24th International Workshop on Next Generation Nucleon Decay & Neutrino Detectors (NNN25)

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NNN25

International Workshop on Next Generation Nucleon Decay and Neutrino Detectors

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SNOLAB sudbury

Book of Abstracts

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The measurement of low energy solar neutrinos with XENONnT experiment

Author: Masatoshi Kobayashi[1]

[1] *KMI, Nagoya University*

Corresponding Author: mkoba@nagoya-u.jp

The XENONnT is an experiment designed to search for dark matter and other rare events. It has been conducted at Laboratori Nazionali del Gran Sasso (LNGS), Italy, using the time projection chamber with 8.5 tons of liquid xenon in total. Data taking started in July 2021 and stopped at the beginning of 2025, for the further upgrade of the detector.
Thanks to its ultra-low radioactive background, the XENONnT is also sensitive to low-energy solar neutrino interactions such as those induced by solar pp neutrinos in the keV energy range.
In this talk, I will present an overview of the experiment and report on the current status of neutrino searches.

Submitter Email:

mkoba@nagoya-u.jp

Submitter Name:

Masatoshi Kobayashi

Submitter Institution:

Kobayashi-Maskawa Institute for the Origin of Particles and the Universe, Nagoya University

Plenary Talks / 2

The Quest for No Neutrinos: Probing the Majorana Nature with LEGEND-200

Author: Andreas Leonhardt[1]

[1] *Technical University of Munich*

Corresponding Author: andreas.leonhardt@tum.de

The LEGEND collaboration aims to uncover the fundamental nature of neutrinos, specifically whether they are Majorana particles, by searching for neutrinoless double-beta ($0\nu\beta\beta$) decay in ^{76}Ge ($Q_{\beta\beta}$ = 2039 keV). In the currently operating phase, LEGEND-200, up to 200 kg of isotopically enriched high-purity germanium (HPGe) detectors are deployed bare in a liquid argon (LAr) cryostat. To identify and suppress backgrounds, the LAr is instrumented to detect scintillation light signals, which are guided by wavelength-shifting fibers to silicon photomultiplier (SiPM) detector units. By combining high-radiopurity components, detector pulse-shape discrimination, and the liquid argon anti-coincidence system, world-leading background levels in the field of $0\nu\beta\beta$ are achieved in the region of interest. In this talk, we present the latest results from LEGEND-200 [arXiv:2505.10440], including the limits on the half-life of neutrinoless double-beta decay in ^{76}Ge and the corresponding effective Majorana mass range. The performance of the HPGe detectors - especially of the newly developed inverted-coaxial designs - will be discussed. The impact of the instrumented LAr environment and its interplay with optically active components will be highlighted. Finally, an outlook on the future of the experiment will be provided.

This work is supported by the U.S. DOE and the NSF; the LANL, ORNL, and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak RDA; the Swiss SNF; the UK STFC; the Canadian NSERC and CFI; the LNGS and SURF facilities.

Submitter Email:

andreas.leonhardt@tum.de

Submitter Name:

Andreas Leonhardt

Submitter Institution:

TUM School of Natural Sciences, Technical University of Munich, 85748 Garching, Germany

Plenary Talks / **4**

Hyper-Kamiokande

Corresponding Author: xiaoyuel@triumf.ca

The Hyper-Kamiokande (Hyper-K) is the third generation of underground water Cherenkov detectors in Japan. It will serve as: (1) the far detector for a long-baseline neutrino oscillation experiment for the upgraded, 1.3 MW power, J-PARC muon neutrino/antineutrino beam, and (2) a detector capable of observing proton decays, atmospheric neutrinos, and neutrinos from astronomical sources. The fiducial region of the Hyper-K detector, with a mass of 186 kton, will be instrumented with 20,000 20-inch photomultipliers (PMTs) and 800 multi-PMT modules, each containing 19 3-inch PMTs. The chamber excavation is nearing completion, tests of detector components are underway, and operation is scheduled to begin in 2028. The Hyper-K status, research program, and sensitivities to different processes, including proton decay and CP violation in the lepton sector, will be presented.

Submitter Email:

jan.kisiel@us.edu.pl

Submitter Name:

Jan Kisiel

Submitter Institution:

University of Silesia, Katowice, Poland

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Exploring BSM Physics and Neutrino Interactions with MicroBooNE

Author: Sergey Martynenko[1]

[1] *Brookhaven National Laboratory*

Corresponding Author: smartynen@bnl.gov

The MicroBooNE experiment uses an 85-ton liquid argon time projection chamber to detect neutrinos from Fermilab's Booster Neutrino Beam (BNB) and off-axis NuMI beam. Its physics program has three main goals. First, it explores beyond-standard-model (BSM) physics by searching for dark sector particles, investigating the MiniBooNE Low Energy Excess, and probing light eV-scale sterile neutrinos. Second, MicroBooNE has produced one of the world's largest neutrino-argon scattering datasets, with results spanning inclusive, exclusive, and rare interaction channels, including novel neutron detection methods. Third, it drives advances in LArTPC technology, supporting future experiments like DUNE. This talk will review recent MicroBooNE results and innovative analysis techniques shaping modern neutrino physics.

Submitter Email:

smartynen@bnl.gov

Submitter Name:

Sergey Martynenko

Submitter Institution:

Brookhaven National Laboratory

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NuDoubt++: Combining Hybrid and Opaque Scintillation Technology in the Search for Positive Double Weak Decays

Author: Stefan Schoppmann[1]

[1] *JGU Mainz*

Corresponding Author: stefan.schoppmann@rwth-aachen.de

Double beta plus decay is a rare nuclear disintegration process. Difficulties in its measurement arise from suppressed decay probabilities, experimentally challenging decay signatures and low natural abundances of suitable candidate nuclei.

