of the geodynamical processes of our planet and lets us glimpse a bright future for this discipline in view of next generation SNO+ (Canada) and JUNO (China) experiments. We must expect much more from this field as novel proposed concepts and technologies promise to allow the attainment of directional information and the possible detection of the still elusive ⁴⁰K geoneutrinos, taking a further step towards the understanding of the Earth.

Attendance type

In-person presentation

Primary authors: Dr SERAFINI, Andrea (University of Padova and INFN); MANTOVANI, Fabio (University of Ferrara and INFN); BELLINI, Gianpaolo (University of Milan and INFN); WATANABE, Hiroko (Tohoku University); INOUE, Kunio (Tohoku University); STRATI, Virginia (University of Ferrara and INFN)

Presenter: Dr SERAFINI, Andrea (University of Padova and INFN)

Contribution ID: **209** Type: **Talk**

Prospects for measuring the Earth's outer core composition with neutrino oscillations

In the last 70 years, geophysics has established that the Earth's outer core is a Fe-Ni alloy containing a few percent of light elements, whose nature and amount remain controversial today. Besides the classical combinations of silicon and oxygen, hydrogen has been advocated as the only light element that could account alone for the density and velocity profiles of the outer core. Neutrino oscillations through the Earth open a new window into this puzzle by providing sensitivity to the electron density of the outer core. In this contribution we will show that the upcoming generation of neutrino detectors, KM3NeT/ORCA, Hyper-Kamiokande and DUNE, have the potential to detect a 1 wt% contribution of hydrogen in the core in 50 years. We then identify the requirements for a next-generation detector to take this measurement further and probe realistic models of the outer core with different light element contents.

Attendance type

In-person presentation

Primary author: COELHO, Joao (APC - France)

Presenter: COELHO, Joao (APC - France)

Contribution ID: **210** Type: **Talk**

New results from the atmospheric neutrino oscillations at Super-Kamiokande

Friday, August 5, 2022 11:59 AM (22 minutes)

Super-Kamiokande (SK) is the world's largest underground water Cherenkov detector which has been studying the atmospheric neutrino oscillations since 1996. Atmospheric neutrinos are famous for covering a wide energy range, have both neutrinos and antineutrinos, with electron and muon flavours, which oscillate to tau neutrinos and are sensitive for matter effects in the earth.

In this talk we would like to present updated results on atmospheric neutrino oscillations using five SK periods (data collected from SK-I to SK-V, years 1996-2020). The data analysis has beed improved by expanding the fiducial volume (FV) of the SK, by adding neutrino interactions taking place 1m from the detector walls. This allowed us to increase the data statistics up to 20 %, and thanks to improvement to the reconstruction algorithms we were able to keep systematics uncertainties still satisfactory.

Attendance type

In-person presentation

Primary author: POSIADALA-ZEZULA, Magdalena (University of Warsaw)

Presenter: POSIADALA-ZEZULA, Magdalena (University of Warsaw)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **211** Type: **Talk**

Neutrino Tomography of the Earth: the Potential of ORCA Detector

Sunday, July 31, 2022 11:25 AM (25 minutes)

Using PREM as a reference model for the
Earth density distribution we present results on
the sensitivity of ORCA detector to deviations of the Earth
i) outer core (OC) density, ii) inner core (IC) density,
iii) total core density, and iv) mantle density,
from their respective PREM densities.
The results are obtained in EPJ C82 (2022) 461
by studying the effects of the Earth matter
on the oscillations of atmospheric ν_μ, ν_e, $\bar{\nu}_\mu$
and $\bar{\nu}_e$. We show that the ORCA sensitivity
to the OC, IC, core and mantle densities
depends strongly on the type of systematic uncertainties
used in the analysis, on the value of the atmospheric neutrino mixing
angle θ_{23}, on whether the Earth mass constraint is implemented
or not, and on the way it is implemented,
and on the type - with normal ordering (NO) or
inverted ordering (IO) - of the light neutrino mass spectrum.
We show, in particular, that in the most favorable" NO case of
implemented Earth mass constraint,minimal" systematic errors and $\sin^2\theta_{23} = 0.58$,
ORCA can determine, e.g., the OC (mantle)
density at 3σ C.L. after 10 years of operation
with an uncertainty of (-18\%)/+15\% (of (-6\%)/+8\%). In the most disfavourable" NO
case ofconservative" systematic errors
and, e.g., $sin^2\theta_{23} = 0.50$ and 0.58 the uncertainties read, respectively:
(-37)\%/+30\% and (-30\%)/+24\% ((-13\%)/+16\% and (-11\%/+14\%)).
We find also that the sensitivity
of ORCA to the OC, core and mantle densities
is significantly worse for IO neutrino mass spectrum.

Attendance type

In-person presentation

Primary authors: Dr CAQPOZZI, Francesco (IFIC, Unicersity of Valencia, Spain); PETCOV, Serguey (SISSA/INFN, Trieste, Italy)

Presenter: PETCOV, Serguey (SISSA/INFN, Trieste, Italy)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **212** Type: **Talk**

Chemical composition and hydrogen content inside Earth

Saturday, July 30, 2022 4:10 PM (45 minutes)

Hydrogen is a strongly siderophile (iron-loving) element under typical conditions of Earth's core formation (40–50 GPa, ~3500 K); its metal/silicate partition coefficient *D*(H) (metal/silicate) = ~50 by weight (Tagawa et al., 2021 Nat. Commun.). Considering the amount of H2O in the mantle and oceans, such high *D*(H) (metal/silicate) suggests 0.3–0.6 wt% H in the core, which accounts for 30–60 % of the outer core density deficit and velocity excess compared to pure iron. The 0.3–0.6 wt% H in the outer core is compatible with seismological observations of its density and velocity; indeed, ab initio calculations showed these observations are explained with 1.0 wt% H as a single light element (Umemoto and Hirose, 2020 EPSL). The solid-Fe/liquid-alloy partition coefficient of hydrogen *D*(H) (solid-Fe/liquid) was recently determined to be 0.7 by weight in the Fe-Si-H system at 50 GPa (Hikosaka et al., 2022 SciRep). If it can be applied to inner core conditions (>330 GPa), the solid core may include 0.2–0.4 wt% H. It agrees with recent theoretical calculations of a possible range of the inner core composition that explains the observed density, compressional and shear velocities (Wang et al., 2021 EPSL). Note that the presence of carbon and/or hydrogen is important to explain the low shear/compressional velocity ratio characteristic of the inner core (He et al., 2022 Nature). In addition, Fe-FeH has recently been found to be an eutectic system (Tagawa et al., 2022 JGR), and the melting (liquidus) temperature of Fe-H alloys is low, in particular when 0.3–0.6 wt% H is included. It suggests low core temperatures, consistent with the fact that the base of the mantle is not globally molten. The 0.3–0.6 wt% H in the core is thus favored, but the present estimate depends largely on the mantle water abundance and the Earth's accretion process. Neutrino observations will be very helpful if they provide additional constraints on hydrogen concentration in the deep interior.

