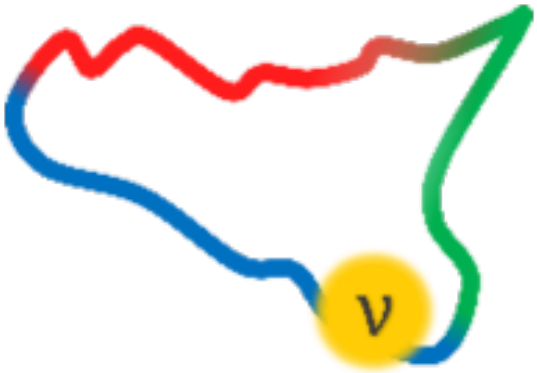
WORKSHOP: Multi-Aspect Young-ORiented Advanced Neutrino Academy (MAYORANA) - International Workshop II edition



Report of Contributions

https://agenda.infn.it/e/mayoranaWorkshop2025

Contribution ID: **1** Type: **not specified**

Constraints on Neutrino Secret Interactionsfrom Multi-messenger neutrinos scattering on CνB

Tuesday, 17 June 2025 11:50 (20 minutes)

We present new constraints on neutrino secret interactions (νSI) by studying high-energy neutrinos from well-known astrophysical sources, such as SN1987A, the blazars TXS $0506+056$ and PKS $0735+178$, NGC 1068 and KM3-230213A neutrino event. Our analysis focuses on Dirac neutrinos interacting with a massive spin-one boson as they propagate through the Cosmic Neutrino Background (CνB). We consider both ultra-relativistic and non-relativistic regimes, deriving bounds on the νSI coupling constant across the full mass range. Our results obtained using analytical methods, demonstrate significant constraints on the νSI coupling in the low-mass mediator mass region for a given cut-off parameter. With recently discovered KM3-230213A neutrino event we probe a new scale of the mediator mass.

Primary author: PETROPAVLOVA, Maria (Faculty of Mathematics and Physics at Charles University, Institute of Experimental and Applied Physics (IEAP) at the Czech Technical University in Prague)

Presenter: PETROPAVLOVA, Maria (Faculty of Mathematics and Physics at Charles University, Institute of Experimental and Applied Physics (IEAP) at the Czech Technical University in Prague)

Session Classification: Oral contribution

Contribution ID: **2** Type: **not specified**

Status of RELICS experiment for reactor CEvNS detection

Tuesday, 17 June 2025 12:10 (20 minutes)

The coherent elastic neutrino-nucleus scattering (CEvNS) process is a promising approach for investigating neutrino properties and exploring physics beyond the Standard Model. The REactor neutrino LIquid xenon Coherent elastic Scattering experiment (RELICS) plans to deploy a 50-kilogram-scale two-phase liquid xenon time projection chamber (LXeTPC) near the reactor at China's Sanmen Nuclear Power Plant. The project aims to detect CEvNS with xenon nuclei using ultra-low background, low threshold, and large exposure techniques. This report will focus on the detector design, background control, and anticipated sensitivity of the RELICS experiment.

Primary author: CHEN, jiangyu (Sun Yat-sen University)

Presenter: CHEN, jiangyu (Sun Yat-sen University)

Session Classification: Oral contribution

Contribution ID: **3** Type: **not specified**

Type-II Seesaw Triplet Scalar Effects on Neutrino Trident Scattering

Tuesday, 17 June 2025 17:00 (20 minutes)