In this context, we present NuDoubt++, a new detector concept to overcome these challenges. It is based on the first-time combination of hybrid and opaque scintillation detector technology paired with novel light read-out techniques. This approach is particularly suitable detecting positron (beta plus) signatures. We expect to measure two-neutrino double beta plus decay modes in less than two years of operation. Moreover, we are able to probe neutrinoless double beta plus decays at several orders of magnitude improved significance compared to current experimental limits.

In this presentation, we will detail our detector concept and highlight our current R&D progress.

Submitter Email:

stefan.schoppmann@uni-mainz.de

Submitter Name:

Stefan Schoppmann

Submitter Institution:

JGU Mainz

Poster Presentations / 8

Radon backgrounds assaying program for nEXO

Authors: Abobakr Emara[1]; Caio Licciardi[1]

[1] *University of Windsor*

Corresponding Authors: emaraa@uwindsor.ca, clicciardi@snolab.ca

Future large-scale detectors searching for rare events such as neutrinoless double beta decay and dark matter nuclear recoils require understanding and an accurate measurement of the background sources present in such detectors. Radon contamination presents a challenge and significant contribution to the background of these experiments. This talk will present the radon assay program developed for the nEXO experiment. nEXO is a proposed next generation experiment planning to search for neutrinoless double beta decay of ^{136}Xe. nEXO plans to use a liquid-xenon filled time projection chamber that employs 5 tonnes of xenon, isotopically enriched to 90% in ^{136}Xe.
More specifically, this work presents the development of electrostatic chambers (ESC), instruments designed to measure radon emanation in a recirculating gas loop, state-of-art in the field sensitive to the micro-becquerel range. ESCs and other detection devices are planned to assay all experiment components that come in contact with the xenon or the liquid heat transfer fluid, envisage to surround the TPC.

Submitter Email:

aemara@snolab.ca

Submitter Name:

Abobakr Emara

Submitter Institution:

University of Windsor

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The PIKACHU Experiment: Search for the Two-Neutrino Double Beta Decay of 160Gd in Kamioka

Author: Takashi Iida[1]

[1] *University of Tsukuba*

Corresponding Author: tiida@hep.px.tsukuba.ac.jp

The PIKACHU experiment is a search for the double beta decay of 160Gd using large single crystals of Ce:Gd3Al2Ga3O12 (GAGG). In particular, it aims to observe the so-far undetected two-neutrino double beta decay (2nbb) of 160Gd down to half-lives predicted by theory. We have been developing high-purity GAGG crystals, and in 2023, succeeded in producing crystals with uranium- and thorium-series impurities reduced by an order of magnitude compared to conventional ones [1]. Since late 2024, we have been establishing a low-background experimental environment at the Kamioka underground laboratory, and have commenced long-term data acquisition using the newly developed high-purity GAGG crystals. In this presentation, we will give an overview of the PIKACHU experiment and report on its current status.
[1] T. Omori, T. Iida et al., Progress of Theoretical and Experimental Physics, Volume 2024, Issue 3, March 2024, 033D01

Submitter Email:

tiida@hep.px.tsukuba.ac.jp

Submitter Name:

Takashi Iida

Submitter Institution:

University of Tsukuba

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Hunting neutrinos with ancient Pb

Author: Nahuel Ferreiro Iachellini[1]

[1] *University of Milano-Bicocca*

Corresponding Author: nahuel.ferreiroiachellini@unimib.it

Core-collapse Supernovae (SN) are critical astronomical events where nearly an entire star's binding energy is emitted as neutrinos. RES-NOVA is pioneering a new approach to their detection, introducing cryogenic detectors constructed from ultra-pure archaeological Pb. The experiment exploits Coherent Elastic Neutrino–Nucleus Scattering (CEvNS), a channel with a cross-section approximately 10^4 times larger than traditional detection modes (e.g. IBD or nu-e scattering).
The RES-NOVA detector is currently being realized and will soon deliver unprecedented sensitivity thanks to its unique design. With a compact volume of just (30 cm)^3, it will be able to monitor about 90% of potential galactic SNe. The cryogenic detectors, fabricated from Pb with extremely low intrinsic radioactivity, are optimized for a low energy threshold and minimal background interference. All these features enable comprehensive measurements of SN neutrino signals, free from uncertainties linked to neutrino flavor oscillations.
RES-NOVA is already producing results with its first prototype detectors, and full detector operations are approaching rapidly. Beyond SN neutrino detection, the technology is opening new opportunities in astroparticle physics: the combination of low-energy thresholds and advanced background suppression makes RES-NOVA a powerful platform for multi-messenger astronomy, dark matter searches, and studies of fundamental neutrino properties.
In this contribution, we will report on the latest experimental progress, present results from the first detectors, and outline the near-term physics reach of RES-NOVA. This project, already underway, represents a decisive step toward establishing the next-generation neutrino and dark matter observatory.

Submitter Email:

nahuel.ferreiroiachellini@unimib.it

Submitter Name:

Nahuel Ferreiro

Submitter Institution:

University of Milano-Bicocca

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Radon-222 Screening Capability and Research at SNOLAB

Author: Nasim Fatemighomi[1]

[1] *SNOLAB*

Corresponding Author: nasim@snolab.ca

Radon-222 is a limiting background in many leading dark matter and low-energy neutrino experiments. At SNOLAB, we have various radon instruments dedicated to material screening and to the measurement of radon concentration in N_2 gas systems and in ultra-pure water. My talk will focus on describing these instruments. In addition, it will describe a recent development aimed at improving our N_2 gas assay capability.

