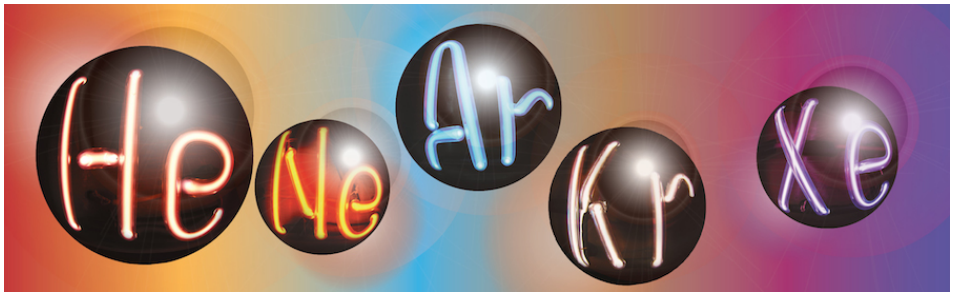
LIDINE 2025: LIght Detection In Noble Elements



Report of Contributions

Contribution ID: **2** Type: **Oral Presentation**

A Comprehensive Monte Carlo Simulation Tool on Electron Transport in Noble Gases and Liquids

Thursday, 23 October 2025 14:40 (20 minutes)

Understanding electron transport dynamics in noble gases (He, Ne, Ar, Kr, Xe) and their liquid phases (Ar, Kr, Xe) is critical for optimizing particle detector performance. We report the development of a MC tool for electron transport through electron-atom collisions, including elastic scattering, excitation and ionization. n coefficient. For the liquid-phase system, two models are discussed. The simulation framework is validated by analyzing electron swarm parameters—specifically drift velocity and diffusion. The results confirm the tool's effectiveness in predicting transport properties, offering a versatile platform for detector design optimization.

Primary authors: CAO, Lei; LIU, Tao; SUN, Xilei; YE, Jingbo; ZHANG, Weixi; HUANG, Yongsheng

Presenter: CAO, Lei

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **3** Type: **Oral Presentation**

The DarkSide-20k Dark Matter Detector: Physics Goals and Data Acquisition

Tuesday, 21 October 2025 16:00 (20 minutes)

The nature of dark matter remains unknown and its origin is currently one of the most important questions in physics. Direct searches for WIMP dark matter particle interactions with ordinary matter are carried out with large detectors located in underground laboratories to suppress the background of cosmic rays. This talk will introduce the DarkSide-20k detector, now under construction in the Gran Sasso National Laboratory (LNGS) in Italy, the largest underground physics facility in the world devoted to astroparticle physics. The experimet is designed to directly detect dark matter by observing weakly interacting massive particles (WIMPs) scattering off the nuclei in 20 tonnes of underground-sourced liquid argon in the dual phase time projection chamber (TPC). The light generated during the interactions in the liquid argon is detected by custom silicon photomultipliers (SiPMs) assemblies of size 20 cm by 20 cm. The data acquisition system (DAQ) for the DarkSide-20k experiment is designed to acquire signals from the 2720 channels of these photosensors in a triggerless mode. The data rate from the TPC alone is expected to be at the level of 2.5 GB/s and will be acquired by 36 newly available commercial VX2745 CAEN 16 bit, 125 MS/s, high channel density (64 ch.) waveform digitizers. The Veto detector is readout by an additional 12 modules. The data is first transferred to 24 Frontend Processor machines for filtering and reduction. Finally the data stream is received by another set of Time Slice Processor computers where the whole detector data is assembled in fixed length time series, analyzed and stored for offline use. These operations will be supervised by a Maximum Integration Data Acquisition System (MIDAS) developed in the Paul Scherrer Institute in Switzerland and TRIUMF laboratory in Canada.

Primary author: WALCZAK, Marek (Gran Sasso Science Institute, Italy)

Presenter: WALCZAK, Marek (Gran Sasso Science Institute, Italy)

Session Classification: Detector techniques

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **6** Type: **Oral Presentation**

Updates on the DEAP-3600 experiment and steps towards the ARGO experiment

Tuesday, 21 October 2025 14:00 (20 minutes)

Over the past decade, liquid argon (LAr) has been established as a promising target for detecting Weakly Interacting Massive Particles (WIMPs), a leading dark matter candidate, due to its high particle discrimination efficiency, scalability, and intrinsic radiopurity. The Global Argon Dark Matter Collaboration (GADMC) was formed to lead a long-term research program utilizing LAr-based detectors for dark matter searches. Among its initiatives, DEAP-3600 has been operating at SNOLAB, Canada, since 2016. It is a single-phase LAr scintillation detector that utilizes a 3.3-tonne atmospheric LAr target viewed by 255 inward-facing photomultiplier tubes. DEAP-3600 has set the most stringent limits on WIMP-nucleon interactions in argon, particularly for WIMPs with masses greater than 30 GeV/c^2. Recent hardware upgrades were implemented to achieve a zero-background environment by mitigating degraded-energy alpha backgrounds. Key results from DEAP-3600 will be presented.

ARGO is being developed with a 400-tonne LAr target, fully instrumented with digital silicon photomultipliers surrounding an acrylic vessel. SNOLAB' s Cube Hall has been selected as the preferred site for this experiment. Studies of radiogenic neutron backgrounds and background mitigation strategies will be discussed.

Primary author: Dr SETH, Susnata (Carleton University, Canada)

Presenter: Dr SETH, Susnata (Carleton University, Canada)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **7** Type: **Oral Presentation**

Update on 3Dpi: PET Scanner with Xenon-doped Liquid Argon and SiPM

Friday, 24 October 2025 09:00 (20 minutes)

The 3Dpi scanner is a Total-Body, Time of Flight, Positron Emission Tomography (PET) imaging device with silicon photomultiplier (SiPM) and a xenon-doped Liquid Argon (LAr) scintillator with the aim of ultra-low-dose imaging for pediatric and pregnant patients. The scanner has an axial field-of-view of 200 cm and consists of nine double-sided concentric rings of SiPM panels. The xenon doping to the LAr scintillator has a few advantages: 1) fast scintillation, 2) suppression of the long tail of the LAr scintillation light, and 3) wavelength shifting to xenon scintillation. These advantages, in turn, improve the time resolution and detection efficiency of positron-electron annihilation signals. Moreover, lowering the operating temperature of the SiPMs to the LAr temperature significantly reduces the dark count rate of SiPMs.

The 3Dpi scanner project is a medical imaging application of the ongoing research and development efforts of the DarkSide collaboration, which is focused on dark matter direct detection experiments using LAr targets. The 3Dpi Monte Carlo simulation package has been derived from the DarkSide simulation package based on the Geant4 toolkit.

I will present the results that we recently published on the performance of the 3Dpi scanner using established NEMA NU 2–2018 standards for spatial resolution, sensitivity, image quality, count rate performance, and timing resolution. I will also discuss the future plan of the 3Dpi project.

Primary author: WADA, Masayuki (Astrocent, CAMK PAN)

Presenter: WADA, Masayuki (Astrocent, CAMK PAN)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **8** Type: **Oral Presentation**

A compact Optical Liquid Argon Facility at Roma Tre

Thursday, 23 October 2025 09:40 (20 minutes)

Liquid argon (LAr) has been used in neutrino and dark matter experiments as an active medium thanks to its excellent properties in charge yield and transport as well as its capacity as a scintillator. We will present the preparation of a compact test facility with a volume of 40 l LAr to fully characterise the response of LAr as a scintillation detector for the LEGEND-1000 experiment. To readout the optical photons, we use the vacuum ultraviolet silicon photomultipliers (VUV SiPM) from Hamamatsu [1], which are sensitive to the 128 nm photons from LAr. The SiPMs will be submerged in the LAr, with the photo-sensitive surfaces directly in contact with the LAr. We use a sealed gamma source to generate scintillation photons, whose timing is defined by the coincidence of three SiPMs placed close to the source. Another ten SiPMs will be placed at multiple distances from the source ranging from 15 cm to 80 cm to measure the attenuation length of the photons. A high intensity LED source will be placed close to the gamma source for calibrating the SiPMs. This configuration is an adaptation from the LLAMA detector [2] which is mounted inside the 64 m^3 LAr tank of LEGEND-200 experiment for monitoring the purity of the LAr. The direct optical contact between the LAr and the VUV SiPMs in the configuration is essential to eliminate the systematics from the wave length shift materials and other optical devices which have been used primarily for the read out of the LAr scintillation photons.
As the dedicated testbench for the R&D of the LEGEND-1000 LAr detector, the compact size of our facility is also important for a quick turnaround in implementing modifications. Impurities including nitrogen and oxygen in the argon can be measured so that we can also monitor the dependence of the LAr optical properties on the level of the impurities.

[1] T. Pershing, et al, "Performance of Hamamatsu VUV4 SiPMs for detecting liquid argon scintillation" , JINST 2022, 17, P04017.
[2] M. Schwarz, et al, "Liquid Argon Instrumentation and Monitoring in LEGEND-200" , EPJ Web of Conferences 2021, 253, 11014.

Primary authors: Dr TAGNANI, Diego (Istituto Nazionale di Fisica Nucleare, Sez. Roma Tre; Uni Roma3); SALAMANNA, Giuseppe (University of Roma Tre and Istituto Nazionale di Fisica Nucleare - Sezione Roma Tre); Dr SHI, Hexi (Uni Roma3, INFN Sez. Roma Tre); Dr D'ANDREA, Valerio (Istituto Nazionale di Fisica Nucleare, Sez. Roma Tre)

Presenters: Dr SHI, Hexi (Uni Roma3, INFN Sez. Roma Tre); SHI, Hexi (GSI Helmholtz Centre for Heavy Ion Research)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **9** Type: **Oral Presentation**

Towards a 0νββ decay search in the LUX-ZEPLIN experiment: mitigating gamma-ray backgrounds

Thursday, 23 October 2025 13:40 (20 minutes)

Dual-phase xenon time projection chambers (TPCs), such as the one at the core of the LUX-ZEPLIN (LZ) experiment, are expected to be well-suited for the search of the neutrinoless double beta decay of ^{136}Xe. In LZ, this rare-event search is primarily limited by the presence of gamma ray backgrounds in the signal's energy region of interest from the decays of ^{214}Bi and ^{208}Tl. These backgrounds, multi-site interactions mis-reconstructed as single-site, can be mitigated by exploiting differences between the topologies of multiple versus single scatters in the TPC. In this talk, I present a new method to unfold event topologies through the deconvolution of detector response from signal waveforms. This technique enables higher granularity in topology reconstruction, and a more effective mitigation of gamma-ray backgrounds.