In Type-II seesaw model, an electroweak triplet scalar field Δ with a non-zero vacuum expectation value (vev) v_Δ is introduced to facilitate the generation of small neutrino masses. A non-zero v_Δ also affects the W mass through the electroweak ρ parameter, making it to be less than 1 as predicted by standard model (SM). The component fields in Δ come along introduce additional contributions to reduce the SM rare neutrino trident scattering cross section. These fields also induce new processes not existed in SM, such as $l_i \to \overline{l_j} l_k l_l$ and $l_i \to l_j \gamma$. There are severe constraints on these processes which limit the effects on neutrino trident scattering and the ρ parameter and therefore the W mass. The newly measured W mass by CDF makes the central value of ρ parameter to be larger than 1, even larger than previously expected. Combining neutrinoless double beta decay, direct neutrino mass and oscillation data, we find a lower limit for v_Δ as a function of the triplet scalar mass m_Δ, $v_\Delta > (6.3 \sim 8.4)\mathrm{eV}(100\mathrm{GeV}/m_\Delta)$. To have significant effect on ρ in this model, v_Δ needs to be in the range of a GeV or so. However this implies a very small m_Δ which is ruled out by data. We conclude that the effect of triplet vev v_Δ on the W mass can be neglected. We also find that at 3σ level, the deviation of the ratio for Type-II Seesaw to SM neutrino trident scattering cross section predictions is reduced to be below 1, but is restricted to be larger than 0.98.

Primary authors: Dr CHENG, Yu (Tsung-Dao Lee Institute, SJTU); Prof. HE, Xiao-Gang (Tsung--Dao Lee Institute, SJTU); Mr HUANG, Zhong-Lv (Tsung-Dao Lee Institute, SJTU); LI, Ming-Wei (Tsung-Dao Lee Institute)

Presenter: LI, Ming-Wei (Tsung-Dao Lee Institute)

Session Classification: Oral contribution

Contribution ID: **5** Type: **not specified**

Insights into Lithium-Germanium Interface Dynamics in HPGe Detectors: A GEANT4 Study

Monday, 16 June 2025 12:40 (20 minutes)

Geometry-dependent performance evaluation of an HPGe detector is crucial for low-level γ-ray spectrometry, rare decay studies [Su, J., et al. 2014. NIM A, 763, 364–371], and environmental radioactivity assessments [Tarabini, E., et al. 2023. Appl. Radiat. Isot., 196, 110768]. In this study, the thickness of the top dead layer (t_d) of an HPGe detector was estimated using low-energy γ-rays, as the manufacturer did not specify this parameter. The investigations have been conducted on a newly installed coaxial p-type HPGe detector, GEM40P4-83-RB/ORTEC, encapsulated in a radiopure carbon fiber housing. To estimate t_d, Monte Carlo simulations have been performed using the GEANT4 framework of [Agostinelli, S., et al. 2003. NIM A, 506, 250–303]. It has been found to be 0.72 mm and 0.71 mm for the sharp corner geometry of the crystal using two different techniques and 0.67 mm for the round corner geometry, thereby accurately replicating the experimental results. Simulated and experimental efficiencies are in good agreement within the uncertainty of 2.5\% for close distances ($<$ 5 cm) and 3.8\% for far distances ($\geq$ 5 cm) across the energy range of 59.54–2614.50 keV. The methodology employed in this work has been validated by overlapping the simulated spectra with the experimental ones using different γ-sources (i.e., ^{109}Cd, ^{137}Cs, ^{60}Co etc). The observed dead layer growth was consistent with initial expectations during the n+ lithium contact growth phase [Gilmore, G. 2008. Practical Gamma-Ray Spectrometry. John Wiley & Sons, New York, U.S.A.]. Thus, this model serves as a reliable tool for predicting dead layer evolution over time, enabling effective monitoring of detector performance degradation with aging.