Attendance type

Virtual presentation

Primary author: HIROSE, Kei (The University of Tokyo)

Presenter: HIROSE, Kei (The University of Tokyo)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **213** Type: **Talk**

The Muon g-2 Experiment: Current status and outlook

Thursday, August 4, 2022 12:20 PM (30 minutes)

First results from the Fermilab Muon $g-2$ experiment were announced in 2021. The muon's anomalous magnetic moment a_μ was measured to an unprecedented 460 ppb precision, and the result is in agreement with the previous Brookhaven National Lab measurement. The 4.2σ tension between the combined experimental result and the Standard Model theoretical prediction suggests new beyond-Standard-Model physics. Analysis of Run 2 and 3 data is in progress, which is expected to reduce the experimental uncertainty by $2\times$. Meanwhile Run 5 data collection was recently completed, reaching very close to the total goal of $20\times$ Brookhaven statistics. In this talk I will present the Fermilab $g-2$ measurement approach and the Run 1 result, and then focus on the experiment's current status and outlook. Experiment upgrades since Run 1 have improved stability of the detector and storage ring systems, and refined characteristics of the stored muon beam. These together with specialized measurement campaigns, analysis improvements, and simulation efforts aim to reduce dominant systematic uncertainties toward the ultimate precision goal of 140 ppb.

Attendance type

In-person presentation

Primary author: MACCOY, Brynn (University of Washington)

Presenter: MACCOY, Brynn (University of Washington)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **214** Type: **Talk**

Imaging the Earth's Interior using Seismic Waves

Saturday, July 30, 2022 11:30 AM (45 minutes)

Earthquakes, ocean waves, and human activity produce seismic waves that travel through the Earth, carrying with them information about variations in elastic properties and density. Since pioneering efforts in the late 1970s, global seismic tomography has revealed structures in our planet's deep interior at increasingly greater detail. Here, I present recent progress in determining Earth's elastic and density structure, and discuss key structures at various scales. Finally, I review challenges and limitations facing seismologists in their efforts to obtain more precise images of the interior.

Attendance type

In-person presentation

Primary author: LEKIC, Vedran (University of Maryland, College Park)

Presenter: LEKIC, Vedran (University of Maryland, College Park)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **215** Type: **Talk**

LGBTQ+ Inclusivity in Physics and Beyond

Thursday, August 4, 2022 11:40 AM (20 minutes)

For over a decade, the LGBTQ+ CERN group has pushed to make CERN a better place for LGBTQ+ people. We interact with CERN management on issues of importance to our community, work to create a welcoming environment for LGBTQ+ people at CERN, make connections with other LGBTQ+ organizations in Geneva, and reach out to the broader CERN community. In this talk, I will discuss what we have accomplished and learned so far and how you can be a good ally to everybody in the LGBTQ+ community.

Attendance type

Virtual presentation

Primary author: KNOSPE, Anders (Lehigh University)

Presenter: KNOSPE, Anders (Lehigh University)

Session Classification: WG7: IDEEO

Track Classification: WG7: IDEEO

Contribution ID: **218** Type: **Talk**

Observing the Earth's Core with Neutrino Oscillations

Sunday, July 31, 2022 4:35 PM (25 minutes)

Neutrinos change flavor as they travel, and this probability depends on the density of electrons in the material they are traveling through. So, we can use neutrinos produced in the atmosphere by cosmic rays to tell us about the density of electrons in the Earth. In this talk, I will present our simulations of this phenomenon that we did in determining the sensitivity of the Deep Underground Neutrino Experiment (DUNE) to the size of the Earth's core.

Attendance type

In-person presentation

Primary author: Mrs PESTES, Rebekah (Virginia Tech)

Co-author: DENTON, Peter (Brookhaven National Laboratory)

Presenter: Mrs PESTES, Rebekah (Virginia Tech)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **219** Type: **Talk**

Neutrino oscillation tomography of the Earth and core composition with large water cherenkov detector

Sunday, July 31, 2022 2:50 PM (25 minutes)

The neutrino oscillation probability depends on the electron density of the media and next generation neutrino detector will have the capability to resolve the earth's electron density distribution with some accuracy.
If we combine the earth's matter density distribution and electron density distribution, then we can obtain the average chemical compositional distribution as Z/A ratio. Also if we assume some chemical composition model of the Earth, then we can obtain the matter density distribution of the Earth complimentaly. We will discuss about the possibility to measure the compositional distribution of the Earth using next generation large water cherenkov detector.

Attendance type

In-person presentation

Primary authors: TAKETA, Akimichi (Earthquake Research Institute, University of Tokyo); ROTT, Carsten (University of Utah)

Presenter: TAKETA, Akimichi (Earthquake Research Institute, University of Tokyo)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **220** Type: **Talk**

Neutrino Earth tomography in DUNE

Sunday, July 31, 2022 5:00 PM (25 minutes)

This talk will show how the Earth's density profile can be measured in the DUNE experiment using atmospheric neutrinos. After crossing the Earth, neutrinos give us access to a rich oscillation phenomenology that strongly depends on the matter potential sourced by the Earth. By performing a detailed simulation of the event reconstruction capabilities of liquid argon time projection chambers, where we have included the particle identification and the nuclear effects, we find that DUNE can measure the Earth's total mass at 8.4% precision with an exposure of 400~kton~year. In this result, we also include the different uncertainties that affect the atmospheric neutrino flux. Considering an effective Earth model with 3 layers, we have explored the sensitivity to each layer by combining DUNE with external measurements of the total mass and the moment of inertial of the Earth. Our analysis indicates that the core, lower mantle, and upper mantle densities can be determined with 8.8%, 13%, and 22% precision for the same exposure.

Attendance type

Virtual presentation

Primary authors: MARTINEZ SOLER, Ivan (Harvard University); KELLY, Kevin; MACHADO, Pedro (Fermilab); Dr PEREZ-GONZALEZ, Yuber (Durham U., IPPP)

Presenter: MARTINEZ SOLER, Ivan (Harvard University)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **221** Type: **Talk**

Unstable structure and dynamics in Earth's deepest mantle

Sunday, July 31, 2022 2:25 PM (25 minutes)

In Earth's deepest mantle, there are two huge structures with anomalously lower seismic velocities, and perhaps different compositions, than their surroundings. One such structure is found beneath Africa and the other is beneath the Pacific Ocean. They are often called "Large Low Velocity Provinces". These structures are footprints of Earth's long-term evolution. By examining their morphology and physical-chemical properties, we can greatly improve our understanding of how the planet evolved in the past 4.5 billion years. Through an exhaustive analysis of previous seismic images of Earth's mantle, we discovered that the African anomaly is about 1,000 km taller than the Pacific anomaly. By performing mantle convection simulations with high-performance computers, we find that the most significant control on the maximum height that a compositionally distinct structure can reach is its density. These results further suggests that the Africa anomaly is unstable because it is not dense enough, in which case it may have been rising up in recent geological time.

Attendance type

Virtual presentation

Primary author: Dr LI, Mingming

Presenter: Dr LI, Mingming

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **222** Type: **Poster**

Gain calibration using dark hits in off-time region of regular data at JSNS2 experiment

Monday, August 1, 2022 7:00 PM (40 minutes)

The JSNS2 experiment aims to search for the existence of sterile neutrino oscillations with deltam2 near 1eV2 at J-PARC MLF. A 1MW beam of 3 GeV protons incident on a spallation neutron target produces an intense neutrino beam from muon decay at rest. The experiment will search for muon antineutrino to electron antineutrino oscillations which can be detected by the inverse beta decay interaction followed by gammas from neutron capture on Gd. PMT in the detector is an essential device to find a signal in JSNS2 experiment. Currently, there are 120 PMTs in JSNS2 detector. But, since the performance of PMTs is not uniform, it is necessary to get the consistency of each PMTs. For that, we have calculated the PMT gains to have a calibration using a laser. However, the method can not monitor the gain in real-time. Thus, instead of that, the gain was monitored by using regular data in real-time. But, it is not sensitive to monitor due to multiple PE of the regular data. So, we developed an algorithm for the gain calibration method using dark hits in an off-time region of regular data.

