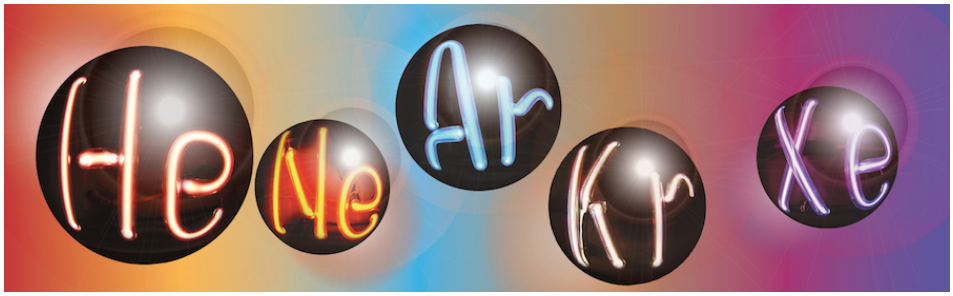
LIDINE 2017: LIght Detection In Noble Elements



Report of Contributions

https://indico.physics.lbl.gov/e/545

Contribution ID: **1** Type: **Presentation**

NEXT experiment: 0νββ search with High pressure Xe gas TPC

Sunday, 24 September 2017 11:25 (15 minutes)

The NEXT experiment seeks to discover the neutrinoless double beta decay (NLDBD) of Xe-136 using a high-pressure gas time projection chamber (TPC), filled with 100kg of enriched xenon, with electroluminesence (EL) gain and optical readout. This technology offers two features of great value in NLDBD decay searches: excellent energy resolution (<1% FWHM at the Q value of Xe-136) and event topology reconstruction to identify signal and background events. Furthermore, this technology can be extrapolated to large source masses, thus allowing the full exploration of the inverted-hierarchy region of neutrino masses.

In the NEXT detector, an array of photomultiplier tubes is located behind the TPC cathode and detects the EL light to provide a precise measurement of the total energy deposited in the gas. These PMTs detect as well the primary scintillation, which is used to mark the start of the event. On the opposite side of the detector, behind the anode, a dense array of silicon photomultipliers is used for track reconstruction.

The installation and commissioning of the NEXT-100 detector at the Laboratorio Subterráneo de Canfranc (LSC) is planned for 2019. Since October 2016, a first phase of the NEXT experiment, called NEW, is running with depleted Xe-136 at the Laboratorio Subterraneo de Canfranc (LSC). The NEW detector is a scale 1:2 in size of the NEXT-100 detector using the same materials and photosensors and will be used to perform a characterization of the NLDBD backgrounds and a measurement of the standard double beta decay with neutrinos. In this talk, I will introduce the plans to measure and understand the NLDBD backgrounds in NEXT using NEW data. In addition, I will present recent results on the characterization of the NEW detector performance using data from calibration sources.

Primary author: Dr LÓPEZ MARCH, Neus (IFIC)

Presenter: Dr LÓPEZ MARCH, Neus (IFIC)

Session Classification: Sunday Morning 2

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

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

Liquid xenon in nuclear medicine: state-of-the art and the PETALO approach

Friday, 22 September 2017 15:20 (40 minutes)

Liquid xenon has several attractive features, which make it suitable for applications to nuclear medicine, such as high scintillation yield and fast scintillation decay time.
In this talk, I will review the state of the art of the investigations of liquid xenon in medical imaging and I will describe the PETALO (Positron Emission Tof Apparatus with Liquid xenOn) concept, a novel idea, which combines liquid xenon scintillating cells and silicon photomultipliers for the readout. A first Monte Carlo investigation has pointed out that this technology would provide an excellent intrinsic time resolution, which opens the possibility of measuring the Time-Of-Flight with high efficiency. Finally, I will explore the possibility of exploiting both scintillation and Cherenkov light for a high-sensitivity TOF-PET.

Primary author: Dr FERRARIO, Paola (IFIC)

Co-authors: Mr BENLLOCH-RODRÍGUEZ, José María (IFIC); Prof. GOMEZ-CADENAS, Juanjo (IFIC)

Presenter: Dr FERRARIO, Paola (IFIC)

Session Classification: Keynote: Overview Talks

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

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

Cryogenic readout for multiple VUV4 Multi-Pixel Photon Counters in liquid xenon

Saturday, 23 September 2017 09:00 (15 minutes)

We present the performances and characterization of an array made of S13370-3050CN (VUV4 generation) Multi-Pixel Photon Counters manufactured by Hamamatsu and equipped with a low power consumption preamplifier for operations in liquid xenon environment. The electronics is designed for the readout of a 8×8 matrix of individual photosensors and it is based on a single operational amplifier (Analog Devices AD8011). A biasing correction circuit has been implemented for the gain equalization of photosensors operating at different voltages. We present the results of the characterization which show a distinct single photon detection capability that makes this device a promising choice for future generation of large scale dark matter detectors based on liquid xenon.