Primary author: Ms DEVI, Soni (Indian Institute of Technology Ropar, Rupnagar - 140 001, Punjab, India)

Co-authors: Ms TIWARI, Katyayni (Indian Institute of Technology Ropar, Rupnagar - 140 001, Punjab, India); Mr KAINTURA, Sanjeet S. (Indian Institute of Technology Ropar, Rupnagar - 140 001, Punjab, India); Dr SINGH, Pushpendra P. (Indian Institute of Technology Ropar, Rupnagar - 140 001, Punjab, India)

Presenter: Ms DEVI, Soni (Indian Institute of Technology Ropar, Rupnagar - 140 001, Punjab, India)

Session Classification: Oral contribution

Contribution ID: **6** Type: **not specified**

Muon lifetime analysis of the MONUMENT experiment

Wednesday, 18 June 2025 12:10 (20 minutes)

The MONUMENT experiment aims to support nuclear matrix element calculations of neutrinoless double beta decay by investigating ordinary muon capture on double-beta daughter isotopes. These measurements were performed at the muon beamline of the Paul Scherrer Institute using a setup of high-purity germanium detectors and scintillator counters. The measured muon lifetimes can be compared to theoretical calculations of the total capture rates. A new analysis of the muon lifetime in ^{76}Se, including a detailed treatment of systematic uncertainties, will be presented in this contribution.

Primary author: Dr MONDRAGON, Elizabeth (Technical University of Munich)

Presenter: Dr MONDRAGON, Elizabeth (Technical University of Munich)

Session Classification: Oral contribution

Contribution ID: **7** Type: **not specified**

Neutrino physics from gamma-ray spectroscopy

Wednesday, 18 June 2025 10:30 (20 minutes)

Nuclear matrix elements (NMEs) are crucial for understanding weak interaction processes such as inverse beta decay (IBD) and neutrinoless double-beta decay ($0\nu\beta\beta$), which provide insights into neutrino properties and physics beyond the Standard Model. A novel experimental approach aims to extract NMEs using electromagnetic (EM) transitions from isobaric analog states (IAS). In this talk, I will present the feasibility of a dedicated campaign, envisioned to take place at the Laboratori Nazionali di Legnaro in the near future.

Primary author: STRAMACCIONI, Damiano (Istituto Nazionale di Fisica Nucleare)

Presenter: STRAMACCIONI, Damiano (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **8** Type: **not specified**

Nuclear beta decay studies for neutrino physics and dark matter search

Tuesday, 17 June 2025 10:30 (20 minutes)

We investigate the atomic exchange effect between the bound electrons of the final atom and those emitted in the allowed β decay of the parent nucleus. Electron wave functions are computed using the self-consistent Dirac–Hartree–Fock–Slater method, with orthogonality between continuum and bound states of the final atom enforced by modifying the last iteration of the self-consistent procedure. Our results suggest that these exchange effects can resolve discrepancies between theoretical predictions and experimental measurements in the low-energy region of the β spectrum. The significance of various atomic corrections is further examined in the context of one of the most promising candidates for determining the neutrino mass scale: the unique first forbidden β transition of ^{187}Re. Additionally, the developed β decay model is used to compute electron spectra for nuclei that represent unavoidable background sources in dark matter search experiments.

Primary authors: Dr NITESCU, Ovidiu ("Horia Hulubei"National Institute of Physics and Nuclear Engineering; International Centre for Advanced Training and Research in Physics (CIFRA);); SIMKOVIC, Fedor

Presenter: Dr NITESCU, Ovidiu ("Horia Hulubei"National Institute of Physics and Nuclear Engineering; International Centre for Advanced Training and Research in Physics (CIFRA);)

Session Classification: Oral contribution

Contribution ID: **9** Type: **not specified**

Reaction Approach to Nuclear Matrix Elements of Lepton Number Violating Processes

Tuesday, 17 June 2025 09:30 (30 minutes)

The search for lepton number violating (LNV) processes are of central interest as signatures for physics beyond the standard model. Nuclear neutrinoless double beta decay (DBD) is a prominent case of active current research as the expected low-energy limit of more general, yet to be identified and explored phenomena. Heavy ion Majorana double charge exchange (MDCE) reactions, proceeding by virtual (pi+,pi-)/(pi-,pi+) processes are well suited to study independently DBD-type nuclear matrix elements. The NUMEN project at LNS Catania is dedicated to systematic measurements of MDCE transitions, thus narrowing a persistent source of uncertainties on the determination of the desired Majorana mass of neutrinos, once confirmed DBD data will be available.