Primary author: JACQUET, Elisa (Imperial College London)

Presenter: JACQUET, Elisa (Imperial College London)

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **10** Type: **Oral Presentation**

Low-Background Multi-Channel PMT for Next-Generation Xenon Detectors

Wednesday, 22 October 2025 13:50 (20 minutes)

In the PandaX-4T experiment, R11410 photomultiplier tubes (PMTs) account for approximately 47% of the detector ' s material-induced electron recoil background, representing a major limitation in background reduction. As future liquid xenon detectors, such as the proposed PandaX-20T with a 20-tonne target, aim to reach sensitivities $3.5\times10^{-49}\ cm^2$ at $40\ GeV/c^2$ near the irreducible neutrino floor, further suppression of internal backgrounds underscores the need for improved photon sensors.

To address this challenge, we present the development of a low-radioactivity, multi-channel 2-inch PMT (R12699), co-developed with Hamamatsu. Radiopurity screening shows significantly reduced ^{60}Co and U/Th chain activities compared to R11410. Cryogenic characterization at -100℃ demonstrates stable operation with a gain of 4.2×10^6, a dark count rate of 2.5 Hz/channel, and an afterpulse probability of 0.5%. These results position R12699 as a promising candidate for future xenon-based rare event searches.

Primary author: GAO, Zhixing (Shanghai Jiao Tong University)

Presenter: GAO, Zhixing (Shanghai Jiao Tong University)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **11** Type: **Oral Presentation**

The low-energy ionization backgrounds in the PandaX-4T experiment

Thursday, 23 October 2025 13:20 (20 minutes)

The energy threshold of traditional liquid xenon time projection chambers limits our sensitivity in detecting boron-8 neutrinos, light dark matter, and other low-energy signals. Ionization signals have demonstrated significant potential for expanding low-energy detection, but low-energy backgrounds remain the principal barriers to improving sensitivity. In this talk, we present our detailed investigations into the sources of low-energy backgrounds using PandaX-4T data and multiple methods we have developed to evaluate them.

Primary author: LI, Shuaijie (Shanghai Jiao Tong University)

Presenter: LI, Shuaijie (Shanghai Jiao Tong University)

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **12** Type: **Oral Presentation**

Study of the signal response of low energy nuclear recoil in PandaX xenon detector

Friday, 24 October 2025 09:20 (20 minutes)

Recently, dual-phase xenon detectors have observed indication of solar boron-8 neutrino CEvNS signals, which demonstrates a promising sensitivity of light mass dark matter detection through xenon. One key issue for is to have a precise measurement of the signal response of low energy nuclear recoil in xenon. In this talk, I will discuss the nuclear recoil signal model parameter determination with PandaX-4T neutron calibration data, especially for nuclear recoil energy less than 20 keV.

Primary author: Prof. ZHOU, Ning (Shanghai Jiao Tong University)

Presenter: Prof. ZHOU, Ning (Shanghai Jiao Tong University)

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **13** Type: **Oral Presentation**

Exploiting Event Topologies in Liquid Argon Scintillation Signals for Background Identification in LEGEND-200

Thursday, 23 October 2025 14:20 (20 minutes)

LEGEND-200 [arXiv:2505.10440] is a low-background experiment searching for neutrinoless double beta decay of ^{76}Ge. Located deep underground at LNGS, it operates up to 200 kg of enriched high-purity germanium detectors immersed in a liquid argon (LAr) cryostat. To reject backgrounds, the LAr is used as an active shield to detect scintillation light produced by interactions with ionizing radiation. In this talk, I will present the background suppression performance of the LAr instrumentation, based on both physics data and dedicated calibration measurements. I will also outline ongoing efforts to improve the LAr background rejection condition by leveraging the characteristics of scintillation light emission and the detection pattern across all argon instrumentation channels, using machine learning methods. Exploiting the information in the scintillation time profile also enables particle discrimination with the LAr detector system, which I will demonstrate with the search for ^{222}Rn daughters.
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.

Primary author: DECKERT, Rosanna (Technical University of Munich)

Presenter: DECKERT, Rosanna (Technical University of Munich)

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **14** Type: **Oral Presentation**

Machine Learning-Assisted Energy and Position Reconstruction in the Light-only Liquid Xenon (LoLX) experiment

Thursday, 23 October 2025 11:20 (20 minutes)

The Light-only Liquid Xenon (LoLX) experiment operates at McGill University in collaboration with TRIUMF. The experiment uses silicon photomultipliers (SiPMs) to examine liquid xenon (LXe) scintillation characteristics for rare physical events searching experiments, such as neutrinoless double beta decay or dark matter. The primary goals are to understand SiPM performance and study LXe scintillation characteristics in the light-only channel. The LoLX detector is a 4-cm cube consisting of two types of SiPMs—HPK VUV4 and FBK HD3—and a VUV-sensitive photomultiplier tube (PMT). During the first commissioning run, we used external gamma sources (^{133}Ba, ^{137}Cs) to study the detector's performance. To address strong position-dependent variations in event response, we developed a detailed photon propagation simulation using Chroma, a GPU-based photon simulation framework, to model position-dependent energy smearing. By combining experimental data with simulation and applying machine learning techniques for energy and position reconstruction, we have improved our understanding of LXe scintillation and enhanced the detector ' s resolution. In this work, we present the measured light yield and energy resolution at 356 keV (^{133}Ba) and 661 keV (^{137}Cs), demonstrating the capabilities of the LoLX detector and our reconstruction approach.

Primary authors: Dr RETIERE, Fabrice (TRIUMF); LI, Xiang (TRIUMF)

Presenter: LI, Xiang (TRIUMF)

Session Classification: Signal reconstruction and identification

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **15** Type: **Poster**

Analysis and suppression of delay photon and delay electron backgrounds of liquid xenon TPCs for ultra-low energy detection

Tuesday, 21 October 2025 22:00 (50 minutes)

Liquid xenon time projection chambers (LXeTPC) own the detection sensitivity of light dark matter and neutrino CEvNS signals due to its ultra-low energy threshold. However, the sensitivity in sub-keV region is significantly limited by the instrument background, specifically delay photons and delay electrons. In this talk, we will present our investigation into the origins of these backgrounds, including material optical properties, xenon purity, and electric field effects, based on recent experimental data. Based on that, we optimized the design of a prototype LXeTPCs, and will present corresponding test results here. These advancements will help to lowering the energy threshold and further enhancing the sensitivity of LXeTPCs to low-energy nuclear recoil signals.

Primary authors: ZHAO, Yifei (Tsinghua University); CAI, Chang (Tsinghua University); GAO, Fei (Tsinghua University); LI, Kaihang (Tsinghua University); GU, Jingfan (Tsinghua University); LEI, Yang (Tsinghua University); XIE, Lingfeng (Tsinghua University)

Presenter: ZHAO, Yifei (Tsinghua University)

Session Classification: Poster

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **16** Type: **Oral Presentation**

Detail performance of FBK HD3 and HPK VUV4 SiPMs' crosstalks

Wednesday, 22 October 2025 14:10 (20 minutes)

This report will include the internal and external crosstalk measurment and analysis results for two SiPM devices: FBK HD3 and HPK VUV4 SiPMs. They are the candidate photosensors of nEXO experiment. External crosstalk (ExCT) is generally difficult to measure. We employed a setup called the Microscope for the Injection and Emission of Light to characterize the single-avalanche light emission intensity and emission spectra of two SiPMs under vacuum and cryogenic conditions. In addition, by illuminating specific SiPMs with a laser, we measured the yeild of ExCT in a liquid xenon detector and investigated its impact on the detector's performance.

Primary author: Dr 王, 磊 (Triumf)

Presenter: Dr 王, 磊 (Triumf)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **17** Type: **Oral Presentation**

Light Detection in DRD2

Wednesday, 22 October 2025 09:00 (30 minutes)

The Detector Research and Development for Liquid Detectors (DRD2) Collaboration is a CERN-recognized international initiative, formally established in 2023, aimed at advancing liquid detector technologies. The collaboration currently includes 17 countries and over 200 researchers, with participation continuing to expand. Light Readout is a dedicated Work Package in DRD2 since light detection in noble element detectors is central to all large-scale experiments in neutrino physics and dark matter using this technology. Improving photon detection efficiency is essential for increasing sensitivity in rare-event searches, enhancing event reconstruction and energy resolution, and enabling novel detection techniques. Following an overview of the DRD2 collaboration and its key objectives, this presentation will focus on current efforts to improve vacuum ultraviolet (VUV) photon detection efficiency in liquid argon and xenon detectors.

Primary author: GARCIA PERIS, Miguel Angel (University of Manchester)

Presenter: GARCIA PERIS, Miguel Angel (University of Manchester)

Session Classification: Plenary Session

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **18** Type: **Oral Presentation**

Latest results from the LUX-ZEPLIN (LZ) experiment

Tuesday, 21 October 2025 13:40 (20 minutes)

The LUX-ZEPLIN (LZ) experiment is a direct detection dark matter experiment that utilises a dual-phase time projection chamber (TPC) with 7 tonnes of active xenon at the Sanford Underground Research Facility in Lead, South Dakota. The experiment is primarily designed to detect interactions of dark matter in the form of weakly interacting massive particles (WIMPs), a well-motivated class of dark matter candidate. After continuously acquiring data since 2021, LZ has placed the most stringent limits on the spin-independent WIMP-nucleon cross section down to 2.1×10^{-48} cm^2 for a 36 GeV/c^2 WIMP mass. In this talk, I will present the latest results from LZ' s dark matter search, in addition to other new physics signatures that are being explored.

Primary author: USON, Alberto (University of Edinburgh)

Presenter: USON, Alberto (University of Edinburgh)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **20** Type: **Oral Presentation**

VUV Reflectivity Measurements for Materials Relevant to Argon and Xenon Experiments

Friday, 24 October 2025 11:40 (20 minutes)

We present the development and initial results of an experimental setup designed to measure the vacuum ultraviolet (VUV) reflectivity of materials commonly used in argon and xenon-based detectors. The system consists of a monochromator coupled to a sealed black box chamber filled with ultra-pure argon gas. A photosensor mounted on a motorized rotation stage enables angular-resolved measurements, allowing the separation of specular and diffuse reflectivity components. Measurements focus on key VUV wavelengths: 128 nm and 175 nm, corresponding to the scintillation light of liquid argon and liquid xenon, respectively. Preliminary results are shown for materials such as aluminum and stainless steel, highlighting their diffuse reflectivity behavior and the relevance of these measurements for detector design, simulation, and optimization.