Submitter Email:

nasim@snolab.ca

Submitter Name:

Nasim Fatemighomi

Submitter Institution:

SNOLAB

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TEST ABSTRACT

Author: Stephen Sekula[1]

[1] *SNOLAB and Queen's University*

Corresponding Author: stephen.sekula@snolab.ca

This is just a test abstract so that the ISAC can practice reviewing without worrying about a real abstract receiving feedback, comments, etc. during reviewing.

Submitter Email:

stephen.sekula@snolab.ca

Submitter Name:

Stephen Sekula

Submitter Institution:

SNOLAB, Queen's University, and Laurentian University

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All-Sky High-Energy Neutrino Sources Searches with IceCube

Author: Riya Shah[1]

[1] *Drexel University*

Corresponding Author: riyatul10@gmail.com

Searches for astrophysical neutrino point-sources in IceCube have been preformed for over a decade. IceCube has two data streams; track-like and cascade-like events. Historically the track-like stream was utilized for these searches, producing observations of the first astrophysical neutrino sources such as NGC 1068 and TXS 0506+06. Cascade-like events were utilized to observe the Galactic Plane in neutrinos for the first time. These recent astrophysical results from the past decade will be reviewed in this talk. Recently, we performed a unified point-source search that incorporates track-like dataset and cascade-like dataset for the first time using a maximum-likelihood framework which can account for differences in signal and background distributions, energy resolutions, and data rates across both datasets. By combining these complementary all-sky samples, we achieve improved sensitivity in the southern sky, with each event type contributing where the other is limited. Using 14 years of track data and 10 years of cascade data, we obtain the most sensitive IceCube all-sky point-source search to date, the results of which will be presented.

Submitter Email:

riyatul10@gmail.com

Submitter Name:

Riya Shah

Submitter Institution:

Drexel University

Poster Presentations / 15

The Water Cherenkov Test Experiment: Detector and Physics Lessons Towards Hyper-Kamiokande

Author: Xiaoyue Li[1]

[1] *TRIUMF*

Corresponding Author: xiaoyuel@triumf.ca

The Water Cherenkov Test Experiment (WCTE) is a 40-ton water Cherenkov detector operated in the T9 beamline of the East Area at CERN from October 2024 to June 2025. It is instrumented with 97 multi-PMT modules, each consisting of 19 3" PMTs. Charged particles in the beam are characterized by a series of trigger scintillators and aerogel Cherenkov threshold detectors on an event-by-event basis before entering WCTE, thus enabling detailed studies of how particles with known momentum, direction, and type are reconstructed in a water Cherenkov detector. In addition, a tagged photon beam is produced using a permanent magnet and hodoscope setup. As a technology prototype of the Intermediate Water Cherenkov Detector (IWCD) of the Hyper-Kamiokande (Hyper-K) experiment, WCTE has provided valuable experience in detector construction, commissioning, operation, and calibration. Physics data collected during the 2025 run in both pure water and gadolinium-loaded configurations will also offer useful physics input to current and future water Cherenkov experiments, such as improved understanding of neutrino multi-nucleon interaction, pion secondary interactions, and ^{9}Li background in the diffuse supernova neutrino background search. In this talk, I will present the detector systems of WCTE and discuss the expected impact on the physics goals of Hyper-K.

Submitter Email:

xiaoyuel@triumf.ca

Submitter Name:

Xiaoyue Li

Submitter Institution:

TRIUMF

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Leveraging Water Cherenkov Detector Technologies for Water Quality Monitoring

Author: Xiaoyue Li[1]

[1] *TRIUMF*

Corresponding Author: xiaoyuel@triumf.ca

Access to clean drinking water is an urgent global challenge, driven by climate change and emerging contaminants beyond the reach of conventional treatment methods. At TRIUMF, we have developed the Water Monitoring System (WMS), a novel in-situ monitoring approach that adapts technologies from large water Cherenkov detectors. The system employs single-photon-sensitive detectors, photon counting technique, and newly developed UV-VIS LEDs capable of pulsing at MHz frequencies with sub-nanosecond widths. The WMS has demonstrated sensitivity to <1% changes in water transparency during deployment at the Water Cherenkov Test Experiment at CERN, corresponding to contaminant concentrations at the parts-per-billion level. Building on this, we are collaborating with water engineering experts to evaluate its effectiveness in detecting substances of concern such as selenium from coal mining effluent, organic mercury from thawing permafrost, and disinfection by-products in drinking water. A complementary scattering detector is also under development, using pulsed-laser Mie scattering and ring-imaging Cherenkov techniques to measure particle size distributions. This enables real-time detection of particulate pollutants such as *E. coli* bacteria and microplastics. Together, these systems offer a powerful multi-modal framework for environmental water quality monitoring. Educational initiatives are also underway to integrate these technologies into STEM programs for Indigenous students.

Submitter Email:

xiaoyuel@triumf.ca

Submitter Name:

Xiaoyue Li

Submitter Institution:

TRIUMF

Poster Presentations / 17

The Quest for No Neutrinos: Advancing the Search with LEGEND-1000

Author: Moritz Neuberger[1]