Attendance type

In-person presentation

Primary author: PARK, RyeongGyoon (Chonnam national university)

Presenter: PARK, RyeongGyoon (Chonnam national university)

Session Classification: Reception & Poster Session

Track Classification: WG6: Detectors

Contribution ID: **223** Type: **Talk**

3D visualization of astronomy data using virtual reality

Friday, August 5, 2022 12:15 PM (20 minutes)

Visualization is an essential part of research, both to explore one's data and to communicate one's findings with others. Many data products in astronomy come in the form of multi-dimensional cubes, and since our brains are tuned for recognition in the 3D world, we ought to display and manipulate these in 3D space. This is possible with virtual reality (VR) devices.

Drawing from our experience developing immersive and interactive 3D experiences from actual science data at the Astrophysical Big Bang Laboratory (ABBL), I will give an overview of the opportunities and challenges that are awaiting astrophysicists in the burgeoning VR space. I will cover both software and hardware matters, as well as practical aspects for a successful delivery to the public.

Attendance type

Virtual presentation

Primary author: FERRAND, Gilles

Presenter: FERRAND, Gilles

Session Classification: WG7: IDEEO

Track Classification: WG7: IDEEO

Contribution ID: **224** Type: **Talk**

DUNE long-baseline oscillation physics sensitivity

Friday, August 5, 2022 3:14 PM (18 minutes)

Abstract: The Deep Underground Neutrino Experiment (DUNE) is a next generation, long-baseline neutrino oscillation experiment which will utilize high-intensity ν_μ and $\bar{\nu}_\mu$ with peak neutrino energies of ~2.5 GeV produced at Fermilab, over a 1285 km baseline, to carry out a detailed study of neutrino mixing. The neutrino beam has an initial design intensity of 1.2 MW, but has a planned upgrade to 2.4 MW. The unoscillated neutrino flux will be sampled with a near detector complex at Fermilab, and oscillated at the DUNE far detector at the Sanford Underground Research Facility, which will ultimately consist of four modules each containing a total liquid argon mass of 17 kt.

Here, the long-baseline neutrino oscillation sensitivity of DUNE is determined, using a full simulation, reconstruction, and event selection of the far detector and a full simulation and parameterized analysis of the near detector. Detailed uncertainties due to the flux prediction, neutrino interaction model, and detector effects are included. DUNE is able to resolve the neutrino mass ordering to a 5σ precision, for all values of the CP-phase, after a 66 kiloton-megawatt-year exposure (kt-MW-yr). It has the potential to observe charge-parity violation in the neutrino sector to a precision of 3σ (5σ) after an exposure of 197 (646) kt-MW-yrs, for 50% of all values of the CP-violating phase. DUNE's sensitivity to other oscillation parameters of interest have been explored.

Attendance type

In-person presentation

Primary author: WILKINSON, Callum (Lawrence Berkeley National Laboratory)

Presenter: WILKINSON, Callum (Lawrence Berkeley National Laboratory)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **225** Type: **Talk**

Welcome

Saturday, July 30, 2022 9:00 AM (15 minutes)

Welcome to the MMTE workshop and event logistics

Attendance type

Presenter: ROTT, Carsten (University of Utah)

Session Classification: Workshop

Contribution ID: **226** Type: **not specified**

Workshop Goals

Saturday, July 30, 2022 9:15 AM (15 minutes)

Presenter: AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar)

Session Classification: Workshop

Contribution ID: **228** Type: **not specified**

The Internal Structure of the Earth

Saturday, July 30, 2022 10:15 AM (45 minutes)

For a century the earth's interior (core (liquid)-mantle-crust) has been recognized and since we have identified a solid inner core and now many new structures that are "anchored" on the core-mantle-boundary (CMB). Moreover, we have successfully imaged subducting oceanic plates penetrating the upper mantle and many entering the lower mantle (>660 km). Over the last two decades, geoneutrino flux measurements are quantifying earth's radiogenic power, giving us the first global determination of bulk composition. More recently the detection of atmospheric and cosmological neutrinos that have traversed the earth are offering a new opportunity to measure other attributes of the earth's interior, mainly its density structure and hydrogen content. The age, origin, nature, and dynamic evolution of these structures will be discussed.

Presenter: MCDONOUGH, Bill

Session Classification: Workshop

Contribution ID: **229** Type: **not specified**

Present status and future prospects of geoneutrinos towards Earth tomography

Saturday, July 30, 2022 12:15 PM (45 minutes)

Presenter: SERAFINI, Andrea (University of Ferrara & INFN)

Session Classification: Workshop

Contribution ID: **230** Type: **not specified**

The first neutrino absorption Earth tomography

Saturday, July 30, 2022 2:30 PM (45 minutes)

Presenter: DONINI, Andrea

Session Classification: Workshop

Contribution ID: **235** Type: **not specified**

Earth's matter effect in neutrino oscillation

Sunday, July 31, 2022 9:45 AM (45 minutes)

Presenter: AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar)

Session Classification: Workshop

Contribution ID: **241** Type: **not specified**

Measuring the Earth's outer core composition using neutrino oscillations

Sunday, July 31, 2022 12:15 PM (25 minutes)

Presenter: COELHO, Joao (Tufts University)

Session Classification: Workshop

Contribution ID: **244** Type: **Talk**

Mentoring program initiative by Women in Technology at CERN (WIT)

Thursday, August 4, 2022 12:00 PM (20 minutes)

The Women in Technology community at CERN (WIT), currently comprising over 500 members, was born in early 2016 with the main aim to create a supportive network for exchanging experiences and career advice among women working at CERN.

This is done through diverse activities, such as:
• interviews featuring senior women scientists,
• social events such as movie screenings and laboratory visits,
• outreach lectures and events,
• social media campaigns,
• yearly mentoring program.

The WIT mentoring program facilitates one-to-one mentoring relationships that connect mentees with more senior colleagues at CERN (and CERN alumni), with the goal to foster professional learning and personal development and facilitate meaningful connections.

The program, which is running its fifth edition this year, is open to everyone at CERN regardless of gender, background or experience and has grown from 11 to 32 mentor-mentee pairs since its start.
This contribution describes how the WIT mentoring program is structured, what were the key pillars when starting the initiative and the ways of scaling it in the last years. It also highlights how this program benefits mentees and mentors alike as well as its potential to support the Organization.

Attendance type

Virtual presentation

Primary authors: PINZONI, Cinzia (CERN); BRONDOLIN, Erica (CERN); ALANDES PRADILLO, Maria (CERN); KRIVA, Simona (CERN); GOUSIOU, Evangelia (CERN); SHADURA, Oksana (University of Nebraska-Lincoln); BRAY, Rachel (CERN)

Presenter: KRIVA, Simona (CERN)

Session Classification: WG7: IDEEO

Track Classification: WG7: IDEEO

Contribution ID: **245** Type: **Talk**

Clockwork Fermions contribution to neutrino mass generation and Charged Lepton Flavor Violation l_i > l_j + \gamma

Thursday, August 4, 2022 5:50 PM (20 minutes)

The clockwork mechanism generates small neutrino masses which includes Dirac mass terms as well as Majorana mass terms for the new fermions with exponentially
suppressed interactions in theories which contain no small parameters at the fundamental level. We work on a general description of the clockwork mechanism valid for
fermions. This mechanism can be implemented with a discrete
set of new fields or, in its continuum version, through an extra spatial dimension. We derive analytic formulas for the masses of the new particles and for their Yukawa couplings to the lepton doublets, in the scenario where the clockwork parameters are universal. When the Majorana masses all vanish, the zero mode of the clockwork sector forms a Dirac pair with the active neutrino, with a mass which is in agreement with oscillations experiments for a sufficiently large number of clockwork gears. On the other hand, when the Majorana masses do not vanish, neutrino masses are generated via the seesaw mechanism. In this case, and due to the fact that the effective Yukawa couplings of the higher modes can be sizable, neutrino masses can only be suppressed by postulating a large Majorana mass for all the gears. Finally, we discuss the constraints on the mass scale of the clockwork fermions from the non-observation of the rare leptonic decay $\mu \longrightarrow e\gamma$.