Primary author: SOTO-OTON, Jose A. (IFIC-CSIC/UV)

Presenter: SOTO-OTON, Jose A. (IFIC-CSIC/UV)

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **21** Type: **Oral Presentation**

Optical modeling of pixelated digital SiPMs for ARGO

Thursday, 23 October 2025 10:40 (20 minutes)

ARGO is a proposed liquid argon (LAr) dark matter direct-detection experiment to be built at SNOLAB in the coming decade. It will have leading sensitivity to heavy dark matter particles above 50 GeV/c² and will also provide excellent sensitivity to detect core-collapse supernova neutrinos and make high-precision measurements of solar neutrinos. ARGO will use pixelated digital silicon photomultipliers (SiPMs) with fast photon timing that will enable excellent position reconstruction and novel hit-pattern-based event discrimination. However, the optical crosstalk (oCT) in SiPMs may impact the electron/nuclear recoil pulse-shape discrimination and distort the spatial/temporal photon hit distributions, potentially limiting the background rejection performance. To evaluate these effects, we have developed a full Monte Carlo simulation of a pixelated SiPM system, including oCT, that has been benchmarked against available measurement results. In this talk, I will present results from this model, focusing on how oCT influences the detector energy threshold and event position reconstruction. I will also briefly discuss a small-scale ARGOlite prototype at SNOLAB and two digital SiPM technologies that are being evaluated for building its 2 m² pixelated photosensor array.

Primary author: MOHARANA, Asish (Carleton University, Ottawa, Canada)

Presenter: MOHARANA, Asish (Carleton University, Ottawa, Canada)

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **22** Type: **Oral Presentation**

Reconstruction capabilities of the Photon Detection System of SBND

Thursday, 23 October 2025 11:00 (20 minutes)

SBND is a Liquid Argon Time Projection Chamber located 110 m from the neutrino source at Fermilab, serving as the near detector for the Short Baseline Neutrino program. With a 112-ton active mass, it enables high-precision studies of neutrino-argon interactions. The detector began data-taking in 2024. Its Photon Detection System (PDS) combines 120 PMTs and 192 X-ARAPUCA devices behind the anode, while reflective wavelength-shifting panels on the cathode enhance light collection especially in the regions furthest away from the detectors. This novel design provides high light yield, more uniform detection efficiency, excellent time resolution, and independent 3D position reconstruction using only scintillation light. This talk will detail the various calibration procedures implemented to optimize the reconstruction capabilities of the PDS. Among the system's many features, particular emphasis will be placed on the achieved timing resolution, which reaches the order of nanoseconds. This level of precision ultimately allows for the recovery of the pulse structure of the Booster Neutrino Beam.

Primary author: SANCHEZ-CASTILLO, Alejandro (University of Granada)

Presenter: SANCHEZ-CASTILLO, Alejandro (University of Granada)

Session Classification: Signal reconstruction and identification

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **23** Type: **Oral Presentation**

Modeling Background Rejection with the Liquid Argon Optical Instrumentation in LEGEND

Thursday, 23 October 2025 14:00 (20 minutes)

LEGEND-200 is a low-background experiment searching for neutrinoless double beta decay in Ge-76 \[arXiv:2505.10440\]. Situated deep underground at LNGS, the experiment is designed to operate 200 kg of enriched high-purity germanium detectors immersed in a liquid argon (LAr) cryostat. Background suppression is enhanced by an optical instrumentation system that detects scintillation light produced by interactions of ionizing radiation in the LAr. In this talk, I will introduce remage \[DOI:10.5281/zenodo.11115662\], a new Monte Carlo simulation framework under development within the collaboration. Designed for simulating particle radiation transport in low-background experiments, remage includes dedicated tools for modeling the transport of optical photons in noble liquids. I will discuss these capabilities in detail and present results from simulations of the LEGEND-200 LAr instrumentation. The results demonstrate notable innovations over previous efforts in predecessor experiments and will be compared with calibration data from LEGEND-200. Finally, I will outline how these simulations lay the groundwork for improved background modeling and the development of new background mitigation strategies within the LEGEND experimental program.

Primary author: PERTOLDI, Luigi (Technical University of Munich)

Presenter: PERTOLDI, Luigi (Technical University of Munich)

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **24** Type: **Oral Presentation**

Imaging of scintillation light with Coded Aperture masks

Thursday, 23 October 2025 11:40 (20 minutes)

Large volumes of liquid Argon or Xenon constitute an excellent medium for the detection of Neutrino interactions and for Dark Matter searches. Traditionally, noble liquid detectors use scintillation light for a timing or calorimetric signal, often in combination with a Time Projection Chamber (TPC).
Imaging of scintillation light may offer an alternative to charge collection, enabling a direct optical reconstruction of events. Using finely segmented SiPM arrays and a suitable optical system, it becomes possible to construct cameras that effectively "photograph" the primary scintillation light.
A major challenge arises from the fact that both Argon and Xenon scintillate in the vacuum ultraviolet (VUV) range. To address this, we employ Coded Aperture masks in place of traditional lenses, enabling thin cameras with wide and deep fields of view. A reconstruction algorithm based on Maximum Likelihood Expectation Maximization has been developed to obtain a 3D map of energy deposition, outperforming traditional deconvolution techniques in simulation under low-light conditions.
This presentation will cover recent simulation results of neutrino interactions in a liquid Argon detector instrumented with these cameras, along with the design, construction, and first tests of a 256-channel prototype. We will also highlight ongoing progress in key enabling technologies, such as novel wavelength shifter materials and VUV-enhanced backside-illuminated SiPMs. This work was supported by Italian Research Ministry Grant "PRIN 2022KJZSYB".

Primary author: CICERO, Valentina (INFN)

Co-authors: Dr TOSI, Nicolò (INFN); Dr BASIRICÒ , Laura (Università di Bologna); Dr COLANTONI, Elisabetta (Università di Bologna); Prof. MARTINA, Luigi (Università del Salento); Prof. MAURI, Nicoletta (Università di Bologna); Dr PIA, Valerio (INFN)

Presenter: CICERO, Valentina (INFN)

Session Classification: Signal reconstruction and identification

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **25** Type: **Oral Presentation**

Measurement of Ionization and Scintillation Yields from 214Bi beta-decay in XENONnT

Friday, 24 October 2025 09:40 (20 minutes)

Precise knowledge of ionization and scintillation yields at high energies is crucial for liquid xenon detectors, particularly for rare-event searches such as neutrinoless double-beta decay. While low-energy yields are extensively studied, data above 100 keV remain limited. Using XENONnT data and a time-coincidence identification method, we present yield measurements from the clean beta decay of 214Bi directly to the ground state of 214Po, providing valuable data up to 3.2 MeV. This dataset enabled us to create an accurate, data-driven yield model for high-energy electron recoils, validated extensively with simulations. These results can significantly enhance electron recoil modeling and detector response predictions at higher energies.

Primary author: FUSELLI, Carlo

Presenter: FUSELLI, Carlo

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **26** Type: **Oral Presentation**

Investigation of photoluminescence as a source of instrumental backgrounds in xenon TPCs

Friday, 24 October 2025 11:20 (20 minutes)

Liquid xenon time projection chambers (LXe TPCs) exhibit delayed photon and electron signals occurring long after an initial interaction. While they represent a significant background for low-energy searches, the origin of these delayed signals remains not fully understood. We explore the hypothesis that vacuum ultraviolet (VUV) scintillation photons from xenon induce delayed photoluminescence (PL) in detector materials. This results in delayed photon emission that can, in turn, photoionize impurities and produce delayed ionization signals. To examine this scenario, we combine data from the XENONnT experiment with dedicated PL measurements performed using a local R&D setup. We study the relationship between PL, delayed photon emission, and delayed electron production to assess their contribution to observed backgrounds in LXe TPCs. This work contributes to a deeper understanding of delayed electrons phenomenology and PL-induced backgrounds. A detailed understanding and mitigation of these effects is crucial for achieving the sensitivity goals of next-generation LXe TPC experiments.

Primary author: KHARBANDA, Pranati (Nikhef)

Presenter: KHARBANDA, Pranati (Nikhef)

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **27** Type: **Oral Presentation**

The RELICS Experiment: Measuring Coherent Neutrino-Nucleus Scattering Utilizing Dual-Phase Xenon TPC

Tuesday, 21 October 2025 15:00 (20 minutes)

The measurement of Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) cross-sections is crucial for advancing neutrino physics and probing for new phenomena beyond the Standard Model. A major challenge lies in mitigating low-energy backgrounds that mimic the CEvNS signal. Liquid Xenon Time Projection Chambers (LXeTPCs), having demonstrated sub-keV energy sensitivity in dark matter searches, present a suitable technology for this challenge. The RELICS experiment utilizes a LXeTPC to detect CEvNS events induced by reactor neutrinos in the ˜MeV energy range. This talk will give recent progress in the RELICS experiment, focusing on advancements in detector design, background suppression, and sensitivity optimization.

Primary author: XIE, Lingfeng

Presenter: LI, Kaihang (Tsinghua University)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **28** Type: **Oral Presentation**

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

Tuesday, 21 October 2025 14:20 (20 minutes)

The Recoil Directionality project (ReD) within the Global Argon Dark Matter Collaboration characterized the response of a liquid argon (LAr) dual-phase Time Projection Chamber (TPC) to neutron-induced nuclear recoils, to measure the charge yield Q_y at low-energy. The charge yield is a critical parameter for the experiments searching for dark matter in the form of low-mass WIMPs and measurements in Ar below 10 keV are scarce in the literature. ReD was designed to cover the gap down to 2 keV.
The ReD data taking took place in 2023 at the INFN Sezione di Catania. The TPC was irradiated by neutrons produced by an intense ^{252}Cf fission source in order to produce Ar recoils in the energy range of interest. The energy of the nuclear recoils produced within the TPC by (n,n') scattering was determined by detecting the outgoing neutrons by a dedicated neutron spectrometer made of 18 plastic scintillators. The kinetic energy of neutrons interacting in the TPC was evaluated event by-event by measuring the time of flight. ReD collected and characterized a sample of nuclear recoils down to 2 keV, thus meeting its design goal.
The ReD effort is being further extended by a new project, ReD+, at INFN Laboratori Nazionali del Sud. ReD+ is designed to reach a threshold of 0.5 keV by using the same conceptual design of ReD and improved components. A dedicated run using a deuterium-deuterium generator is then planned to achieve 0.2 keV.
In this contribution, we describe the experimental setup and present the preliminary results on Q_y measured down to 2 keV from the data analysis of ReD. We also discuss the perspectives to further lower the coverage down to the sub-keV range with ReD+.