[1] *Technical University of Munich (TUM)*

Corresponding Author: moritz.neuberger@tum.de

The LEGEND collaboration aims to unambiguously discover neutrinoless double-beta decay (0νββ) using high-purity germanium (HPGe) detectors enriched in the double-beta-decaying isotope ^{76}Ge (Q = 2039 keV). The HPGe detectors operate in liquid argon, which serves as a coolant and an active

shield, enabling a quasi background-free search for 0νββ decay. The first phase, LEGEND-200, utilizes up to 200 kg of enriched HPGe detectors and is currently operational in Hall A of the Laboratori Nazionali del Gran Sasso (LNGS), Italy. The subsequent phase, LEGEND-1000, is scheduled to begin construction in Hall C of the LNGS in 2026 and aims to scale up to 1000 kg of detectors.
Achieving a discovery sensitivity of 3σ for 0νββ decay at a half-life of 10^{28} years requires maintaining a background contribution at Q of less than 10^{-5} counts/(keV kg yr). Strategies to meet this requirement include selecting radiopure materials and using underground liquid argon. Alternatives are being explored, such as optically active enclosures and specialized pulse shape discrimination. Furthermore, novel background suppression techniques have been developed for the in-situ produced isotope $^{77(m)}$Ge based on delayed coincidences. This poster will provide insights into the LEGEND-1000 baseline design and discuss various background reduction techniques, focusing on the suppression of the decays of in-situ produced isotopes.
This work is supported by the U.S. DOE and the NSF; the LANL, ORNL, and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak RDA; the Swiss SNF; the UK STFC; the Canadian NSERC and CFI; the LNGS and SURF facilities.

Submitter Email:

moritz.neuberger@tum.de

Submitter Name:

Moritz Neuberger

Submitter Institution:

Technical University of Munich (TUM)

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Non-standard interactions and tau neutrino detection at DUNE

Authors: Nikolina Ilic[1]; Ushak Rahaman[1]; William Dallaway[1]; Xinyue Yu[1]; Zishen Guan[1]

[1] *University of Toronto*

Corresponding Authors: nick.guan@mail.utoronto.ca, nikolina.ilic@cern.ch, william.dallaway@mail.utoronto.ca, ushak.rahaman@cern.ch, xinyue.yu@cern.ch

Non-standard interactions (NSI) are a compelling beyond-the-Standard-Model (BSM) framework for explaining the tensions between the T2K experiment and the
$operatorname NO\nu A$ experiment results. They can be formulated as general neutrino–or antineutrino–flavour-changing scattering processes with fermions in matter. In oscillation phenomenology, NSI enter as additional matter-potential terms in the Hamiltonian, leading to observable effects on oscillation probabilities for neutrinos and antineutrinos in matter.

We assess the impact of tau-neutrino data from the Deep Underground Neutrino Experiment (DUNE). DUNE is a next-generation long-baseline experiment. With its 1300 km baseline, it provides an exciting probe of matter effects in neutrino propagation through Earth. Its tau-optimized beam setup provides a unique method to constrain the NSI parameters. We find that the leading observable effect in the tau-neutrino channels arises from $\epsilon_{\mu\tau}$. Adding tau-neutrino appearance to the traditional muon-neutrino and electron-neutrino samples also yields a slightly stronger constraint on $\epsilon_{\mu\tau}$ than muon- and electron-neutrino data alone. In addition, using best fits of NSI parameters from T2K and

$operatorname NO\nu A$, we compute DUNE's sensitivity to neutrino-oscillation parameters and to the mass hierarchy in the presence of NSI effects, and note that degeneracies can limit mass-ordering sensitivity. We consider the impact on sensitivity from the contributions of DUNE's regular beams, tau-optimized beams, and the combination of data from both beam types. We also show that tau-neutrino data improve tests of PMNS unitarity.

This study underscores the importance of tau-neutrino detection and appearance data in the DUNE experiment.

Submitter Email:

xyz.yu@mail.utoronto.ca

Submitter Name:

Xinyue(Theodore) Yu

Submitter Institution:

University of Toronto

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Scalable DAQ Performance for Supernova Neutrino Observations in DUNE

Author: Robert-Mihai Amarinei[1]

Co-authors: DUNE Collaboration ; Nikolina Ilic [1]

[1] *University of Toronto*

Corresponding Authors: robert.mihai.amarinei@cern.ch, nikolina.ilic@cern.ch

The Deep Underground Neutrino Experiment (DUNE) is an international next-generation project that will use a powerful neutrino beam produced at Fermilab and two detectors: a near detector at Fermilab and a far detector ~1300 kilometers away at the Sanford Underground Research Facility in South Dakota. DUNE features a high-throughput, modular data acquisition system (DAQ) specifically designed to capture intense physics events, including Supernova Neutrino Bursts (SNBs). Within the first 10 seconds of such a burst, approximately 10^57 neutrinos are emitted, with around 60 expected to interact in the far detectors. Given DUNE's ambitious scientific goals and the rarity of supernova bursts, the DAQ is required to meet stringent performance criteria: the ability to run continuously for extended periods with a 99% up-time requirement, the functionality to record both beam neutrinos and low-energy neutrinos, data throughputs of up to 1.8 TB/s for the far detectors, and a total storage capacity of 30 PB per year.
The system's modular design enables this workload to be shared evenly across 150 identical detector units, distributed among high-performance commercial off-the shelf servers where one readout server manages four detector units. These servers interface directly with the detector electronics, receiving data over Ethernet. The data are then buffered and processed to extract "trigger primitives" used for data selection. In this talk we present the results of performance tests conducted using the protoDUNE horizontal drift time projection chamber at the Neutrino Platform at CERN, including the ability to record a 100 s-long data capture that will be used for SNB readout. We show that the DUNE DAQ readout system is reliable and scalable for capturing SNB neutrino interactions in DUNE's far detector modules.

Submitter Email:

robert.mihai.amarinei@cern.ch

Submitter Name:

Robert-Mihai Amarinei

Submitter Institution:

University of Toronto

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Tau Neutrino Detection In The DUNE Far Detector With NuGraph

Author: William Dallaway[1]

[1] *University of Toronto*

Corresponding Author: william.dallaway@mail.utoronto.ca

The DUNE experiment is a future long baseline experiment planned with a 1300km baseline and a flux spectrum peaked at approximately 3.5GeV. This means the DUNE experiment has a unique opportunity to detect tau neutrino charged current interactions. Our goal is to identify the tau neutrino charged current events in DUNE's liquid argon time projection chamber (LArTPC) far detectors. To identify these events, we have employed the NuGraph graph neural network, utilizing only the spatial coordinates of the hits and the charge recorded at each hit. This allows the model to be as modular and general as possible and gives a solid reference for benchmarking against many possible methods of improvement.