Attendance type

Virtual presentation

Primary author: GHOSH, Gayatri (Assistant professor, physics Department , Pandit Deendayal Upadhayay Mahavidyalaya college, india)

Presenter: GHOSH, Gayatri (Assistant professor, physics Department , Pandit Deendayal Upadhayay Mahavidyalaya college, india)

Session Classification: WG5: Beyond PMNS

Track Classification: WG5: Beyond PMNS

Contribution ID: **248** Type: **Talk**

muEDM: The search for a muon electric dipole moment using the frozen-spin technique at PSI

Friday, August 5, 2022 3:20 PM (30 minutes)

Permanent electric dipole moments (EDMs) are excellent probes of physics beyond the Standard Model. Recently, the muon EDM has been of particular interest due to the tensions in the magnetic anomaly of the muon and the electron and hints of lepton-flavor universality violation in B-meson decays. At PSI, we proposed a dedicated muon EDM search experiment using the frozen-spin technique. In this technique, a radial electric field is applied in a solenoid storage ring with a vertical magnetic field to cancel the muon anomalous precession. The signal of the EDM can be inferred from the up-down asymmetry of the decay positron count versus time. The experiment is planned to take place in two phases. The sensitivity goal of phase I is 3×10^{-21} e cm and for phase II, it is 6×10^{-23} e cm. In this talk, I will present the principle and current status of the experiment.

Attendance type

Virtual presentation

Primary author: Prof. KHAW, Kim Siang (Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Presenter: Prof. KHAW, Kim Siang (Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Session Classification: WG4: Muon Physics

Track Classification: WG4: Muon Physics

Contribution ID: **249** Type: **Talk**

The NEUT Neutrino Interaction Simulation

Friday, August 5, 2022 12:15 PM (20 minutes)

NEUT is a neutrino-nucleus interaction simulation. It can be used to simulate interactions for neutrinos with between 100 MeV and a few TeV of energy. NEUT is also capable of simulating hadron interactions within a nucleus and is used to model nucleon decay and hadron–nucleus interactions for particle propagation in detector simulations. This talk describes the range of interaction channels modelled within NEUT, providing details on how each is implemented and on the tools available for propagating associated uncertainties. A range of comparisons of NEUT predictions to lepton and hadron scattering data are also shown.

Attendance type

Virtual presentation

Primary authors: WRET, Clarence; DOLAN, Stephen (LLR / CEA Saclay); PICKERING, Luke (Royal Holloway, University of London); HAYATO, Yoshinari (The University of Tokyo)

Presenter: DOLAN, Stephen (LLR / CEA Saclay)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **250** Type: **Talk**

Atmospheric Neutrinos for Non-Specialists

Saturday, July 30, 2022 9:30 AM (45 minutes)

The aim of this talk is to set the stage for the neutrino tomography workshop and to provide basic information about the properties of atmospheric neutrinos. I will present a pedagogical overview on atmospheric neutrinos, their history, and briefly review their current use in the study of neutrino oscillation.

Attendance type

Virtual presentation

Primary author: KEARNS, Edward (Boston University)

Presenter: KEARNS, Edward (Boston University)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **251** Type: **Poster**

Construction of a new scintillation tracker in T2K experiment

Monday, August 1, 2022 6:20 PM (40 minutes)

In the T2K experiment, new detectors are going to be installed to the near detector.
Super-FGD is one of them and a tracker which consists of 2 millions plastic scintillator cubes.
60 thousands wave length shifting fibers will be inserted to the cubes to lead scintillation light and it will be detected by SiPMs.

I will report the procedure to construct and install this detector.
The first step of construction is to insert fibers to the cubes.
This work should be done quickly because we have the 60 thousands fibers.
Our concern about it is that inserted fibers can be damaged by distortion of array of cubes and we have to check the quality of fibers during inserting the fibers.
I will also talk about a dedicated system for the fiber quality check.

Attendance type

In-person presentation

Primary author: KAWAUE, Masaki (Kyoto University)

Presenter: KAWAUE, Masaki (Kyoto University)

Session Classification: Reception & Poster Session

Track Classification: WG6: Detectors

Contribution ID: **253** Type: **Talk**

MultiPMTs at the Water Cherenkov Test Experiment / IWCD at Hyper-K

A new photosensor module that consists of 19 3-inch photomultiplier tubes has been developed for the Hyper-Kamiokande experiment, a next generation neutrino experiment. This talk will present the current status of the new photosensor module development and how the module will be used in the water Cherenkov test experiment and the intermediate water Chereknov detector that will be one of the near detectors to be used in the Hyper-Kamiokade long-baseline program.

Attendance type

Primary author: AKUTSU, Ryosuke

Presenter: AKUTSU, Ryosuke

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **254** Type: **Talk**

Options for PMT electronics at the Hyper-K far detector

Hyper-Kamiokande (HK) consists of a large Water Cherenkov detector, far detector (FD), and neutrino beam line, J-PARC. The FD is under construction now, and will be equipped with 20,000 PMTs whose diameter is 20 inch. It is improved and has twice better performance than that of Super-Kamiokande detector. For the 20 inch PMTs, we have been developing several types of readout electronics. They are required to utilize the improved performance as much as possible. This talk presents detailed schemes of each option and the status of R&D.

Attendance type

Primary author: IZUMIYAMA, Shota

Presenter: IZUMIYAMA, Shota

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **255** Type: **Talk**

ProtoDUNE Vertical Drift

Presenter: LANTWIN, Oliver (LAPP)

Session Classification: WG6: Detectors

Contribution ID: **256** Type: **Talk**

Current Understanding of Inner Core Structure and Open Questions

Sunday, July 31, 2022 11:50 AM (25 minutes)

Seismic imaging of the structure of Earth's inner core remains a challenging topic. The inner core occupies < 1% of Earth's volume and the few seismic waves that do sample it can be significantly influenced by heterogeneities in the overlying crust and mantle. Furthermore, the seismic sources and receivers used in imaging the inner core are located at or near (< 700 km depth) Earth's surface and are irregularly distributed—most seismometers are deployed on land and most earthquakes occur near tectonic plate boundaries. Here I review the current standard model of inner core structure and describe some of the outstanding questions such as topography on the inner core boundary, hemisphericity, the innermost inner core, and shear velocity in the inner core.