Direct access to LNV beyond the static limit of nuclear DBD could be obtained by lepton-induced double charge exchange (LDCC) reactions on nuclei. LDCC reactions are second order charged current processes. An in principle feasible case is A(Z)(e-,e+)B(Z-2) reactions. The reaction relies on the transformation of the intermediate electron-neutrino into an anti-neutrino, either by the Majorana mechanism or due to higher dimensional LNV operators. Theoretical aspects of these hitherto never considered reactions and first estimates of cross sections are discussed.

Primary author: LENSKE, Horst

Presenter: LENSKE, Horst

Session Classification: Oral contribution

Contribution ID: **10** Type: **not specified**

Optimization of the light detection system of the ICARUS detector

Wednesday, 18 June 2025 15:30 (20 minutes)

The ICARUS detector, a key component of the Short Baseline Neutrino (SBN) Program at Fermilab, is a 600-ton Liquid Argon Time Projection Chamber (LArTPC) equipped with a Light Detection System (LDS) that uses 360 Hamamatsu R5912-MOD 8-inch photomultiplier tubes (PMTs), specifically designed to operate under cryogenic conditions (~87 K). These PMTs feed the trigger signal to the readout, improve the spatial and timing resolution of the events and contribute to cosmic rays mitigation.
During operation at Fermilab, a progressive degradation in PMT gain was observed. We developed an experimental setup to investigate the temperature dependence of PMT performance. Gain measurements were carried out from room temperature to -70 ° C using an environmental chamber. The results show that, while the PMTs exhibit stable performance under ambient conditions, a significant and irreversible reduction in gain emerges at lower temperatures. Although -70◦C remains above liquid argon temperatures, the trend clearly reveals a gain-sensitive degradation mechanism.
A simplified physical model was developed to reproduce and interpret the observed behavior. Based on these findings, a series of mitigation strategies were implemented in the ICARUS detector to preserve PMT performance and ensure reliable operation under cryogenic conditions.

Primary author: SAIA, Clara

Co-authors: PETTA, Catia Maria Annunziata (Istituto Nazionale di Fisica Nucleare); RASELLI, Gian Luca (Istituto Nazionale di Fisica Nucleare); BRIO, Vanessa (Istituto Nazionale di Fisica Nucleare)

Presenter: SAIA, Clara

Session Classification: Oral contribution

Contribution ID: **11** Type: **not specified**

Charting the Path to Discovery: The Status and Future of Neutrinoless

Monday, 16 June 2025 09:30 (40 minutes)

Presenter: SCHÖNERT, Stefan (TUM)

Session Classification: Oral contribution

Contribution ID: **12** Type: **not specified**

The solution of the quenching puzzle within the microscopic approach to nuclear structure

Monday, 16 June 2025 10:10 (30 minutes)

Presenter: CORAGGIO, Luigi (INFN-NA)

Session Classification: Oral contribution

Contribution ID: **13** Type: **not specified**

Overview of neutrino experiments

Monday, 16 June 2025 15:00 (40 minutes)

Presenter: Prof. PALLAVICINI, Marco (GE)

Session Classification: Oral contribution

Contribution ID: **14** Type: **not specified**

Recent progress on modeling neutrino-nucleus cross sections for oscillation experiments

Monday, 16 June 2025 10:40 (30 minutes)

Presenter: BARBARO, Maria Benedetta (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **16** Type: **not specified**

Light Dark Matter search at accelerators: the BDX experiment at Jefferson Lab

Monday, 16 June 2025 11:40 (30 minutes)

Presenter: BATTAGLIERI, Marco (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **17** Type: **not specified**

Solar and neutrino physics with Borexino

Monday, 16 June 2025 16:10 (30 minutes)

Presenter: ZAVATARELLI, Sandra (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **18** Type: **not specified**