Primary author: PANDOLA, Luciano (INFN Laboratori Nazionali di Frascati)

Presenter: PANDOLA, Luciano (INFN Laboratori Nazionali di Frascati)

Session Classification: Applications

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **29** Type: **Oral Presentation**

Enhancing sensitivity to low-mass WIMPs with an improved ionization response model of liquid argon within the DarkSide programme

Tuesday, 21 October 2025 14:40 (20 minutes)

The search for dark matter with liquid argon detectors critically depends on a precise modeling of the ionization response to nuclear recoils. We present a unified analysis of ionization data from the ReD experiment, in combination with existing measurements from DarkSide-50, ARIS, and SCENE. This combined approach allows us to place stronger constraints on electron-ion recombination and screening effects, refining the ionization response model for nuclear recoils. Integrating this improved model into the DarkSide analysis framework leads to significantly enhanced sensitivity to low-mass WIMPs. In particular, we report updated exclusion limits that improve upon previous DarkSide-50 results, setting new world-leading constraints in the 1–3 $\mathrm{GeV/c^2}$ mass range. Additionally, we present updated sensitivity projections for the next-generation DarkSide-20k detector, highlighting its enhanced potential for probing low-mass dark matter interactions.

Primary author: PANDOLA, Luciano (INFN Laboratori Nazionali di Frascati)

Presenter: FRANCO, Davide (APC)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **30** Type: **Oral Presentation**

Light and charge yield model from first principles for Sub-keV energies up to 1 MeV

Friday, 24 October 2025 10:00 (20 minutes)

Liquid noble time proportional chambers (TPCs) are one of the most widely used scintillators in particle detection due to their low cost, high availability, and excellent scintillation properties. Many experiments in the neutrino and dark matter sectors are based on this detection technique. Here, we present a first principles study of the total quanta yield for liquid noble elements and the recombination process. We use inter-atomic potentials and the solution of the integro-differential Lindhard equation for atomic motion with electronic straggling. We introduce, from the electronic stopping cross section, the electronic scaling length as a fundamental parameter. We will study the energy and electric field dependence of the exciton-to-ion ratio for nuclear recoils based on the Bates–Griffing atomic process and spin interactions. The results for light and charge yield will be presented in terms of recombination probability within the Thomas-Imel box model, using just one fit parameter, rather than the NEST model or other models that use more than ten parameters. We will provide an explanation and comparison with recent measurements of the box size electric field dependence for LAr, LXe and LNe.

Primary authors: Dr ALEXIS A., Aguilar-Arevalo (ICN-UNAM); Dr JUAN CARLOS, D'Olivo (ICN-UNAM); SARKIS, Youssef (ICN-UNAM)

Presenter: SARKIS, Youssef (ICN-UNAM)

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **31** Type: **Oral Presentation**

High-Voltage Performance Testing in LAr of the PMMA Cathode Connection for the DarkSide-20k Experiment

Wednesday, 22 October 2025 16:30 (20 minutes)

Dual-phase noble liquid time projection chambers (TPCs) are a leading technology in the direct detection of weakly interacting massive particles (WIMPs), one of the most promising dark matter candidates. In such detectors, the strength and uniformity of both the drift and electroluminescence electric fields are critical for maximizing signal sensitivity and minimizing background.
DarkSide-20k (DS-20k) is a dual-phase liquid argon (LAr) TPC filled with 20-tonnes fiducial mass. The active volume is immersed in a uniform electric drift field generated by applying a potential of -73.4 kV to a cathode made of transparent acrylic (PMMA) coated with a conductive material. The high voltage is delivered through a dedicated high-voltage (HV) cable connected to the cathode via a stress cone assembly. The key challenges include delivering such high voltage while minimizing the risk of electrical discharges, verifying the stability of the HV stress cone under cryogenic conditions, and ensuring a reliable connection in such a confined space.
At the University of California, Davis, we developed a dedicated test setup replicating—in terms of local electric fields —the HV connection to the PMMA cathode used in DS-20k. The setup consists of the same HV cable and stress cone, inserted into a PMMA cylinder and connected to an aluminum sphere, all immersed in 20 liters of LAr.
This talk will present the results of the test campaign, which evaluated the long-term stability of the system and HV operation procedures up to -100 kV.

Primary author: LUZZI, Ludovico (University of California Davis)

Co-authors: FLEMING, Dylon (University of California Davis); PANTIC, Emilija (University of California Davis); ERJAVEC, Tyler (University of California Davis)

Presenter: LUZZI, Ludovico (University of California Davis)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **32** Type: **Oral Presentation**

Impact of extreme ultraviolet radiation on the scintillation of pure and xenon-doped liquid argon

Friday, 24 October 2025 11:00 (20 minutes)

The X-ArT (Xenon-Argon Technology) collaboration has studied the scintillation mechanisms in pure and Xe-doped liquid argon (LAr) using silicon photomultipliers sensitive to different wavelength ranges. Thanks to our measurements we identified a long-lived (>10μs) component attributed to extreme ultraviolet (EUV) photons emitted by the metastable levels of atomic argon. Based on this observation we developed a Xe-Ar scintillation model that includes both the EUV radiative contribution and the traditional collisional transfer process. Moreover we explored how the scintillation light yield and pulse shape discrimination vary as a function of the xenon concentration. Finally we proposed the EUV component as a possible source of the spurious electron emission in pure liquid argon, the main background in the search of light dark matter with noble liquid TPCs.

Primary author: NIKOLOUDAKI, Evangelia (APC)

Presenter: NIKOLOUDAKI, Evangelia (APC)

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **33** Type: **Oral Presentation**

Design of a Shielding Plane for LArPix

Wednesday, 22 October 2025 14:30 (20 minutes)

The Deep Underground Neutrino Experiment (DUNE) is a next-generation long-baseline neutrino oscillation experiment. A critical component of the DUNE Near Detector (ND) is a Liquid Argon Time Projection Chamber (LArTPC) called ND-LAr. A novel pixelated charge readout technology, LArPix, has been developed for use in ND-LAr and other LArTPCs. This technology has been implemented in the 2x2 Demonstrator, an array of four 600 kg liquid argon modules exposed to the NuMI beam in Fermilab that serves as a prototype for ND-LAr.

The pixelated anode consists of a collection plane without induction planes in front, unlike in a wire-based readout. This makes it susceptible to induction signals from the approaching ionization electrons. To reduce this effect, we developed a field response simulation to understand the behavior of the electronics and design a shielding plane, which is being considered for implementation in ND-LAr. In this talk, we will present our shielding plane design and discuss its impact based on cosmic-ray tests.

Primary author: YANG, Jiangmei (Hong Kong University of Science and Technology)

Presenter: YANG, Jiangmei (Hong Kong University of Science and Technology)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

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

Production of GEM-like structures for cryogenic applications, using laser-cutting techniques

Tuesday, 21 October 2025 22:00 (50 minutes)

A new concept of GEM-like structures was recently proposed. In this concept, a wavelength-shifting material is deposited inside the holes of GEM-like structures, which can improve the light collection efficiency in Ar-based dual-phase TPCs, solving problems related with the scalability of future dual-phase TPCs.

In this work, we report the newest developments on the production of GEM-like structures using laser-based techniques, namely the manufacture of a first batch of PMMA-based GEM-like structures. This process allows low-cost, reproducible fabrication of a high volume of such structures. In addition to being a low radioactive technique, we expect that it will allow the scaling up of the production of these structures at a reduced cost. First tests indicate good electrical stability, while the performance assessment is still ongoing.

Primary authors: CORTEZ, André (Astrocent / CAMK PAN); RODAS-RODRÍGUEZ, Diego (Astrocent / CAMK PAN); KUŹNIAK, Marcin (Astrocent / CAMK PAN)

Co-authors: GNAT, Aleksander (Astrocent / CAMK PAN); SWOROBOWICZ, Tadeusz (Astrocent / CAMK PAN); NIERADKA, Grzegorz (Astrocent / CAMK PAN); AMEDO, Pablo (IGFAE); AZEVEDO, Carlos (University of Aveiro); FLOETHNER, Karl (CERN); GONZÁLEZ-DIAZ, Diego (IGFAE); GASIK, Piotr (GSI); MONTEIRO, Cristina (LIBPhys / University of Coimbra); DE OLIVEIRA, Rui (CERN); PESKOV, Vladimir (CERN); DOS SANTOS, Joaquim (LIBPhys / University of Coimbra)

Presenter: CORTEZ, André (Astrocent / CAMK PAN)

Session Classification: Poster

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **36** Type: **Oral Presentation**

Wavelength-shifting optical amplification structures for future Dark Matter searches.

Wednesday, 22 October 2025 11:30 (20 minutes)

Driven by growing astrophysical and cosmological evidence supporting the existence of dark matter (DM), numerous direct detection experiments have been developed to search for particle DM candidates, such as DarkSide, XENON, LZ. The use of noble elements as the target medium are commonly adopted in the field for their intrinsic characteristics, and where vacuum ultraviolet (VUV) scintillation or scintillation and ionization, induced by elastic scattering of WIMPs on nuclei, is detected.

One of the main challenges in argon-based detectors is the relatively low efficiency of commercially available VUV-optimized photosensors. This limitation makes light collection and detection of S1 and S2 light in liquid argon (LAr) challenging. Therefore, efficient wavelength-shifting (WLS) materials are needed to enhance light collection efficiency. In recent years, substantial progress has been made in the development of WLS materials and MPGD-based light amplification structures, such as the Field-Assisted Transparent Gaseous Electron Multiplier (FAT-GEM). These advances, together with the growing importance of effects in the liquid-gas phase interface in the performance of such detectors as well as the scalability of such detectors, have led to the development of the WLS wavelength-shifting FAT-GEMs, a novel floating optical amplification structure that enhances scintillation light detection and can be easily tiled, making it inherently scalable. This makes it a promising approach for next-generation experiments.

In this work, we present the current status of the project related with the development of these new FAT-GEM structures with wavelength-shifting capability, including the assessment of their performance, carried out using two different experimental setups available at Astrocent (Poland) and IGFAE (Spain).