Attendance type

In-person presentation

Primary author: KOPER, Keith (University of Utah)

Presenter: KOPER, Keith (University of Utah)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **257** Type: **Talk**

Cross-section tuning from a NOvA perspective

Tuesday, August 2, 2022 3:22 PM (20 minutes)

Knowledge of neutrino interaction cross-sections are critical for accurately carrying out neutrino oscillation measurements. However, current models do not fully agree with data, requiring every experimental collaboration to choose the best available models, adjust them as appropriate, and assign sufficient systematic uncertainties before any oscillation analysis can take place. This talk highlights how the NOvA collaboration has dealt with this issue.

Attendance type

In-person presentation

Primary author: BAYS, Kirk (IIT)

Presenter: BAYS, Kirk (IIT)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **258** Type: **Talk**

overview of light sterile neutrino searches

Thursday, August 4, 2022 8:30 AM (30 minutes)

Attendance type

Primary authors: KARAGIORGI, Georgia (Columbia University); KARAGIORGI, Georgia (Columbia University)

Presenters: KARAGIORGI, Georgia (Columbia University); KARAGIORGI, Georgia (Columbia University)

Session Classification: Plenary

Contribution ID: **260** Type: **Talk**

Centering Identity & Equity in Physics & STEM Education

Thursday, August 4, 2022 12:20 PM (30 minutes)

Diversity, equity, and inclusion (DEI) are hot topics across all STEM fields. As we collectively work to address DEI concerns in our departments, institutions, and professions, what are tools and strategies we can use to intentionally center equity in our teaching, research, and work? This session will set a foundation of how identity-based inequities manifest in physics & STEM education, on which a dialogue exploring strategies to actively center identity and equity can be built.

Attendance type

Presenter: GUTZWA, Justin Andrew (University of Utah)

Session Classification: WG7: IDEEO

Contribution ID: **261** Type: **Talk**

Discussion

Friday, August 5, 2022 12:35 PM (10 minutes)

Presenters: BECHTOL, Ellen (UW Madison); DORDEI, Francesca (INFN, Cagliari (IT)); HIROSHIMA, Nagisa (University of Toyama)

Session Classification: WG7: IDEEO

Contribution ID: **262** Type: **Talk**

Three-flavor Oscillations Results for the NOvA Experiment

Friday, August 5, 2022 2:38 PM (18 minutes)

NOvA is a long-baseline beam neutrino experiment. It uses the 700 kW NuMI
beam at Fermilab to send muon neutrinos (or muon antineutrinos) to two functionally identical detectors, located 14.6 mrad off the beam axis. The Near Detector is located at Fermilab, and the 14 kton Far Detector is located 810 km away in Ash River, Minnesota. Both the detectors are tracking calorimeters filled with liquid scintillator which can detect and identify muon and electron neutrino interactions with high efficiency. In order to constrain neutrino oscillations parameters, neutrino mass hierarchy, and the CP-violating phase δCP, NOvA measures the electron neutrino and antineutrino appearance rates, as well as the muon neutrino and antineutrino disappearance rates. This talk will present NOvA's latest results combining both neutrino data (13.6×10^20 POT) and antineutrino data (12.5×10^20 POT).

Attendance type

In-person presentation

Primary author: SHARMA, Richa (Panjab University)

Presenter: SHARMA, Richa (Panjab University)

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **263** Type: **Talk**

Mu2e-II : next generation muon conversion experiment

Thursday, August 4, 2022 4:40 PM (30 minutes)

We propose an evolution of the Mu2e experiment, called Mu2e-II, that would leverage advances in detector technology and utilize the increased proton intensity provided by the Fermilab PIP-II upgrade to improve the sensitivity for neutrinoless muon-to-electron conversion by one order of magnitude beyond the Mu2e experiment, providing the deepest probe of charged lepton flavor violation in the foreseeable future. Mu2e-II will use as much of the Mu2e infrastructure as possible, providing, where required, improvements to the Mu2e apparatus to accommodate the increased beam intensity and cope with the accompanying increase in backgrounds.

Presenter: OKSUZIAN, Yuri (Argonne)

Session Classification: WG4: Muon Physics

Contribution ID: **264** Type: **not specified**

Status and future prospects of lepton universality tests at LHCb

Thursday, August 4, 2022 3:35 PM (25 minutes)

Tests of lepton flavour universality are particularly sensitive to the presence of physics beyond the Standard Model. Recent results and future prospects with semileptonic and rare heavy flavour decays at the LHCb experiment are presented.

Attendance type

Presenter: DORDEI, Francesca

Session Classification: WG4: Muon Physics

Contribution ID: **265** Type: **Talk**

Preparing for MUonE experiment — what can we learn from lattice and dispersive data?

Thursday, August 4, 2022 11:20 AM (30 minutes)

The hadronic vacuum polarization (HVP) is one of the main contributors to the total uncertainty in the theoretical prediction of the muon $g-2$. The HVP term is historically obtained from a data-driven calculation based on a dispersive approach from time-like processes. To improve the theoretical prediction of HVP, in parallel to the lattice communities' effort to obtain HVP by space-like simulations, an alternative space-like data-driven approach is proposed, known as the MUonE experiment. In this talk, we first review the advantage of exploiting the space-like over the time-like processes. We present an overview of lattice calculations of the HVP term and discuss how the choice of fit functions affects the systematic error in lattice calculations and potentially the MUonE experiment. In particular, we explore Pad\'e-based fits and investigate their effects when employed on the space-like data with the precision expected from the MUonE experiment.

Presenter: KOMIJANI, Javad (University of Glasgow)

Session Classification: WG4: Muon Physics

Contribution ID: **266** Type: **Talk**

Measuring density of Earth's core using high-energy neutrinos observed by IceCube

Saturday, July 30, 2022 3:15 PM (25 minutes)

The world largest neutrino observatory IceCube, located at the South Pole, is collecting high-energy neutrino events for over 10 years, and has observed a diffuse cosmic neutrino flux since 2013. While the main aim is searching for extra-terrestrial neutrinos, the collected data contains a large sample of atmospheric neutrino interactions as background events. Using our understanding of the atmospheric neutrino flux and detector systematics of IceCube, these events can be utilised to probe for the density structure of the Earth's interior. In this talk we discuss the analysis method and expected performance using the IceCube muon neutrino sample collected from 2010 to 2020.

Attendance type

In-person presentation

Primary author: HOSHINA, Kotoyo (University of Wisconsin Madison)

Presenter: HOSHINA, Kotoyo (University of Wisconsin Madison)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **267** Type: **Talk**

Recent developments in the GENIE neutrino event generator

Thursday, August 4, 2022 4:50 PM (20 minutes)

The GENIE neutrino event generator seeks to be a universal tool for simulating neutrino-nucleus scattering across the wide energy range of interest for current and future experiments. The international GENIE Collaboration maintains and continues to develop its software suite to meet the interaction modeling needs of a broad user community. Recent improvements to GENIE include implementation of new theoretical calculations across several processes of interest, model parameter tuning to neutrino cross-section data, and extensions to the technical infrastructure needed for the successful execution of experimental analyses. This talk presents selected highlights from these ongoing developments in GENIE.

Presenter: GARDINER, Steven (Fermilab)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **268** Type: **Talk**

Current Need for Simulation Tuning Based on New Experimental Results in nu-A Scattering

Simulation plays a critical role in neutrino experiments. But for a variety of reasons no simulation is perfect, and experiments must confront discrepancies between simulated predictions and their own measurements and observations. This inevitably leads to the need to tune the simulation in order to obtain robust and reasonable systematic uncertainties in analyses. In this talk I give an overview of the challenges that both simulation developers and experiments face, and the mechanisms employed by various collaborations to deal with this challenge using new experimental results in neutrino-nucleus scattering as examples.