Probing two-body charge-exchange transition densities in heavy ion reactions

Monday, 16 June 2025 15:40 (30 minutes)

Presenter: COLONNA, Maria (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **20** Type: **not specified**

Beta and double beta decays: a joint effort in Milano to understand neutrinos

Tuesday, 17 June 2025 10:00 (30 minutes)

Presenter: BROFFERIO, Chiara (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **21** Type: **not specified**

The KM3NeT neutrino detectors: status and recent results

Tuesday, 17 June 2025 11:20 (30 minutes)

Presenter: LEONORA, Emanuele (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **22** Type: **not specified**

Present status of three-family global fits to neutrino oscillation data

Tuesday, 17 June 2025 14:30 (30 minutes)

Presenter: Dr MALTONI, Michele (Instituto de Fisica Teorica UAM/CSIC)

Session Classification: Oral contribution

Contribution ID: **23** Type: **not specified**

Calibration of the KM3NeT detector

Tuesday, 17 June 2025 15:00 (30 minutes)

Presenter: FERRARA, Giovanna (Università degli Studi di Catania)

Session Classification: Oral contribution

Contribution ID: **24** Type: **not specified**

Multimessenger search for neutrino emission from binary mergers with neutrino telescopes in the depths of the Mediterranean Sea

Wednesday, 18 June 2025 11:20 (30 minutes)

Presenter: TOSTA E MELO, Iara (UniCT - INFN)

Session Classification: Oral contribution

Contribution ID: **25** Type: **not specified**

Two-neutrino double beta decay - a key for the 0νββ NMEs problem

Wednesday, 18 June 2025 09:30 (30 minutes)

Presenter: SIMKOVIC, Fedor

Session Classification: Oral contribution

Contribution ID: **26** Type: **not specified**

Characterization of argon recoils at the keV scale with ReD and ReD+

Wednesday, 18 June 2025 10:00 (30 minutes)

Presenter: PANDOLA, Luciano (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **27** Type: **not specified**

Neutrinos as messengers from the Sun and the Earth

Wednesday, 18 June 2025 14:30 (40 minutes)

Presenter: LUDHOVA, Livia (Forschungzentrum Juelich IKP-2)

Session Classification: Oral contribution

Contribution ID: **28** Type: **not specified**

Experimental Challenges and Construction Status of the NUMEN Project

Tuesday, 17 June 2025 16:30 (30 minutes)

Presenter: PIERROUTSAKOU, Dimitra (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **29** Type: **not specified**

Latest Results from the ICARUS Experiment at the Short-Baseline

Tuesday, 17 June 2025 15:30 (30 minutes)

Presenter: FARNESE, Christian (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **31** Type: **not specified**

The multichannel approach within the NUMEN project

Wednesday, 18 June 2025 11:50 (20 minutes)

Nowadays, the search for neutrino-less double beta ($0\nu\beta\beta$) decay continues with undiminished interest since it is a prominent tool for probing neutrino nature and its absolute mass scale. However, the latter task is hampered by the puzzling inconsistencies in the calculations of the nuclear matrix elements (NMEs) of $0\nu\beta\beta$ decay [1], despite the existing experimental constraints. In this respect, a challenging experimental campaign has been initiated at the Istituto Nazionale di Fisica Nucleare –Laboratori Nazionali del Sud (INFN-LNS) in Catania under the NUMEN and NURE projects [2,3], aiming to provide data-driven information on the NMEs for various $0\nu\beta\beta$ decay target candidates, through the study of heavy ion induced double charge exchange (DCE) reactions [4]. A key element for this campaign is the use of MAGNEX acceptance large-acceptance magnetic spectrometer which facilitates the measurement of various reaction channels under the same experimental conditions as the more suppressed DCE reactions. Such a multichannel approach allows for a global description of a plethora of reaction observables within a unique and coherent theoretical framework. This contribution will provide an overview of the pivotal experimental campaign which was performed within NUMEN over the past few years, emphasizing the main results and future perspectives.
[1] M. Agostini et al., Rev. Mod. Phys. 95, 025002 (2023).
[2] F. Cappuzzello et al., Eur. Phys. J. A 54, 72 (2018).
[3] M. Cavallaro et al., Proceedings of Science, BORMIO2017:015 (2017).
[4] F. Cappuzzello et al., Prog. Part. Nucl. Phys. 128, 103999 (2023).