Primary authors: RODAS RODRÍGUEZ, Diego (Astrocent, CAMK PAN); KUŹNIAK, Marcin (Astrocent, CAMK PAN); GNAT, Aleksander (Astrocent, CAMK PAN); NIERADKA, Grzegorz (Astrocent, CAMK PAN); SWOROBOWICZ, Tadeusz (Astrocent, CAMK PAN); AMEDO, Pablo (IGFAE); GONZÁLEZ DÍAZ, Diego (IGFAE); AZEVEDO, Carlos (University of Aveiro); FLOETHNER, Karl Jonathan (CERN); GASIK, Piotr (GSI); MONTEIRO, Cristina (LIBPhys, University of Coimbra); OLIVEIRA, Rui (CERN); PESKOV, Vladimir (CERN); DOS SANTOS, Joaquim (LIBPhys, University of Coimbra); CORTEZ, André (Astrocent, CAMK PAN)

Presenter: RODAS RODRÍGUEZ, Diego (Astrocent, CAMK PAN)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **37** Type: **Oral Presentation**

“The Art of Cleaning Xenon: Technologies Behind Ultra-Low Backgrounds”

Wednesday, 22 October 2025 15:50 (20 minutes)

Liquid xenon (LXe) has become a cornerstone medium for rare event detection, including dark matter searches, neutrino physics, and neutrinoless double beta decay experiments. These applications demand ultra-low background environments, where even a trace amount of impurity—such as krypton, radon, or electronegative molecules—can significantly degrade the sensitivity of the detector.

In this talk, I will present the key technologies behind the purification and handling of liquid xenon, developed through the XENONnT experiment. Topics will include sub-ppt krypton removal via cryogenic distillation, radon mitigation techniques, gas-phase and liquid-phase purification circuits, as well as material outgassing control and online monitoring systems.

Emphasis will be placed not only on the performance of each method but also on the integrative design philosophy that enables long-term operation and scalability.

Primary authors: YAMASHITA, Masaki (Kavli IPMU); LIN, Ying-Ting (Universität Münster Institut für Kernphysik Willkommen)

Presenter: LIN, Ying-Ting (Universität Münster Institut für Kernphysik Willkommen)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **38** Type: **Oral Presentation**

Development of a Silicon Interposer with an Ultralow Radioactivity Background

Wednesday, 22 October 2025 13:30 (20 minutes)

Developing a photodetector system with an ultralow radioactivity background is crucial for experiments focused on detecting rare events. Silicon photomultipliers (SiPMs) and application-specific integrated circuits (ASICs) are ideal for low-background photosensors and readout electronics, respectively, as they can attain high radiopurity without significant additional effort. However, interposers, which provide mechanical support and signal routing between the photosensor and electronics, pose a challenge in constructing ultralow-background photodetectors. Motivated by the requirements of the nEXO project, IHEP and IME developed the first prototype of a silicon interposer in 2018 with a size of 10x10 cm^2 and a thickness of 320 μm, based on double-sided TSV interconnect technology. Following this, the technologies were further refined through four additional production runs of interposers. Each run involved careful evaluation of both the electrical and mechanical performance of the interposers across a range of temperatures, from room temperature to liquid xenon temperature. Results from the third and fourth runs indicate that the interposers can meet the nEXO project's requirements. In this talk, we will highlight the development of silicon interposer technology and evaluate the performance of the interposers.

Primary authors: Prof. CAO, Guofu (IHEP); Mr LIN, Que (IHEP)

Presenter: Mr LIN, Que (IHEP)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **39** Type: **Oral Presentation**

Noble gas impurities suppression in PandaX-4T by the distillation method

Wednesday, 22 October 2025 16:10 (20 minutes)

In recent years, liquid xenon detectors have played a crucial role in dark matter searches and neutrino physics. However, noble gas impurities such as krypton, argon and radon contribute significantly to electron backgrounds in these detectors. The PandaX-4T experiment recently reported its WIMP search results based on a 1.54 tonne-year exposure, where radon accounted for approximately half of the background events.
To mitigate this issue, the latest data-taking campaign employed the online distillation process, successfully suppressing the radon background to a level of 3 μBq/kg. Additionally, the online krypton distillation process reduced the argon concentration by more than an order of magnitude. In this talk, I will present the methods and results of impurity reduction in the PandaX-4T experiment, focusing on the effectiveness of the online distillation technique.

Primary author: 崔, 祥仪 (上海交通大学)

Presenter: 崔, 祥仪 (上海交通大学)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **40** Type: **Oral Presentation**

Characterization, mass tests and first results of the FBK SiPMs for the Photon detection system of DUNE Far Detector

Wednesday, 22 October 2025 09:50 (20 minutes)

The Deep Underground Neutrino Experiment (DUNE) is a next-generation 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). Light signals are indeed extremely important to determine one of the spatial coordinates of the interaction and also allow triggering non-beam events.
The SiPMs are photosensors consisting of matrices of single-photon avalanche diodes 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, make them an ideal choice for the DUNE FD photo detection system. This system will use a combination of 6x6mm^2 area sensors produced by Hamamatsu Photonics K.K. (HPK) and Fondazione Bruno Kessler (FBK).
An international consortium of research groups is currently engaged in systematic characterization and quality assurance tests of all the sensors that will be installed in the FD to ensure their specifications. A custom set-up, CACTUS (Cryogenic Apparatus for Continuous Tests Upon SiPMs), has been developed at Ferrara and Bologna Universities and INFN sites to automatically perform the tests for a large number of sensors in parallel. This system can characterize up to 120 SiPMs simultaneously both by 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 and the breakdown voltage, the key operating parameters of the SiPMs.
Furthermore, the CACTUS test facility allows for dark noise characterization through a custom-made fixed threshold amplifier-discriminator system.
Until now, more than 2400 arrays of 6 sensors each, produced by FBK., have been fully tested by the laboratories involved in the measurements, showing a failure rate of less than 0.8%. In this presentation we will show the main features of these sensors and the first results obtained during characterization and tests.

Primary author: GUARISE, marco (Università e INFN, Ferrara (IT))

Presenter: GUARISE, marco (Università e INFN, Ferrara (IT))

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **41** Type: **Oral Presentation**

Gas Electroluminescence in a Dual Phase Xenon-Doped Argon TPC

Friday, 24 October 2025 10:40 (20 minutes)

Two-phase liquid argon detectors measure ionization signals by detecting electroluminescence light produced by ionization electrons extracted from liquid into gas under a strong electric field. Xenon-doping of argon at the few percent level in the liquid phase populates xenon in the gas phase at the 10s of ppm level, which perpetuates energy transfer from 128 nm Ar2 dimer light to 147 nm and 178 nm light. We discuss the most recent results from the CHILLAX experiment at LLNL, which operates a ˜40 g active target dual phase argon detector doped with percent level xenon in the liquid phase. We summarize the observed improvements to the S2 signal and discuss the mechanisms and implications for future experiments.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory (LLNL) under Contract DE-AC52-07NA27344.

Primary author: KINGSTON, James (University of California, Davis)

Presenter: KINGSTON, James (University of California, Davis)

Session Classification: Light/charge response in Noble Elements

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **42** Type: **Oral Presentation**

PoWER: an innovative Photon Detection System for DUNE Phase II

Wednesday, 22 October 2025 10:50 (20 minutes)

The Deep Underground Neutrino Experiment (DUNE) is designed to tackle major open questions in neutrino physics, such as CP violation and neutrino mass ordering, by using large-scale liquid argon time projection chambers (LArTPCs). The Phase II of the project, the Far Detector modules will feature vertical-drift, single-phase LArTPCs with an active volume of 13 m × 13 m × 60 m and dual anode planes.

Within this framework, we present PoWER (Polymer Wavelength-shifter and Enhanced Reflection), an innovative photon detection system developed to optimize light collection and improve sensitivity to low-energy events. PoWER employs full field cage coverage with polymer-based wavelength-shifting foils (PEN), paired with enhanced specular reflector (ESR) panels and arrays of Light Detection Units (LDUs) mounted along the cryostat membrane. A key innovation is the integration of both standard and vacuum-ultraviolet (VUV) sensitive silicon photomultipliers (SiPMs) within the LDUs. This configuration increases the photon detection efficiency, provides active veto capabilities by utilizing the surrounding liquid argon buffer volume. As a result, the system can identify and suppress external backgrounds in real time thereby enhancing the experiment sensitivity to detect rare low-energy signals. With an effective photodetector coverage of about 4%, PoWER offers a comprehensive solution for light detection and veto strategy.

This contribution presents the most recent Monte Carlo simulation results, covering photon light map generation and veto performances, and provides an update on ongoing efforts to prototype small-scale demonstrators of this innovative photon detection system concept.

Primary authors: MACHADO, Ana Amelia (UNICAMP); Prof. SEGRETO, Ettore (UNICAMP); DI CAPUA, Francesco (University of Naples and INFN); Prof. STEKLAIN LISBOA, Andre (UTFPR); Dr BOTOGOSKE, Gabriel (Padova University and INFN Napoli); Prof. HIRSCH, Luciana (UTFPR); Prof. ADAMES, Marcio (UTFPR); Dr CANCI, Nicola (INFN Sezione di Napoli)

Presenter: DI CAPUA, Francesco (University of Naples and INFN)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **43** Type: **Oral Presentation**

Xenoscope: a vertical demonstrator for the XLZD observatory

Tuesday, 21 October 2025 15:40 (20 minutes)

The XLZD (XENON-LZ-DARWIN) collaboration is developing the next-generation observatory for dark matter, neutrino and rare-event physics. The detector will use a dual-phase xenon time projection chamber (TPC) with 60 tonnes of active xenon in a volume of approximately 3 meters in both height and diameter.
Xenoscope, at the University of Zurich, is a vertical demonstrator built to address the technical challenges associated with the large scaling up with respect to current experiments. The facility hosts a 2.6 m tall TPC to study electron drift, diffusion, and light propagation in liquid xenon. It also serves as a test bench for hardware R&D such as characterising different coating materials or photosensor technologies.
In this talk I will present the Xenoscope facility and the results from the commissioning of the TPC and its first run, including the observation of correlated S1–S2 signals from cosmic muons.