Attendance type

In-person presentation

Primary author: PALEY, Jonathan (Fermilab)

Presenter: PALEY, Jonathan (Fermilab)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **269** Type: **Talk**

EMPHATIC: Table-top Hadron Scattering Measurements for Improved Neutrino Flux Predictions

Tuesday, August 2, 2022 6:00 PM (20 minutes)

State-of-the-art predictions of accelerator-based neutrino fluxes have uncertainties ranging from 5-15%, dominated by hadron production uncertainties. The EMPHATIC Collaboration has proposed a unique, compact spectrometer to measure hadron-scattering and hadron-production cross sections that are needed to reduce neutrino flux uncertainties for current and future neutrino experiments to the few-percent level. In this talk I present an overview of the motivation, design and run plan of the experiment, and progress in data collection and analysis.

Attendance type

In-person presentation

Primary author: PALEY, Jonathan (Fermilab)

Presenter: PALEY, Jonathan (Fermilab)

Session Classification: WG2: Neutrino Scattering Physics

Track Classification: WG2: Neutrino Scattering Physics

Contribution ID: **270** Type: **not specified**

Current Need for Simulation Tuning Based on New Experimental Results in nu-A Scattering

Tuesday, August 2, 2022 4:04 PM (20 minutes)

Simulation plays a critical role in neutrino experiments. But for a variety of reasons no simulation is perfect, and experiments must confront discrepancies between simulated predictions and their own measurements and observations. This inevitably leads to the need to tune the simulation in order to obtain robust and reasonable systematic uncertainties in analyses. In this talk I give an overview of the challenges that both simulation developers and experiments face, and the mechanisms employed by various collaborations to deal with this challenge using new experimental results in neutrino-nucleus scattering as examples.

Presenter: PALEY, Jonathan (Fermilab)

Session Classification: Joint Session

Contribution ID: **271** Type: **Talk**

Beyond Standard Model Neutrino Oscillation Results from NOvA

Tuesday, August 2, 2022 6:12 PM (18 minutes)

NOvA is a long-baseline neutrino experiment optimised for studying neutrino oscillations in the NuMI beam. The experiment consists of two functionally identical liquid scintillator detectors at baselines of 1km and 810km, with the latter placed 14.6 mrad from the beam's central axis.

This talk summarises beyond-standard-model neutrino oscillation results from NOvA, including the recent search for 3+1 sterile neutrino oscillations in neutrino beam using 11.0×10^{20} protons on target (POT) in the near detector and 13.6×10^{20} POT in the far detector. This analysis utilises charged current ν_μ and neutral current selections in a two-detector fit procedure utilising a Gaussian multivariate treatment of systematic uncertainties and a Poisson likelihood treatment of statistical uncertainties to place 90% CL limits on the Δm^2_{41}, θ_{24} and θ_{34} mixing parameters.

A search for non-standard interactions that augment the standard 3-flavour oscillation paradigm is also presented, utilising charged current ν_μ and ν_e selections in neutrino and antineutrino beam modes to produce 90% CL allowed regions for the $\epsilon_{e\tau}$ and $\delta_{e\tau}$ parameters.

Attendance type

Virtual presentation

Primary author: Dr HEWES, V (University of Cincinnati)

Presenter: Dr HEWES, V (University of Cincinnati)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **272** Type: **Talk**

The Path to Precision: Role of the DUNE Near Detectors

Thursday, August 4, 2022 11:20 AM (18 minutes)

The Deep Underground Neutrino Experiment (DUNE) is a next-generation long baseline neutrino oscillation experiment. DUNE will make precise measurements of neutrino oscillations, which will enable a definitive determination of the neutrino mass ordering, and a high potential to discover charge-parity violation in neutrinos. DUNE will use the most intense accelerator neutrino beam and employ liquid argon TPC technology to achieve excellent resolution. Similar to all long-baseline experiments, DUNE will include a suite of near detectors (ND) located onsite at Fermilab to constrain systematic uncertainties to the few percent levels, necessary to achieve its ambitious physics goals. In this talk, I will describe the technology, design, and purpose of the DUNE ND and its impact on neutrino oscillation measurements.

Attendance type

In-person presentation

Primary author: VALLARI, Zoya (Caltech)

Presenter: VALLARI, Zoya (Caltech)

Session Classification: Joint Session

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **273** Type: **Talk**

Oscillation tomography of the Earth with solar neutrinos and future experiments

Saturday, July 30, 2022 5:20 PM (15 minutes)

We study in details the Earth matter effects on the boron neutrinos
from the Sun using recently developed 3D models of the Earth.
The models have a number of new features of the density profiles,
in particular, a substantial deviation from spherical symmetry.
In this connection, we further elaborate on relevant aspects
of oscillations (ϵ^2 corrections, adiabaticity violation, entanglement, {\it etc.})
and the attenuation effect.
The night excesses of the $\nu e-$ and $\nu N-$ events and
the Day-Night asymmetries, A_{ND}, are presented in terms of the
matter potential and the generalized energy resolution functions.
The energy dependences of the cross-section and the flux improve the resolution,
and consequently, sensitivity to remote structures of the profiles.
The nadir angle (η) dependences of A_{ND} are computed for future detectors DUNE,
THEIA, Hyper-Kamiokande, and MICA
at the South pole.
Perspectives of the oscillation tomography of the Earth
with the boron neutrinos are discussed. Next-generation detectors
will establish the integrated day-night asymmetry with high confidence level.
They can give some indications of the $\eta-$
dependence of the effect, but will discriminate among different models
at most at the $(1-2)\sigma$ level.
For high-level discrimination, the MICA-scale experiments are needed. MICA can
detect the ice-soil borders and perform unique tomography of Antarctica.

Attendance type

Virtual presentation

Primary authors: Prof. SMIRNOV, Alexei Yu. (Max-Planck Institute for Nuclear Physics); BAKHTI, Pouya (JBNU)

Presenter: BAKHTI, Pouya (JBNU)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **274** Type: **not specified**

Widening the talent pool for physics worldwide

Thursday, August 4, 2022 11:20 AM (20 minutes)

Presenter: SHAW, Kate (University of Sussex)

Session Classification: WG7: IDEEO

Contribution ID: **275** Type: **Poster**

Detectors of the Telescope Array Experiment

Monday, August 1, 2022 6:20 PM (40 minutes)

The Telescope Array (TA) experiment, located near Delta, Utah, USA, is the largest ultra-high energy cosmic ray (UHECR) observatory in the northern hemisphere. When a UHECR primary particle arrives at the Earth, it collides with the atmosphere and produces a cascade of secondary particles known as an extensive air shower (EAS). The Telescope Array is designed to observe the EAS using a hybrid of techniques: fluorescence detectors (FDs) and surface detectors (SDs). The FDs measure the nitrogen fluorescence light emitted when the secondary particles excite the gas of the atmosphere as they pass through it. They utilize telescopes consisting of large area mirrors and photo-multiplier tube cameras. Meanwhile, the SDs use two-layer plastic scintillators to sample the density of charged particles in the showers when it reaches the Earth's surface. Using data from both the FDs and SDs, we explore the nature and origin of UHECRs by investigating the energy spectrum, mass composition, and arrival direction distribution. In this presentation, we describe the design and technical features as well as some of the measurements of the Telescope Array detectors.