Submitter Email:

william.dallaway@mail.utoronto.ca

Submitter Name:

William Dallaway

Submitter Institution:

University of Toronto

Plenary Talks / 21

Latest results from CUORE and prospects for CUPID

Author: Stefano Dell'Oro[1]

[1] *University of Milano-Bicocca*

Corresponding Author: stefano.delloro@unimib.it

The search for neutrinoless double beta decay (0νββ) is fundamental for investigating lepton-number violation, probing new physics beyond the Standard Model, and determining whether neutrinos are Majorana particles. CUORE, a cryogenic bolometric experiment at LNGS, studies 0νββ in 130Te using 988 TeO2 crystals. It is a milestone of cryogenic detector arrays with a tonne-scale detector operated for more than 7 years below 15 mK. Since 2017, CUORE has accumulated over 2.5 tonne-years of exposure, achieving one of the leading 0νββ limits and one of the most precise two-neutrino double beta decay (2νββ) half-life measurements thanks to a detailed background reconstruction across a broad energy range. Building on CUORE's success, CUPID (CUORE Upgrade with Particle ID) aims to significantly enhance its 0νββ discovery sensitivity to 10 27 yr in 100 Mo, covering the Inverted Hierarchy of neutrino masses. It will employ 1596 lithium molybdate (Li 2 MoO 4) crystals enriched in 100 Mo, alongside 1710 light detectors with Neganov-Trofimov-Luke amplification, enabling simultaneous heat and light readout for enhanced background rejection, particularly against alpha contamination and 2νββ pileup. CUPID will reuse CUORE's cryostat and infrastructure. Current efforts focus on detector performance validation, sensitivity studies, and finalizing the experimental

design to maximize physics reach. This work presents the latest CUORE results and outlines the key milestones toward CUPID's realization.

Submitter Email:

stefano.delloro@unimib.it

Submitter Name:

Stefano Dell'Oro

Submitter Institution:

University of Milano-Bicocca

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Results and Prospects from Atmospheric Neutrinos

Author: Jürgen Brunner[1]

[1] *CPPM*

Corresponding Author: brunner@cppm.in2p3.fr

The measurement of atmospheric neutrinos led to the discovery of neutrino oscillations 27 years ago. Since, they have developed into a valuable tool for precision measurements of neutrino properties and for searches of physics beyond the Standard Model. Their propagation through the Earth is strongly affected by matter effects, which makes them a perfect probe to pin down the neutrino mass ordering. A new generation of atmospheric neutrino detectors is currently under construction and will become operational within the next few years. With instrumented water/ice masses ranging from 0.2 Mtons to several Mtons they will accumulate several 100,000 neutrino events per year. This wealth of data is accompanied by significant improvements of systematic uncertainties and will allow to perform competitive measurements of mixing parameters and in particular of the neutrino mass ordering before the end of the decade.

Submitter Email:

brunner@cppm.in2p3.fr

Submitter Name:

Jürgen Brunner

Submitter Institution:

CPPM

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Scintillation and Cherenkov Light Separation in a Liquid Argon Detector

Author: Darcy Newmark[1]

[1] *Massachusetts Institute of Technology*

Corresponding Author: dnewmark@mit.edu

This talk will present the first event-by-event observation of Cherenkov radiation from sub-MeV electrons in a high-yield scintillator (liquid argon) detector, representing a milestone in low-energy particle detector development and one of the major goals of 2021 Snowmass Process. This work utilizes the Coherent CAPTAIN-Mills (CCM) experiment, a 10-ton liquid argon light collection detector located at the Los Alamos National Lab pion decays at rest source. The detector is instrumented with 200 8-inch PMTs, 80% of which are coated in a wavelength shifter and 20% are uncoated. Using gamma-rays from a sodium-22 radioactive source, we have isolated prompt Chernekov light with >5 sigma confidence, possible through the unique combination of coated and uncoated PMTs. Cherenkov light identification allows for a highly pure selection of electromagnetic events, enabling exciting beyond Standard Model physics searches that I will review.

Submitter Email:

dnewmark@mit.edu

Submitter Name:

Darcy Newmark

Submitter Institution:

Massachusetts Institute of Technology

Plenary Talks / **24**

Neutrino Detection with ARGO

Authors: Asish Moharana[1]; Christopher Jillings[2]; The Global Argon Dark Matter Collaboration[None]

[1] *Carleton University*

[2] *SNOLAB/Laurentian University*

Corresponding Authors: asishmoharana@cunet.carleton.ca, chris.jillings@snolab.ca

The proposed ARGO detector, under development for deployment at SNOLAB is a 300-tonne fiducial mass single-phase liquid-argon detector. The physics program is broad and includes many relevant neutrino studies including a precise measurement of Boron-8 solar neutrinos from charged-current neutrino absorption on Ar-40. ARGO will have excellent supernovae neutrino sensitivity as well. The detector is being designed for ultra-low backgrounds to have sensitivity to Weakly-Interactiving Massive Particles with sensitivity well into the neutrino fog.

This talk will survey the physics program of ARGO, with particular attention to neutrino physics and the background control program. In addition, we will describe cutting-edge pixilated digital photon detectors that will allow for nano-second timing resolution and linear detector response to high energies.