Primary author: CAPELLI, Chiara (University of Zurich)

Presenter: CAPELLI, Chiara (University of Zurich)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **44** Type: **Oral Presentation**

Production and characterization of WLS coatings for the photon detection system of noble liquid detectors

Wednesday, 22 October 2025 11:50 (20 minutes)

Wavelength-shifting (WLS) materials are essential in noble liquid detectors (such as those using liquid argon or xenon) to convert vacuum ultraviolet (VUV) scintillation light into visible wavelengths, enabling efficient photon detection. The overall performance of these detectors relies heavily on the quality, uniformity, and stability of the wavelength-shifting coatings applied to various substrates.
To this purpose, a large-scale evaporation system has been constructed to deposit wavelength-shifting materials, such as p-Terphenyl (PTP), onto the glass windows intended for installation in the X-Arapuca Megacell, which forms key component of the photon detection system (PDS) of the DUNE experiment.
After deposition, the PTP-coated glass samples undergo quality control procedures.
These include measurements of WLS thickness and uniformity, characterization of essential optical properties, and mechanical as well as environmental stress tests to verify long-term durability.
In this work, a detailed description of the evaporation system and coating process will be provided, the adhesion testing setup and its operational procedures will be reported
and the characterization based on some of optical measurement results will be presented.

Primary authors: BOTOGOSKE, Gabriel (Padova University and INFN Napoli); CANCI, Nicola (INFN); DI CAPUA, Francesco (University of Naples and INFN); FERRARO, Giarita (University of Naples and INFN); MACHADO, Ana Amelia (UNICAMP); MERLINO, Antonello (University of Naples and INFN); SEGRETO, Ettore (UNICAMP)

Presenter: CANCI, Nicola (INFN)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **45** Type: **Oral Presentation**

DArT-in-ArDM: A Dedicated Detector for 39Ar Characterization in Underground Argon

Thursday, 23 October 2025 09:20 (20 minutes)

DArT-in-ArDM: A Dedicated Detector for 39Ar Characterization in Underground Argon
DarkSide-20k, the next-generation dual-phase liquid argon TPC under construction at LNGS, is set to push the boundaries of the global search for WIMP dark matter. A crucial requirement for its success relies on the use of underground argon (UAr) depleted in cosmogenic 39Ar with respect to atmospheric argon (AAr) whose natural activity represents a major background at multi-tonne scale.
The 39Ar production chain involves the extraction at the Urania plant in the USA and the cryogenic purification at the Aria facility in Italy, both currently advancing towards full operation.
The DArT-in-ArDM setup has been developed at the Canfranc Underground Laboratory (LSC, Spain) to verify the purity of the UAr throughout its production.
DArT is a small, single-phase liquid argon detector operated within the refurbished ArDM detector, which serves both as a thermal buffer and as an active veto against external backgrounds. The setup is optimized for ultra-sensitive direct measurements of 39Ar decays in UAr samples, targeting specific activities down to the sub-mBq/kg level.

In this talk we present the DArT detector, the cryogenic test system, and theresults from commissioning runs with both atmospheric and underground argon, including a cross-check of the 39Ar activity in AAr. A dedicated full simulation chain, including detector response, has been developed to enable detailed comparisons between data and Monte Carlo, improving our understanding of detector performance and background contributions. These results validate DArT as a precision tool for UAr characterization in the DarkSide-20k production and filling campaign.

Primary author: TULLIO, Sara (INFN CA)

Presenter: TULLIO, Sara (INFN CA)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **46** Type: **Oral Presentation**

A Tonne-scale Demonstrator for the DarkSide-20k Inner Detector at LNGS

Tuesday, 21 October 2025 16:40 (20 minutes)

DarkSide-20k is a dark matter search experiment based on a dual-phase liquid argon time projection chamber (LAr TPC), currently under construction at the Laboratori Nazionali del Gran Sasso (LNGS), Italy. The detector will use 100 tonnes of underground-sourced argon and custom cryogenic silicon photomultiplier (SiPM) arrays for efficient detection of scintillation light within a novel acrylic-based TPC structure.
To address the technical and engineering challenges of scaling up from the DarkSide-50 experience, a tonne-scale prototype detector was designed, commissioned and operated at LNGS. This demonstrator replicated the mechanical design and integrated several critical subsystems of the full DarkSide-20k Inner Detector. It was built to validate cryogenic performance, high-voltage stability, material compatibility, structural integration, and assembly procedures under realistic conditions.
This presentation will provide an overview of the demonstrator TPC design, emphasizing features shared with the DarkSide-20k detector. Results from the commissioning and testing campaign at LNGS will be presented, including cryogenic operation, liquid argon filling and monitoring, temperature mapping, and high-voltage behavior in both single and dual-phase configurations.

Primary author: SALOMONE, Paolo (University of Rome, La Sapienza)

Presenter: SALOMONE, Paolo (University of Rome, La Sapienza)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **47** Type: **Oral Presentation**

PE Activities for DS-20k at NOA: Production, Tile-Testing, and Assembly

Wednesday, 22 October 2025 14:50 (20 minutes)

Darkside-20k is designed as a dual phase Time Projection Chamber (TPC), relying on light + charge signal readout, to explore the parameter space of WIMP candidates of Dark Matter with an unprecedented sensitivity down to the neutrino fog. The experiment will deploy a total of > 26 m^2 area of Silicon Photo-multiplier (SiPMs) as the photon sensitive surface, integrated on the TPC top-bottom as optical planes and in the inner neutron veto. While SiPMs provide advantages over PMTs, their deployment on this scale at cryogenics conditions has never been done before.

The talk intends to highlight the efforts devoted to the development of a large area, low noise, cryogenic readout system for SiPMs, the production & testing the performance of Tiles (an array of 24 SiPMs) and their integration in form of Photo-detector Units(PDUs) at Nuova Officina Assergi (NOA) in LNGS. A strong QA/QC evaluation at the level of Tiles is done before qualifying them for PDUs. A discussion on the impact of some QA/QC parameters on the data acquisition system and physics potential of the experiment. Furthermore, we shall discuss the challenges related to device deployment on the optical planes for the TPC at NOA, once the PDUs pass the cold test and are qualified for final assembly.

Primary author: GAHAN, Devidutta (INFN-LNGS)

Presenter: GAHAN, Devidutta (INFN-LNGS)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **48** Type: **Oral Presentation**

Characterization of DarkSide-20k Photodetector Units

Wednesday, 22 October 2025 09:30 (20 minutes)

DarkSide-20k is a next-generation experiment designed to search for dark matter using a dual-phase liquid-argon time projection chamber (TPC). In DarkSide-20k, more than 500 SiPM-based Photodetector Units (PDUs) will instrument the TPC and its active veto. This talk will focus on the cryogenic validation of those modules, carried out in the dedicated Photodetector Test Facility (PTF) and in the separate veto-PDU testing facilities. The PTF accommodates 16 PDUs at a time, immersing them in liquid nitrogen and providing pulsed-laser calibration, continuous stability monitoring, and diagnostics of the possible problems. Key figures of merit, including gain stability, signal-to-noise ratio, resolution, and their uniformity, will be presented for the first ˜10% of detector-grade PDUs produced and tested to date. Complementary measurements on the veto-PDU assemblies will be reported. The talk will conclude with a summary of lessons learned, current throughput, and the path to full-scale qualification of the remaining PDUs before detector integration.

Primary author: RUDIK, Dmitrii (UNINA and INFN sezione di Napoli)

Presenter: RUDIK, Dmitrii (UNINA and INFN sezione di Napoli)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **49** Type: **Oral Presentation**

First test of the PoWER concept

Wednesday, 22 October 2025 11:10 (20 minutes)

The proof of the PoWER concept will be presented. PoWER is based on the use of PEN and acrylic foils, coupled with conventional and Vacuum Ultra Violet (VUV) silicon photomultipliers (SiPM) to read-out liquid argon (LAr) scintillation light. The LAr volume of the detector is divided up into a core region and a veto buffer which surrounds the core, both filled with argon. The two regions are separated by foils of PEN on top of foils of acrylic. PEN is used to down-convert the LAr scintillation light from 127 nm to around 420 nm and acrylic to prevent VUV photons produced in the buffer to be converted by the PEN. SiPMs are arranged in arrays that combine conventional SiPM (C-SiPM) and VUV ones (V-SiPM). Each array has two electronic read-out channels: one for the C-SiPM and the other for the V-SiPM. The unbalance between the number of photons detected by the C-SiPM channel and the V-SiPM one allows one to identify if a ionizing event happened in the veto region or in the core of the detector with high efficiency. A small scale experimental test of the PoWER concept has been performed at UNICAMP (Brazil) with a 10cmX10cmX10cm cubic detector with two arrays of 8 6mmX6mm SiPM (4 C-SiPM and 4 V-SiPM) in LAr. Preliminary results with alpha and gamma particles will be presented.

Primary author: Prof. MACHADO, Ana Amelia (UNICAMP)

Co-authors: Mrs BARBOSA, Mirela (UNICAMP); BOTOGOSKE, Gabriel (Padova University and INFN Napoli); CANCI, Nicola (INFN); DI CAPUA, Francesco (University of Naples and INFN); Ms FRANDINI, Heriques (University of Liverpool); KUŹNIAK, Marcin (Astrocent / CAMK PAN); Dr MENDONÇA, Ana Paula (UNICAMP); Mr PAGLIUSO, Lucca (UNICAMP); Mr PILON, Theo (UNICAMP); Mr SANTOS, Roberto (UNICAMP); SEGRETO, Ettore (UNICAMP)

Presenter: Prof. MACHADO, Ana Amelia (UNICAMP)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **50** Type: **Oral Presentation**

Proto-0: a prototype for validating key technologies of the DarkSide-20k experiment and beyond.

Tuesday, 21 October 2025 16:20 (20 minutes)

Within the DarkSide Program, which aims at the direct detection of Weakly Interacting Massive Particles (WIMPs), the DarkSide-20k experiment is currently under construction at LNGS. It is based on a next-generation dual-phase liquid argon Time Projection Chamber (TPC). The Proto-0 project, currently running at the DarkMatter facility in Naples (Italy), was designed to demonstrate the viability of key design aspects proposed for DarkSide-20k, such as light readout using low-background Photodetector Units (PDUs) based on cryogenic SiPMs and the use of innovative bulk materials.
Moreover, in the Proto-0 TPC the geometry can be modified during operation, for studying the formation of the secondary signal in the gaseous phase under different boundary conditions. This aspect is critical for instance to optimize the setting of a dual-phase liquid-argon TPC that aims at low-mass WIMPs detection.In this talk, we present the Proto-0 detector along with its main ancillary systems, together with the key results obtained and the lessons learned.