Attendance type

In-person presentation

Primary author: KIM, Jihyun (The University of Utah)

Presenter: KIM, Jihyun (The University of Utah)

Session Classification: Reception & Poster Session

Track Classification: WG6: Detectors

Contribution ID: **276** Type: **Talk**

Landscape of Neutrino Physics

Sunday, July 31, 2022 9:00 AM (45 minutes)

In the last decade IceCube has opened a new window on the Universe using neutrinos as astronomical messengers. The instrument detects more than 100,000 neutrinos per year in the GeV to 10,000 TeV energy range. IceCube and similar detectors now under construction or at the concept stage, will perform neutrino physics with high statistics samples of atmospheric neutrinos and with the beam of high-energy neutrinos of cosmic origin that can be separated from atmospheric neutrinos at TeV energies and above. We will discuss the surprising observation that extragalactic cosmic ray accelerators dominate nearby Galactic sources with an energy flux that is comparable to that of high-energy photons. We will discuss the emergence of their sources after a decade of IceCube observations and in multimessenger campaigns. Importantly for this meeting, cosmic neutrinos provide us with a PeV-energy beam for neutrino physics.

Attendance type

Virtual presentation

Primary author: Prof. HALZEN, Francis (UW-Madison)

Presenter: Prof. HALZEN, Francis (UW-Madison)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **277** Type: **Talk**

An overview of the core-mantle boundary region from seismological studies

Sunday, July 31, 2022 2:00 PM (25 minutes)

The core-mantle boundary (CMB) region is both a compositional and thermal boundary layer with the largest density contrast anywhere in the planet. As a result, the structures found within the lowermost mantle are as complex as those found on the Earth's surface. In this presentation we review the major features that have been identified from seismological studies. We review features at (1) the largest (> 1000 km) scales as revealed through seismic tomography of body wave and normal modes (2) intermediate scales (~10's to 1000 km) as revealed through waveform modeling, and (3) at the smallest scales (~10s of km) as revealed through stochastic studies. At the largest scales two Large Low Velocity Provinces (LLVPs) beneath Africa and the Pacific Ocean dominate the tomographic images. These two features are surrounded by high seismic wave velocity regions that are consistent with remains of the past ~200 million years of subduction. At the largest scales, D" discontinuity structure is consistently observed in the high velocity regions, but has also been observed within the LLVP's at an apparently shallower depth. We discuss the nature of the LLVP's, their possible origins, and the ongoing debate surrounding what they physically represent. At the intermediate scales, multiple features have been observed, including core rigidity zones (CRZs), ultra-high velocity zones (UHVZs), and ultra-low velocity zones (ULVZs). Of these features, the ULVZs have received the most attention and appear to occupy a significant portion of the CMB landscape, with as much as 20% of the CMB region containing ULVZs inferred. Here we review current ideas about what these features are, where they are located, and their importance for whole Earth dynamic processes. At the smallest scales, the CMB area contains regions that generate the largest amplitude scattered arrivals. We discuss the locations where this scattered energy originates and the potential origins of the scatterers.

Attendance type

In-person presentation

Primary author: Dr THORNE, Michael (University of Utah)

Presenter: Dr THORNE, Michael (University of Utah)

Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)

Contribution ID: **278** Type: **not specified**

Intro to NuFact 2022

Monday, August 1, 2022 8:30 AM (10 minutes)

Presenters: ROTT, Carsten (University of Utah); SANDICK, Pearl (University of Utah); ZHAO, Yue (University of Utah)

Session Classification: Plenary: WG Introductions

Contribution ID: **279** Type: **Talk**

Negotiation and Communication Skills for Early Career Researchers

Friday, August 5, 2022 6:00 PM (2 hours)

The workshop will focus on negotiation and communication skills useful to physics researchers as they navigate their careers, including how to:

- Negotiate a position in academia, industry, or at a national lab
- Interact positively on teams and with a mentor or advisor
- Think tactically
- Enhance personal presence
- Develop alliances
- Achieve professional goals

Presenter: SANDICK, Pearl (University of Utah)

Session Classification: Workshop

Contribution ID: **281** Type: **Talk**

Neutrino mass scale from cosmological constraints

Friday, August 5, 2022 2:20 PM (18 minutes)

In this talk, we shall present the latest and tightest cosmological constraints on the neutrino mass scale and the prospects from future surveys. Special attention will be devoted to the interplay between cosmological and laboratory neutrino mass searches, along with the role of neutrinos in solving the present cosmological tensions.

Attendance type

Virtual presentation

Primary authors: Dr MENA, OLga; MENA, Olga (IFIC (CSIC-UV))

Presenter: MENA, Olga (IFIC (CSIC-UV))

Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics

Contribution ID: **282** Type: **Talk**

Multi PMTs at the Water Cherenkov Test Experiment/IWCD at Hyper-K

Tuesday, August 2, 2022 3:00 PM (20 minutes)

A new photosensor module that consists of 19 3-inch photomultiplier tubes has been developed for the Hyper-Kamiokande experiment, a next generation neutrino experiment. This talk will present the current status of the new photosensor module development and how the module will be used in the water Cherenkov test experiment and the intermediate water Chereknov detector that will be one of the near detectors to be used in the Hyper-Kamiokade long-baseline program.

Attendance type

In-person presentation

Primary author: AKUTSU, Ryosuke

Presenter: AKUTSU, Ryosuke

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **283** Type: **Talk**

Options for PMT electronics at the Hyper-K far detector

Tuesday, August 2, 2022 3:20 PM (20 minutes)

Hyper-Kamiokande (HK) consists of a large Water Cherenkov detector, far detector (FD), and neutrino beam line, J-PARC. The FD is under construction now, and will be equipped with 20,000 PMTs whose diameter is 20 inch. It is improved and has twice better performance than that of Super-Kamiokande detector. For the 20 inch PMTs, we have been developing several types of readout electronics. They are required to utilize the improved performance as much as possible. This talk presents detailed schemes of each option and the status of R&D.

Attendance type

In-person presentation

Primary author: IZUMIYAMA, Shota (Tokyo Institute of Technology)

Presenter: IZUMIYAMA, Shota (Tokyo Institute of Technology)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **284** Type: **Talk**

Introduction to the Workshop

Sunday, July 31, 2022 2:00 PM (5 minutes)

Presenter: TOLBA, Tamer (Institut für Experimentalphysik, Universität Hamburg)

Session Classification: Workshop

Contribution ID: **285** Type: **Talk**

The DUNE vertical drift TPC

Thursday, August 4, 2022 4:10 PM (20 minutes)

The DUNE experiment is a future long-baseline neutrino oscillation experiment aiming at measuring the neutrino CP violation and establishing the neutrino mass hierarchy, as well as at a rich physics programme from supernovae over low-energy physics to beyond standard model searches.

The baseline technology for the first far detector is a proven single-phase horizontal drift liquid Argon TPC based on standard wire-chamber technology.

For the second far detector, a new technology, the so-called "vertical drift" TPC is currently being developed: It aims at combining the strengths of the two technologies tested in the ProtoDUNE cryostats at the CERN neutrino platform into a single design, a vertical-drift single-phase liquid Argon TPC using a novel perforated-PCB anode design. This design maintains excellent tracking and calorimetry performance while significantly simplifying the complexity of the TPC construction.

This talk will introduce the concept of the vertical drift TPC, present first results from small-scale prototypes and a first full-scale anode module, as well as outlining the plans for future prototypes and the next steps towards the full second DUNE far detector.