Submitter Email:

chris.jillings@snolab.ca

Submitter Name:

Christopher Jillings

Submitter Institution:

SNOLAB, Laurentian University

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Experimental Overview of Inelastic Neutrino-Nucleus Interactions

Author: Kevin McFarland[1]

[1] *University of Rochester*

Corresponding Author: kevin@rochester.edu

Planned precision neutrino oscillation experiments at accelerators have motivated a world-wide program to study interactions of GeV neutrinos on nuclei. I will review recent results and insights gained from these measurements and will discuss future prospects for this work.

Submitter Email:

kevin@rochester.edu

Submitter Name:

Kevin McFarland

Submitter Institution:

University of Rochester

Plenary Talks / 26

Status of the Short-Baseline Near Detector at Fermilab

Author: Tereza Kroupova[1]

[1] *University of Pennsylvania*

Corresponding Author: kroupa@sas.upenn.edu

The Short-Baseline Near Detector (SBND) is one of three liquid argon time projection chamber (LArTPC) neutrino detectors positioned along the axis of the Booster Neutrino Beam (BNB) at Fermilab, and serves as the near detector in the Short-Baseline Neutrino (SBN) Program. The SBND detector completed commissioning and began taking neutrino data in the summer of 2024, and has finished its Run1 in the summer of 2025 recording about 3 million neutrino interactions, already the largest ν-Ar dataset in the world. Using its superb tracking and calorimetric capabilities, and powerful light collection system, SBND will soon carry out a rich program of neutrino interaction measurements and novel searches for physics beyond the Standard Model (BSM). As the near detector, it will enable the full potential of the SBN sterile neutrino program by precisely characterizing the unoscillated neutrino beam, constraining BNB flux and neutrino-argon cross-section systematic uncertainties. In this talk, the current status and future prospects of SBND are discussed.

Submitter Email:

kroupa@sas.upenn.edu

Submitter Name:

Tereza Kroupova

Submitter Institution:

University of Pennsylvania

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The SuperNEMO Double-Beta-Decay Experiment

Author: Emmanuel Chauveau[1]

[1] *LP2i Bordeaux, CNRS / IN2P3*

Corresponding Author: chauveau@lp2ib.in2p3.fr

SuperNEMO is a double-beta-decay experiment, whose isotope-agnostic tracker-calorimeter architecture has the unique ability to track trajectories and energies of individual particles. If the hypothesised lepton-number-violating process, neutrinoless double-beta decay (0νββ), is discovered, this full topological event reconstruction will be the only way to determine the mechanism. The detector serves as proof of concept for many novel developments in tracker-calorimeter technology, which could be used in a scaled-up version with neutrino-mass sensitivity comparable to next-generation experiments. In addition, the Demonstrator is uniquely positioned to make detailed studies of the Standard Model double-beta decay process (2νββ). Precise kinematic measurements of these events can place important constraints on nuclear models and the axial coupling constant, gA. Additionally, the Demonstrator can probe beyond-the-Standard-Model phenomena, including exotic 0νββ modes, Lorentz-violating decays, and bosonic neutrino processes. The SuperNEMO Demonstrator, located at LSM, France, is currently collecting double-beta-decay data from a 6.11kg Se-82 0νββ source. First physics data and physics objectives will be presented.

Submitter Email:

chauveau@lp2ib.in2p3.fr

Submitter Name:

Emmanuel Chauveau

Submitter Institution:

LP2i Bordeaux, CNRS / IN2P3

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Neutrino measurements with the FASER detector at the LHC

Author: Charlotte Cavanagh[1]

[1] *ETH Zurich (CH)*

Corresponding Author: charlotte.cavanagh@cern.ch

The Forward Search Experiment (FASER) is a small experiment in the far-forward region 480 m upstream of the ATLAS interaction point at the LHC. It is designed to detect highly-energetic neutrinos as well as to search for feebly-interacting new particles predicted by extensions of the Standard Model. So far in Run 3 FASER has collected close to 200 fb^{-1} of data and has yielded results from both the emulsion-based technology used in the sub-detector FASERν and from the electronic components of the detector. These results include the first ever observation of electron and muon neutrinos produced at a particle collider, measurements of their interaction cross sections, and the first differential cross section and flux measurements of muon and anti-muon neutrinos at TeV energies, closing the gap between fixed-target experiments and astrophysical measurements. This talk will present an overview of the experiment, recent neutrino results, and future prospects.

Submitter Email:

charlotte.cavanagh@cern.ch

Submitter Name:

Charlotte Cavanagh

Submitter Institution:

ETH Zurich

Poster Presentations / **29**

Targeted Low Energy Data Capture: Region of Interest Filter Optimization for the DUNE Experiment

Author: Matthew Man[1]

Co-authors: Nikolina Ilic [1]; Robert-Mihai Amarinei [1]

[1] *University of Toronto*

Corresponding Authors: nikolina.ilic@cern.ch, robert.mihai.amarinei@cern.ch

The Deep Underground Neutrino Experiment (DUNE) is a future long baseline neutrino oscillation experiment that will use a powerful neutrino beam produced at Fermilab and two detectors: a near detector at Fermilab and a far detector, 1300 kilometers away, at the Sanford Underground Research Facility in South Dakota.

The DUNE experiment will feature a high-throughput, modular Data Acquisition (DAQ) system engineered to record a wide range of physics signals, including low-energy events like supernova burst and solar neutrinos. Due to their very large active volume, the far detectors at DUNE produce data volumes that exceed the available storage capacity by four orders of magnitude.
The DAQ plays a fundamental role in achieving a data reduction of this scale. A central element of this reduction is the Region of Interest (RoI) filter, which applies data rate limitations while preserving sensitivity to low-energy events below 10 MeV. By implementing zero suppression on detector signals and carefully tuning the readout window and threshold parameters, the RoI filter achieves data rate reductions exceeding 90%. Its performance has been thoroughly validated through LArsoft simulations using MARLEY-generated low-energy Monte Carlo events passed through the full detector simulation. In this talk, I will describe how the RoI filter significantly enhances DUNE's data processing capabilities and scientific potential, allowing for detailed exploration of neutrino interactions at energies below 10 MeV.