Primary author: CARAVATI, Mauro (Gran Sasso Science Institute (GSSI))

Presenter: MATTEUCCI, Giuseppe (Università degli Studi di Napoli Federico II)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **53** Type: **Oral Presentation**

NEXT: Searching for the ββ0ν decay with High-Pressure Xenon Electroluminescent TPCs

Tuesday, 21 October 2025 11:20 (20 minutes)

The NEXT experiment aims to conduct a sensitive search of the neutrinoless double beta decay ($\beta\beta0\nu$) in ^{136}Xe, using high-pressure gas electroluminescent time projection chambers (HP-ELTPCs). Two dedicated readout planes, equipped with PMTs and SiPMs, are used to collect the primary and secondary (EL) scintillation light. While the PMTs provide the start time and the total energy of the events, the SiPMs provide their topological signatures. The NEXT-White detector, a first radiopure demonstrator, was operated between 2016 and 2021 in the Canfranc Underground Laboratory (LSC). This detector demonstrated the capabilities of the HP-ELTPC technology by providing a measurement of the two-neutrino mode of the $\beta\beta$ decay, as well as a $\beta\beta0\nu$ half-life limit of 1.3×10^{24} yr at 90\% C.L., using a fiducial mass of only 3.50±0.01 kg of ^{136}Xe. Following the decommissioning of NEXT-White, the NEXT-100 detector, which can hold up to ∼100 kg of Xe at 15 bar, has started operation in 2024 at the LSC. The goal of NEXT-100 is to prove the scalability of the NEXT technology and to provide the first competitive results on the $\beta\beta0\nu$ search. After a successful commissioning stage, the detector has been calibrated with low (^{83m}Kr) and high energy (^{228}Th) sources, reaching an energy resolution of around 1\% FWHM at the $Q_{\beta\beta}$ value (2.46 MeV), which meets the experimental target. Currently, NEXT-100 is undergoing a low-background data-taking campaign to measure and characterize the different background sources using ^{136}Xe-depleted xenon. With an expected background index below 10^{-3} counts/keV/kg/year, this detector is projected to reach a sensitivity of 6×10^{25} yr at 90\% C.L. after 3 years of data collection with ^{136}Xe-enriched xenon. Furthermore, NEXT-100 will lay the groundwork for the construction of a ton-scale detector, boosting the sensitivity above 10^{27} yr and establishing the ^{136}Xe HP-ELTPCs as major players in the quest for the discovery of the $\beta\beta0\nu$ decay.

Primary author: NOVELLA, Pau (IFIC)

Presenter: NOVELLA, Pau (IFIC)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **54** Type: **Poster**

R&D Developments for PoWER Proof of Concept Tests

Tuesday, 21 October 2025 22:00 (50 minutes)

A prototype setup is being developed at the Leptons Laboratory, Universidade Estadual de Campinas (UNICAMP), for preliminary validation of the PoWER (Polymer Wavelength shifter and Enhanced Reflection) concept. PoWER is a novel detector design aimed at improving spatial discrimination of scintillation photons in liquid argon (LAr) detectors. The concept relies on wavelength-shifting PEN foils to convert 127 nm LAr scintillation light into visible photons (~420 nm), and on acrylic barriers to suppress VUV photon conversion in undesired regions. Conventional (C-SiPM) and VUV-sensitive (V-SiPM) silicon photomultipliers are coupled to read out the converted and native scintillation light, respectively.
The current proof-of-concept features a 10 × 10 × 10 cm3 cubic detector. The inner structure is made of acrylic and contains the PEN foils. A highly reflective foil is applied to the inner walls of the Teflon structure to minimize photon losses and enhance light collection. The arrays combine regular Hamamatsu C-SiPMs and C-SiPMs coated with a thin PTP layer to simulate VUV SiPMs. The detector is inserted into a larger cryostat using a motorized trolley system and filled with ultrapure
gaseous argon, which is subsequently liquefied in situ. Alpha and gamma particles will be used to excite scintillation in the argon.
Instrumentation includes resistive level sensors integrated into the Teflon vessel to monitor the LAr height at three distinct levels. SiPM signals are digitized using a CAEN digitizer, with power and bias supplied by an APSAIA unit. A pulsed 400 nm LED is employed for periodic gain calibration of the photosensors. This contribution presents the instrumentation layout, mechanical design, and electronic configuration of the setup. Preliminary results are presented.

Primary authors: PAGLIUSO, Lucca (Unicamp); SEGRETO, Ettore (UNICAMP); MACHADO, Ana Amelia (UNICAMP)

Co-authors: BARBOSA, Mirela (UNICAMP); PILON, Theo (UNICAMP); SANTOS, Roberto (UNICAMP); BOTOGOSKE, Gabriel (Padova University and INFN Napoli); CANCI, Nicola (INFN); DI CAPUA, Francesco (University of Naples and INFN); FRANDINI, Heriques (University of Liverpool); KUŹNIAK, Marcin (Astrocent / CAMK PAN); MENDONÇA, Ana Paula (UNICAMP)

Presenter: PAGLIUSO, Lucca (Unicamp)

Session Classification: Poster

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

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

Impact of Annealing p-Terphenyl Films Deposited on Dicroic Filters: Emission, Absorption, and Adhesion Analysis.

Tuesday, 21 October 2025 22:00 (50 minutes)

Annealing is widely recognized as a key post-deposition thermal treatment for enhancing the performance of thin films by improving their microstructure, morphology, and electrical and optical properties. In this study, we investigate the physical behavior of p-terphenyl thin films deposited on dichroic filters and subjected to annealing processes carried out at fixed durations and varying temperatures. The optical properties of the films—namely, relative efficiency, absorption, and emission—are systematically analyzed before and after annealing. Furthermore, cryogenic immersion tests are conducted to evaluate the adhesion of the films to the substrate as a function of annealing temperature. Surface morphology is examined via optical microscopy to assess possible structural changes induced by thermal and cryogenic treatments. The results provide insights into the thermal stability and adhesion performance of p-terphenyl films under varying annealing conditions, contributing to the optimization of their application in optical devices.

Primary author: MENDONÇA, Ana Paula (UNICAMP)

Co-authors: PAGLIUSO, Lucca (UNICAMP); Dr MERLO, Rafael (UNICAMP); Dr MACHADO, Ana Amélia (UNICAMP); Dr MARQUES, Francisco (UNICAMP); Dr SEGRETO, Ettore (UNICAMP)

Presenter: MENDONÇA, Ana Paula (UNICAMP)

Session Classification: Poster

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **56** Type: **Oral Presentation**

The Search for Dark Matter using Underground Argon

Tuesday, 21 October 2025 10:00 (30 minutes)

The DarkSide-20k experiment represents the latest phase of the Global Argon Dark Matter Collaboration, leveraging expertise from previous argon-based detectors. This effort is focused on constructing a dual-phase liquid argon time projection chamber (LAr-TPC) that will deploy 100 tonnes of underground argon outfitted with silicon photomultiplier (SiPM) arrays for precise light detection. This presentation will provide an overview of argon-based dark matter searches with an emphasis on the DarkSide detector, highlight its key design elements and its objectives, as well as updates on the ongoing construction of the underground infrastructure at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy.

Primary author: JAMIL, Ako (Princeton University)

Presenter: JAMIL, Ako (Princeton University)

Session Classification: Plenary Session

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **58** Type: **Oral Presentation**

Long-term performance of VUV-sensitive silicon photomultipliers (SiPM) for large-scale liquid xenon detectors

Wednesday, 22 October 2025 10:10 (20 minutes)

Cryogenic, vacuum-ultraviolet (VUV)-sensitive silicon photomultipliers (SiPMs) are being developed for next-generation experiments to search for neutrinoless double beta decay like nEXO. nEXO is a time-projection chamber enriched to 90% Xe-136 designed to search for neutrinoless double-beta decay with a projected half-life sensitivity of 1.35*10ˆ28 years over a 10-year lifespan. Achieving this sensitivity requires high efficiency VUV SiPMs to detect the 175 nm xenon scintillation light, motivating a rigorous characterization of their long-term performance under cryogenic conditions. We present selected results from a multi-year study of a single Fondazione Bruno Kessler HD3 VUV SiPM in a kilogram-scale liquid xenon cryostat with precise temperature control at UMass Amherst. This setup allows for the characterization of the SiPM through IV curves, the measurement of single photon event (SPE) spectra, and the measurement of xenon scintillation light. This enables the characterization of SiPM properties such as gain, breakdown voltage, correlated avalanches, and photon detection efficiency across three mediums: vacuum, gaseous nitrogen, and liquid xenon. These conditions directly replicate the nEXO detector environment, providing essential validation of SiPM longevity and performance for the experiment’s decade-scale lifetime.

Primary author: POCAR, Andrea (University of Massachusetts, Amherst)

Presenter: POCAR, Andrea (University of Massachusetts, Amherst)

Session Classification: Light/charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)

Contribution ID: **59** Type: **Poster**

Determining Astrophysical Parameters of a Supernova in the Liquid Argon Scintillator Experiment

Tuesday, 21 October 2025 22:00 (50 minutes)

Neutrinos from Supernova 1987A (SN1987A) were fundamental in understanding the formation of a newborn neutron star (NS). From an astrophysical perspective, the importance of these neutrinos is that they allowed us to "see" inside the structure of the NS. Approximately 99% of the energy released after the SN1987A explosion was in the form of neutrinos of all species, with equal probability. To study the cooling process of a newborn NS, we simulated neutrinos from SNe using a program created by the Lepton Group at Unicamp, which can be detected by the liquid argon scintillator experiment. We tested the exponential cooling model and estimated the emission temperature and the neutrinosphere radius.