Primary author: SGOUROS, Onoufrios (Istituto Nazionale di Fisica Nucleare)

Co-author: NUMEN COLLABORATION, for the

Presenter: SGOUROS, Onoufrios (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

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

The flux of electron antineutrinos from supernova SN1987A data

Wednesday, 18 June 2025 15:10 (20 minutes)

The neutrinos from the core collapse SN1987A are the first extrasolar neutrinos to be ever detected and have been widely studied to infer the thermodynamical and temporal features of a supernova; however their interpretation in terms of the astrophysical properties of the explosion has been giving rise to heated debates since ever. At date, models are still under construction and simulations do not always depict same things, thus the significance of the data at our disposal must be assessed as accurately as possible.
By adopting a state-of-the-art parameterized model of electron antineutrino emission, we have made some steps forward in the analysis of the available data from core collapse SN1987A taking into account the times, energies and angles of arrival of all detected events in a reliable framework which includes a finite ramp in the initial stage of the neutrino emission.
We determine the parameters of the accretion and cooling emissions and discuss their durations. The results compare well with theoretical expectations and overcome some tensions found in previous similar analyses. We estimate the delay times between the first antineutrino and the first event in the detectors. We test the agreement of the best-fit flux with the empirical temporal, energy and angular distributions, eventually finding a good compatibility with the observed data.

Primary author: OLIVIERO, Veronica (Istituto Nazionale di Fisica Nucleare)

Presenter: OLIVIERO, Veronica (Istituto Nazionale di Fisica Nucleare)

Session Classification: Oral contribution

Contribution ID: **33** Type: **not specified**

Neutrino mass ordering determination and the JUNO experiment

Monday, 16 June 2025 12:10 (30 minutes)

Neutrino mass ordering (NMO) is a fundamental problem that remains unresolved, with significant implications for interpreting the origin of neutrino mass, calculating the half-life of neutrinoless double-beta decay and understanding the cosmic structure formation. Current experimental approaches to determine NMO include: (1) Studying vacuum oscillations of reactor neutrinos; (2) Studying matter-induced oscillations of atmospheric or accelerator neutrinos; (3) Measuring mßß, mß, Σ of neutrinos; (4) Investigating the collective oscillation effects in core-collapse supernovae neutrinos. The current experimental hints of NMO come from T2K, NOvA, Super-Kamiokande and IceCube experiments.

The Jiangmen Underground Neutrino Observatory (JUNO), designed to determine the NMO and investigate a broad range of physics topics, is scheduled for completion this year. JUNO features a 20 kton liquid scintillator (LS) detector surrounded by 35 kton of pure water, equipped with 17,612 20-inch and 25,600 3-inch photomultiplier tubes (PMTs). This configuration enables an unprecedented energy resolution of 3% at 1 MeV and a daily detection rate of 57.4 reactor neutrinos at a baseline of 52.5 km. With an expected exposure of 6.5 years, JUNO will achieve a median sensitivity of 3σ to reject the incorrect NMO hypothesis. Beyond reactor neutrinos, JUNO possesses significant capabilities for studying atmospheric, solar, geo- and supernova neutrinos.

This talk presents the global landscape of NMO sensitivity, the JUNO's design principles, current construction and commissioning status and physics prospects.

Primary author: HUANG, Guihong (Wuyi University)

Presenter: HUANG, Guihong (Wuyi University)

Session Classification: Oral contribution