Submitter Email:

robert.mihai.amarinei@cern.ch

Submitter Name:

Robert-Mihai Amarinei

Submitter Institution:

University of Toronto

Public Event / **30**

Capturing Innovations and Underlying Physics in Sports

Sports occupy an important part of our lives. It is often difficult to flip through the TV channels without encountering sports shows. Surprisingly, a large fraction of the intriguing and often spectacular sports actions and feats can be explained using relatively basic physics concepts. In this talk I will present and discuss the physics behind some remarkably creative innovations in popular sports (baseball, soccer/football, volleyball, basketball, high Jump, gymnastics, etc.) using basic concepts in classical physics.

The talk will feature exquisite and exclusive videos created by the New York Times graphics/multimedia team for sports that capture innovative feats of athletes like Simone Biles.

The main part of this presentation was initially created in collaboration with Bedel Saget, a New York Times graphics/multimedia editor for sports. Bedel Saget received a 2nd place award for his team's work, titled, "The Fine Line: Simone Biles Gymnastics" at the prestigious 2017 World Press Photo Digital Storytelling contest in the Immersive Storytelling category.

Default location: The YES Theatre Refettorio
https://yestheatre.com/yes-refettorio/

Backup Location (bad weather): Place des Arts

Submitter Email:

Submitter Name:

Submitter Institution:

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EDII and Scientific Practice

Corresponding Author: ecaden@snolab.ca

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Theoretical Overview of Neutrino Oscillations

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Overview of Reactor Neutrino Experiments

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Results and Prospects from Solar Neutrinos

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Neutrinoless double beta decay

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SNO+: Progress and Prospects

Author: Ryan Bayes[1]

[1] *Queen's University*

Corresponding Author: rbayes@snolab.ca

SNO+ is a liquid scintillator detector located 2 km below the Canadian Shield in the Vale Creighton mine. SNO+ has a rich neutrino program that includes the observation of solar neutrinos. Detection of anti-neutrinos from nearby reactors and the Earth have been also been reported upon and leveraged for a nascent supernova detection program. Preparations of the search for neutrinoless double beta decay using Tellurium suspended in the scintillator are well advanced. The new calibration systems are fully commissioned and the first internal source deployment has been performed. This talk will present the latest results from the SNO+ scintillator phases with discussion of near-term physics goals and prospects for neutrinoless double beta decay.

Submitter Email:

rbayes@snolab.ca

Submitter Name:

Ryan Bayes

Submitter Institution:

Queen's University

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The HALO Supernova Neutrino Detector

Author: Tom Sonley[1]

[1] *SNOLAB*

Corresponding Author: tjsonley@snolab.ca

HALO, the Helium and Lead Observatory, has been operating at SNOLAB for thirteen years as a low-maintenance, high-livetime supernova neutrino detector. The HALO detector is principally composed 79 tonnes of lead from a decommissioned cosmic ray station, and is instrumented by 368 m of SNO's ultra-low activity He-3 neutron counters. Supernova neutrinos interacting with the lead target may produce one or two neutron emission through CC or NC excitation of the lead nuclei. HALO detects these neutrons with an average efficiency of 28% and an extended burst of detected

neutrons would be consistent with a galactic supernova explosion. Since October 2015 HALO has been providing low threshold and very low latency supernova alarms to the SuperNova Early Warning System (SNEWS) coincidence servers. The collaboration will present the status of the detector as well as concepts for future HALO-like detectors.

Submitter Email:

tjsonley@snolab.ca

Submitter Name:

Tom Sonley

Submitter Institution:

SNOLAB

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Overview of Supernova Neutrinos

Submitter Email:

Submitter Name:

Submitter Institution:

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Machine Learning and Artificial Intelligence for Neutrino Science

Corresponding Author: kterao@slac.stanford.edu

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Probing the Nature of Neutrinos with the Deep Underground Neutrino Experiment (DUNE)

Author: Gianfranco Ingratta[1]

[1] *York University*

Corresponding Author: ingratta@yorku.ca

The Deep Underground Neutrino Experiment (DUNE) is an ambitious research program in neutrino physics under construction at Fermilab and the Sanford Underground Research Facility (SURF). Neutrino oscillations have led to the discovery that neutrinos have nonzero masses. The current model describes the oscillation phenomenon in terms of three mixing angles and one CP-violating phase. Within the three-flavor paradigm, the other two major unknowns are the neutrino mass ordering and whether charge-parity is violated in the leptonic sector.

Unlike past neutrino experiments, DUNE is uniquely designed to measure many oscillation parameters and eventually test the validity of the oscillation model. Additionally, its design will offer the opportunity for non-beam-related neutrino physics, including the detection of supernova and solar neutrinos. Such a broad physics program is made possible by measuring neutrinos and antineutrinos as function of energy over a wide-band beam, using large underground Liquid Argon Time Projection Chambers (LArTPC) able to provide exquisite imaging capabilities. DUNE is a dual-site experiment with a detector close to the neutrino beam source at Fermilab (Near Detector) and a detector 1300 km away in South Dakota (Far Detector). The Near Detector measures the unoscillated neutrino flux and constrains systematic uncertainties to predict the neutrino flux at the Far Detector, where the oscillated (anti-)neutrino beam is measured. In its first phase, the Far Detector will comprise two 10,000 ton (fiducial) LArTPC a mile underground; the Near Detector will consist of a LArTPC module and two additional trackers to obtain a robust characterization of the neutrino flux.