Primary author: VALENTIM DA COSTA LIMA, Rodolfo (Federal University of São Paulo)

Presenter: VALENTIM DA COSTA LIMA, Rodolfo (Federal University of São Paulo)

Session Classification: Poster

Track Classification: Signal reconstruction and identification (analysis methods, simulations)

Contribution ID: **60** Type: **Oral Presentation**

Portable LAr Scintillation Analyser

Wednesday, 22 October 2025 15:30 (20 minutes)

A portable analyser of the Liquid Argon (LAr) scintillation light (Scintillation Analyser) has been built. It allows to perform fast analysis of the lifetime of the argon triplet excitation state. The system was originally used to monitor the quality of LAr after its purification during filling of the LEGEND-200 cryostat. High purity of the argon (0.1 ppm for water, nitrogen and oxygen) was needed to achieve a very good light yield, and thus increase the efficiency of the LAr veto in the experiment.
The Scintillation Analyser is based on two 2-inch Hamamatsu photomultipliers (PMTs) capable to work in LAr. They are covered with Tetraphenylbutadiene (TPB) to shift the UV light to the visible range and are equipped with dedicated bias high voltage (HV) dividers. PMTs were installed face-to-face on a special support structure attached to a CF-150 flange. The latter has appropriate liquid/gas feedthroughs for the LAr filling/draining and electrical feedthroughs to pass the PMTs high voltage and signals. The flange is mounted on a dedicated portable wide-neck cryogenic vessel with 90 L capacity. The fill level of the vessel is controlled by a set of PT-100 sensors installed on the PMT support structure.
A dedicated electronic unit has been built to provide HV to both PMTs and amplify their signals. Each channel has two electronic paths: one for fast linear amplification of the pulses (fast), and the second for linear amplification but with a "semi gaussian shaper" to allow for operation with slower digitizers. A sum of "slow" pulses from both PMTs is also available and sum signal can be used as an acquisition trigger. In the recent upgrade of the system the older digitizer, which worked with the slow pulses (250 MHz sampling rate), was replaced by a new 2-channel FADC card providing 16-bit precision and 500 MHz sampling rate. It allows to use the fast track and record signals from both PMTs simultaneously. New acquisition and analysis software has also been prepared. It allows for fast analysis of the acquired data including fitting of the triplet lifetime.
Filling of the vessel with LAr to be analysed takes about 40 min. The analysis of the triplet lifetime with a decent statistics should not take longer than 15-20 min depending on the radioactive source activity. Including draining of the vessel the entire measurement should closed in 90 min. This allows for quasi-real-time analysis. The system is planned to be used to monitor LAr purity during filling of the LEGEND-1000 cryostat.
Details of the system, its operation principles, and analysis will be presented.

Primary author: KOWALEWSKA, anna (Jagiellonian University)

Presenter: KOWALEWSKA, anna (Jagiellonian University)

Session Classification: Detector techniques

Track Classification: Light/charge response in Noble Elements (gas, liquid, dual phase)

Contribution ID: **62** Type: **Oral Presentation**

Ultra-Low-Radioactive titanium alloy as a promising construction material for low background cryostats

Thursday, 23 October 2025 10:00 (20 minutes)

Modern experiments based on registration of scattering of neutral particles (neutrinos, neutrons, WIMPs, etc.) on ultra-low-background targets of liquid and compressed noble gases require a reduction in the energy threshold for success. This can only be achieved by reducing the natural radioactive background of both the target itself and the detector's structural materials. As the target mass increases to tens and hundreds of tons, the requirements for the structural materials increase, which creates a challenging task for the developers of such detectors. Searching for the necessary volumes of ultra-low-background materials for manufacturing a detector in finished product warehouses becomes unrealistic. The task of industrial production of tens of tons of construction materials with predetermined, guaranteed by technological processes, levels of intrinsic radioactivity at the level of μBqs/kg becomes relevant.
Basic principles of titanium alloys production together with very high technological culture of titanium industry predefined a possibility to develop a technological cycle of the ultra-low-radioactive titanium (ULR-Ti) production. It was confirmed experimentally that it is possible to produce a titanium sponge with a level of contaminations below 100 uBq/kg of U and Th within an industrial Kroll-process. Then, the ULR-Ti sponge was converted into the construction titanium of VT-00 grade using EB-vacuum melting followed by bi-directional cold rolling and annealing to avoid a recontamination and keep the material as pure as the original sponge. The mechanical properties of the manufactured ULR-Ti meet the requirements of VT-00 grade, which is very suitable for cryogenic applications. Hence, this material could be used for production of cryostats, containment tanks, passive shielding and other mechanical elements of the modern low-background detectors. It was also tested and confirmed that a laser welding is preferable to an arc welding in order to keep ULR-Ti original purity and mechanical properties. The mass of the first ULR-Ti bunch produced for test purposes and spent for radio-purity and mechanical tests at different production stages was of a scale of tens kilos. The jump from a laboratory kilos scale to the tons scale needs additional investigations, but it should be noted, that current kilos scale samples where manufactured by the standard industrial processes.

Primary author: CHEPURNOV, Aleksandr (Moscow State University, Skobelcyn Institute for Nuclear Physics)

Presenter: CHEPURNOV, Aleksandr (Moscow State University, Skobelcyn Institute for Nuclear Physics)

Session Classification: Detector techniques

Track Classification: Detector techniques (HV, purification, cryogenics, calibration etc.)

Contribution ID: **63** Type: **Oral Presentation**

The Liquid Argon Atmospheric Veto for LEGEND 1000

Tuesday, 21 October 2025 11:40 (20 minutes)

LEGEND-1000 is the next-generation, ton-scale experiment searching for neutrinoless double beta decay of germanium (Ge) using p-type, high-purity germanium (Ge) detectors. It is a scaled-up project of LEGEND-200. The experiment will use 1,000 kilograms of germanium detectors enriched to over 90% ^{76}Ge.
The experiment has been approved and supported by the relevant agencies and will be installed at LNGS (3,800 m.w.e.).
Simulations suggest that the residual muon flux at LNGS generates neutrons in the detector. Upon absorption, these neutrons produce long-lived isotopes in both the liquid argon and germanium detectors. If their decay is not properly identified, it will contribute significantly to the maximum background budget of 10^{-5} counts/(keV kg y)-1 required for LEGEND-1000 to fully span the inverted order region of mββ.
Since the liquid argon cuts developed for prompt background mitigation are suboptimal for sibling neutron tagging, a neutron moderator and a new liquid argon veto volume, external to the germanium detector array, will be deployed. This will allow for delayed coincidence cuts between the water Cerenkov muon veto, the inner liquid argon veto, and the germanium detectors.
In this talk, I will present the design concept and status of the detector instrumentation. This instrumentation aims to maximize the efficiency of the delayed coincidence cuts by identifying neutron captures in hydrogen and argon via de-excitation gamma rays. We will also discuss light yield and photon detection efficiency requirements and possible instrumentation configurations that can efficiently detect neutron captures by hydrogen and ^{40}Ar. Additionally, we will discuss technologies to achieve low activity requirements and performance based on current knowledge and experimental data.
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 SRDA; the Swiss SNF; the UK STFC; the Russian RFBR; the Canadian NSERC and CFI; the LNGS, SNOLAB, and SURF facilities.

Primary author: CATTADORI, Carla Maria (INFN-MiB)

Presenter: CATTADORI, Carla Maria (INFN-MiB)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **64** Type: **Oral Presentation**

Using Argon for neutrino Physics: the Deep Underground Neutrino Experiment

Tuesday, 21 October 2025 09:30 (30 minutes)

Thanks to its properties, argon is a special element for large apparatus used in searches for neutrinos. The single/dual phase liquid argon time projection chamber is a wellestablished technique that has been used by a number of projects since the 1980s. It is usually complemented by reading the scintillation light of the liquid/gas argon.
The Deep Underground Neutrino Experiment (DUNE) is a long baseline neutrino project with a broad physics program primarily aiming to probe CP violation in the neutrino sector and to identify the neutrino mass ordering. This by observing inside its far detectors located at the SURF Laboratory, the interactions of neutrino/antineutrino produced 1300 km away by the Long-Baseline Neutrino Facility. In addition, the search for proton decay and the measurement of the neutrino flux from supernova bursts are also goals of DUNE. The latters are no beam triggerable events whose detection will be enhanced by the Photon Detection System (PDS).
The experiment detectors are located at the near (FERMILAB) and at the far (SURF Laboratory) sites. The far detectors will be made of four modules: the first is a vertical drift single-phase LArTPC, the second is a horizontal drift single-phase LArTPC, and for both the PDS will complement the TPC. The technology of the last two modules is still being defined.
In this talk I will discuss the current status of the photon detection system of the first two modules, which uses two different optimized and modified version of the so-called XARAPUCA photon detector concept, that allow to safely attain the PDS sensitivity required for the low energy neutrino events. The main ingredient of the device optimization will be presented.
Thanks to an intense R&D campaign conducted in several labs and in ProtoDUNE runs at CERN, the PDS system has been finally optimized and validated: selected results from the protoDUNE and coldbox test runs performed at CERN will be also presented.

Primary author: CATTADORI, Carla Maria (INFN-MiB)

Presenter: CATTADORI, Carla Maria (INFN-MiB)

Session Classification: Plenary Session

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **65** Type: **Oral Presentation**

Status of New Physics Search using Liquid Xenon Detectors

Tuesday, 21 October 2025 10:30 (30 minutes)

Primary author: LIN, Qing (University of Science and Technology of China)

Presenter: LIN, Qing (University of Science and Technology of China)

Session Classification: Plenary Session

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)

Contribution ID: **66** Type: **Oral Presentation**

RDTM

Tuesday, 21 October 2025 09:20 (10 minutes)

RDTM

Primary author: ZHENG, Wenli (高能所)

Presenter: ZHENG, Wenli (高能所)

Session Classification: Welcome & Opening

Contribution ID: **67** Type: **Oral Presentation**

Welcome & Opening

Tuesday, 21 October 2025 09:00 (20 minutes)

Presenter: Prof. WANG, Yi (IHEP, CAS)

Session Classification: Welcome & Opening

Contribution ID: **71** Type: **Oral Presentation**

Design and status of the CDEX-300 0νββ experiment

Tuesday, 21 October 2025 12:00 (20 minutes)

The CDEX-300 is a next generation neutrinoless double beta (0νββ) decay experiment based in China Jinping underground laboratory (CJPL). CDEX-300 aims at searching the 0νββ decay of Ge-76 in the inverted neutrino mass hierarchy using high purity germanium (HPGe) detectors. We propose to build a 200 kg scale HPGe array in the liquid argon and achieve 2.5 keV (FWHM) energy resolution and 1E-4 cts/keV/kg/yr background level in the 0νββ (2039 keV) signal region. CDEX-300 is projected to achieve a 1.9×1027 yr Ge-76 0νββ half-life 3σ discovery sensitivity with 10-yr operation. This report will outline the experimental design, background control technologies of CDEX-300 with focus on the LAr veto system.

Primary authors: MA, Hao (Tsinghua University); DAI, Wenhan (清华大学工程物理系)

Presenter: DAI, Wenhan (清华大学工程物理系)

Session Classification: Applications

Track Classification: Applications (dark matter, neutrino, precision frontier, medicine, etc.)