Attendance type

Virtual presentation

Primary author: LANTWIN, Oliver (LAPP)

Presenter: LANTWIN, Oliver (LAPP)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **286** Type: **Poster**

Gain calibration using dark hits in off-time region of regular data at JSNS2 experiment (at WG6)

Tuesday, August 2, 2022 5:15 PM (10 minutes)

The JSNS2 experiment aims to search for the existence of sterile neutrino oscillations with deltam2 near 1eV2 at J-PARC MLF. A 1MW beam of 3 GeV protons incident on a spallation neutron target produces an intense neutrino beam from muon decay at rest. The experiment will search for muon antineutrino to electron antineutrino oscillations which can be detected by the inverse beta decay interaction followed by gammas from neutron capture on Gd. PMT in the detector is an essential device to find a signal in JSNS2 experiment. Currently, there are 120 PMTs in JSNS2 detector. But, since the performance of PMTs is not uniform, it is necessary to get the consistency of each PMTs. For that, we have calculated the PMT gains to have a calibration using a laser. However, the method can not monitor the gain in real-time. Thus, instead of that, the gain was monitored by using regular data in real-time. But, it is not sensitive to monitor due to multiple PE of the regular data. So, we developed an algorithm for the gain calibration method using dark hits in an off-time region of regular data.

Attendance type

In-person presentation

Primary author: PARK, RyeongGyoon (Chonnam national university)

Presenter: PARK, RyeongGyoon (Chonnam national university)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **287** Type: **Poster**

First light detection with an optical Time Projection Chamber (at WG6)

Tuesday, August 2, 2022 5:35 PM (10 minutes)

An optical Time Projection Chamber (TPC) is proposed for future neutrino experiments. Its excellent particle detection momentum threshold, together with cost-effective scale-up prospects, make the TPC a strong candidate for reducing systematic errors due to neutrino-nucleus interactions.
In order to produce a high number of photons, the TPC is equipped with a thick gaseous electron multiplier (ThGEM). Per each electron produced in the ThGEM holes, thousands of photons are created. Next, the electrons created in the ThGEM are extracted and drifted further towards a mesh. Here, by applying a high enough electric field to excite the Argon atoms, but low enough in order not to ionise them, electroluminescence (EL) photons are produced. The photons, normally in the UV range, are shifted to visible using a PEN wavelength shifter.

The firsts tests of the chamber were carried with a photo-multiplier tube. Several methods, including drift velocity, and trigger rate studies confirm that the TPC works as expected.

For a second phase of tests, voltage was placed on the EL mesh too, and a light yield increase was observed, as expected due to the electroluminescence effect. Surprisingly, a yield increase was observed even for small electric fields. This can not be explained through EL but it is rather an effect of the electrons being forced out of the ThGEM holes; the more towards the exterior the photons are produced, the less they get absorbed by the walls of the ThGEM.

For a third, and final study of the TPC, a 256 SiPM array has been set up.
Simulations show that by using two simple bi-convex lenses, hundreds of photons can be detected per cosmic-ray crossing the detector. Moreover, magnitudes of up to 12 can be obtained. In other words, if a particle leaves a track of 12cm in the real detector, the projected image on the SiPM array is only 1cm.
Currently, the SiPM array is in its first analysis phase, being very close to its first full track reconstruction. Thank you!

Attendance type

In-person presentation

Primary authors: Mr ROE, Edward (University of Geneva); SANCHEZ, Federico (Universite de Genève); Mr AMARINEI, Robert (University of Geneva); Mr GIANESSI, Lorenzo (University of Geneva); BORDONI, Stefania (CERN); LUX, Thorsten (IFAE - BIST)

Presenter: Mr AMARINEI, Robert (University of Geneva)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **288** Type: **Poster**

A High Rate Readout System for a High-Efficiency Cosmic Ray Veto for the Mu2e Experiment (at WG6)

Tuesday, August 2, 2022 5:25 PM (10 minutes)

The Mu2e Cosmic Ray Veto must veto cosmic-ray muons over a large area with an efficiency of 99.99% in the presence of high background rates. It consists of over 5000 scintillator extrusions with embedded wavelength-shifting fibers coupled to 2×2 mm2 silicon photomultipliers. A custom readout system consists of: (1) small circuit board, the Counter Mother Board, which provides a temperature sensor, flasher LEDs, and passive SiPM pulse shaping; (2) a Front End Board which digitizes, zero-suppresses, and stores signals from up to 64 Counter Mother Boards, provides bias to the SiPMs, pulses to the LEDs, and a measurement of the SiPM currents; and (3) a Readout Controller which collects data from the Front End Boards via Cat6 cables, which also deliver 48V power to the Front End Boards using power over ethernet. The Readout Controller serves as the interface between the Front End Boards and the DAQ. This poster provides an overview of this high rate readout system for the Mu2e Cosmic Ray Veto.

Attendance type

In-person presentation

Primary author: CORRODI, Simon

Presenter: CORRODI, Simon

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **289** Type: **Poster**

Construction of a new scintillation tracker in T2K experiment (at WG6)

Tuesday, August 2, 2022 5:45 PM (10 minutes)

In the T2K experiment, new detectors are going to be installed to the near detector.
Super-FGD is one of them and a tracker which consists of 2 millions plastic scintillator cubes.
60 thousands wave length shifting fibers will be inserted to the cubes to lead scintillation light and it will be detected by SiPMs.

I will report the procedure to construct and install this detector.
The first step of construction is to insert fibers to the cubes.
This work should be done quickly because we have the 60 thousands fibers.
Our concern about it is that inserted fibers can be damaged by distortion of array of cubes and we have to check the quality of fibers during inserting the fibers.
I will also talk about a dedicated system for the fiber quality check.

Attendance type

In-person presentation

Primary author: KAWAUE, Masaki (Kyoto University)

Presenter: KAWAUE, Masaki (Kyoto University)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **290** Type: **Poster**

Detectors of the Telescope Array Experiment (at WG6)

Tuesday, August 2, 2022 5:55 PM (10 minutes)

The Telescope Array (TA) experiment, located near Delta, Utah, USA, is the largest ultra-high energy cosmic ray (UHECR) observatory in the northern hemisphere. When a UHECR primary particle arrives at the Earth, it collides with the atmosphere and produces a cascade of secondary particles known as an extensive air shower (EAS). The Telescope Array is designed to observe the EAS using a hybrid of techniques: fluorescence detectors (FDs) and surface detectors (SDs). The FDs measure the nitrogen fluorescence light emitted when the secondary particles excite the gas of the atmosphere as they pass through it. They utilize telescopes consisting of large area mirrors and photo-multiplier tube cameras. Meanwhile, the SDs use two-layer plastic scintillators to sample the density of charged particles in the showers when it reaches the Earth's surface. Using data from both the FDs and SDs, we explore the nature and origin of UHECRs by investigating the energy spectrum, mass composition, and arrival direction distribution. In this presentation, we describe the design and technical features as well as some of the measurements of the Telescope Array detectors.

Attendance type

In-person presentation

Primary author: KIM, Jihyun (The University of Utah)

Presenter: KIM, Jihyun (The University of Utah)

Session Classification: WG6: Detectors

Track Classification: WG6: Detectors

Contribution ID: **291** Type: **Talk**

Summary of the ESSnuSB+ Workshop

Thursday, August 4, 2022 10:30 AM (10 minutes)

Presenter: FANOURAKIS, George

Session Classification: Plenary

Contribution ID: **292** Type: **not specified**

Star Party (cancelled due to bad weather)

Thursday, August 4, 2022 9:00 PM (2 hours)

Attendance type