In this talk, I will present the rich DUNE neutrino physics program, including opportunities for Beyond Standard Model physics. I will highlight how its sophisticated design makes DUNE a robust and comprehensive experiment. I will also outline the current status of its operating prototypes and ongoing construction.

Submitter Email:

ingratta@yorku.ca

Submitter Name:

Gianfranco Ingratta

Submitter Institution:

York University, Toronto

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The Large-Aperture Photodetector for Improved Water Cherenkov Detector Performance

Author: Yasuhiro Nishimura[1]

[1] *Keio University*

Corresponding Author: nishimura@phys.keio.ac.jp

Newly designed photodetectors with a large 50-cm aperture were developed for future neutrino experiments. About twenty thousand R12860 photomultiplier tubes (PMTs) with a box-and-line dynode, manufactured by Hamamatsu Photonics, were selected for the next-generation water Cherenkov detector, Hyper-Kamiokande. Operation is scheduled to begin in 2028 with the world's largest 260k metric tons of ultra-pure water toward various physics topics on neutrinos and nucleon decays.

The improved performance of the photodetector enables the construction of a deeper water tank, with twice the strength against high hydrostatic pressure. It provides higher physics sensitivity through half the timing resolution and twice the detection efficiency for a single photoelectron, as well as a uniform response under varied magnetic fields and light-injection positions. A long-term stability was confirmed using a 200-ton water tank at EGADS (Evaluating Gadolinium's Action on Detector Systems), and a 50k-ton water at Super-Kamiokande.

The properties of the PMTs over six years of production since 2020 are assured with a continuous quality monitoring system using two 8-PMT measurement rooms with temperature control, two 100-PMT measurement rooms for dark noise stability monitoring, 16-PMT measurement setup for aging checks, and visual inspection in preparation for the installation in 2027. Furthermore, various studies to investigate the performance dependency on environmental properties were performed to suppress detection uncertainties.

I will present the overall achievements in performance improvements and quality assurance during production for the successful operation of Hyper-Kamiokande observation.

Submitter Email:

nishimura@phys.keio.ac.jp

Submitter Name:

Yasuhiro NISHIMURA

Submitter Institution:

Keio University

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High-energy astrophysical neutrinos

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Overview of Neutrino Mass Measurements

Author: Marcello Messina[1]

[1] *INFN*

Corresponding Author: marcello.messina@lngs.infn.it

Neutrino mass is a fundamental parameter of particle physics with important implications for cosmology and the Standard Model of particle physics. Despite of almost 100 years of experimental effort, its absolute scale remains unknown. Over that period, direct kinematic measurements, searches for neutrino-less double beta decay, and oscillation experiments have progressively put constraints on combinations of neutrino mass eigenvalues.

In this talk I will give a brief introduction to the methods used to probe neutrino mass and then focus on an overview of current experiments dedicated to the direct neutrino mass measurement. Then I will summarise their measurement strategies, status, and projected sensitivities, and discuss the complementarity between different projects.

Submitter Email:

Submitter Name:

Submitter Institution:

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The Theia physics program and the Eos demonstrator

Author: Logan Lebanowski[1]

[1] *University of California, Berkeley*

Corresponding Author: llebanowski@berkeley.edu

Theia is a proposed large-scale neutrino detector with a novel liquid scintillator target and fast, spectrally-sensitive photon detectors, leveraging both the direction resolution of the Cherenkov signal and the remarkable energy resolution and low detection threshold of a scintillator detector. The Theia physics program spans low-energy neutrino physics, such as solar, geo, supernova burst, diffuse supernova, and a high-sensitivity search for neutrinoless double-beta decay that could reach into the normal hierarchy. Theia has recently received Gateway-0 approval at SNOLAB. Measurements of δ_{CP} and the neutrino mass hierarchy using high-energy neutrinos from the LBNF neutrino beam are also possible if located at SURF. Several technology demonstrators are evaluating the performance of relevant state-of-the-art technologies. In particular, the 20-tonne Eos detector based at Berkeley uses new 8"Hamamatsu 14688-100 PMTs, which have been measured to have a 450-ps transit-time spread, coupled with 12 dichroic light concentrators for photon spectral sorting. Data acquisition with a range of radioactive and picosecond-precision optical sources has been completed with a 4-tonne fiducial water target. Water-based scintillator is currently deployed for the second time. Eos will continue characterizing technologies at Berkeley, before a possible move to a neutrino source, which would enable a number of technical demonstrations, such as the ability to differentiate CC from ES interactions, as well as a physics program in cross section measurements and BSM searches.

Submitter Email:

llebanowski@berkeley.edu

Submitter Name:

Logan Lebanowski

Submitter Institution:

University of California, Berkeley

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Sterile Neutrinos and Beyond the Three Flavours Overview

Author: Yue Zhang[1]

[1] *Carleton University*

Corresponding Author: yzhang@physics.carleton.ca

I will give an overview on the sterile neutrino extension of the Standard Model, including motivations and terrestrial/cosmological probes.

Submitter Email:

yzhang@physics.carleton.ca

Submitter Name:

Yue Zhang

Submitter Institution:

Carleton University

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Experimental Overview of Neutrino Oscillations

Author: Akira Konaka[1]

[1] *TRIUMF*

Corresponding Author: konaka@triumf.ca

Neutrino oscillation offers a precise measurement of the lepton mixing (PMNS) matrix, including the CP violation phase, and sensitive search windows for new physics, such as new mass eigenstates (sterile neutrinos) and interactions beyond the standard model through matter oscillation effects. In this presentation, an overview of the neutrino oscillation experiments with a focus on the next generation of experiments will be provided.

Submitter Email:

konaka@triumf.ca

Submitter Name:

Akira Konaka

Submitter Institution:

TRIUMF