Primary authors: Dr DI GIOVANNI, Adriano (NYUAD); Prof. ARNEODO, Francesco (NYUAD); Dr FRANCHI, Giovanni (age scientific srl); Prof. BENABDERRAHMANE, Mohamed Lotfi (NYUAD)

Co-authors: Dr CANDELA, Attanasio (LNGS); Dr MESSINA, Marcello (NYUAD); Dr FAWWAZ, Osama (NYUAD); Mr CONICELLA, Valerio (NYUAD)

Presenter: Dr DI GIOVANNI, Adriano (NYUAD)

Session Classification: Saturday Morning 1

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

Contribution ID: **4** Type: **Presentation**

Liquid argon scintillation detection utilizing wavelength-shifting plates and light guides

Saturday, 23 September 2017 14:45 (15 minutes)

As liquid argon (LAr) time-projection chamber (TPC) detectors are built to provide increased sensitivity to neutrino oscillation physics and other rare phenomena such as supernova neutrino bursts and nucleon decays, larger fiducial volumes have become necessary. While the ionization signals are detected by the TPC, the scintillation signals from LAr provide additional information about events and thus serve as a complementary detector system. The upcoming Deep Underground Neutrino Experiment (DUNE) will place a 40kt fiducial mass LArTPC nearly a mile underground in South Dakota. In DUNE, the event timing provided by detection of the prompt scintillation light will yield ~mm spatial resolution in the drift direction, especially useful for non-beam physics where no event time is known *a priori*. The baseline solution for the first 10kt single phase module is a design that fits the photon detector (PD) system into the natural gap between the wire planes of adjacent TPC volumes. A prototype PD technology which has been developed at Indiana University utilizes plates coated in wavelength shifter to convert the VUV scintillation signal to the visible, and a commercially-produced wavelength-shifting light guide behind the plates converts and transports photons to silicon photo-multipliers at the ends. The individual components of this system have been tested and characterized, and an integrated prototype test has been conducted at the liquid argon facilities at Fermilab. The characteristics of the system and knowledge gained through component and integrated prototype tests will be discussed.

Primary author: HOWARD, Bruce (Indiana University)

Presenter: HOWARD, Bruce (Indiana University)

Session Classification: Saturday Afternoon

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

Contribution ID: **5** Type: **Presentation**

First underground run of ArDM and measurement of the attenuation lenght of the argon scintillation light

Friday, 22 September 2017 09:45 (15 minutes)

With an active target mass of 850 kg, ArDM represents an important milestone towards developments for large LAr Dark Matter detectors. In this talk we introduce the experimental apparatus currently installed underground at the Laboratorio Subterráneo de Canfranc (LSC), Spain, presenting the results of the analysis of the first underground run. A relatively low value close to 0.5 m was found for the attenuation length of the liquid argon bulk to its own scintillation light. We interpret this result as a presence of optically active impurities in the liquid argon which are not filtered by the installed purification systems. We also present analyses of the argon gas employed for the filling and discuss cross sections in the vacuum ultraviolet of various molecules in respect to purity requirements in the context of large liquid argon installations. Finally, the status and the plans of the project will be presented.

Summary

We investigated the influence of impurities on the VUV light yield in a tonne scale LAr target. In particular the following two processes are considered, the non-radiative destruction of excimers states, often referred-to as (impurity) quenching, and
secondly and more important the absorption of produced VUV scintillation light during its propagation through the LAr bulk. By first principles both effects trace back to the presence of impurities in the argon.
The study of the VUV light yield in the tonne scale LAr detector ArDM resulted in a lower than expected value of 0.5 m for the attenuation length of the liquid argon bulk to its own scintillation light. The result was found by means of a Bayesian variation technique and yielded systematic uncertainties on the order of 20%. We interpret this result with the presence of optically-active trace impurities in the LAr which are not filtered by the installed purification systems primarily designed to target O2 and H2O molecules.
This allowed us to conduct a combined analysis of our result with respect to the involved photoabsorption cross sections, the lifetime of the slow scintillation component, as well as mass spectra taken on argon gas samples.
The results of the work presented here has pointed out that other trace elements than the usually targeted water and oxygen molecules might affect the overall performance of a liquid argon TPC. This observation will likely have some implications on the design and optimisation of light detection systems and/or on the liquid argon purification systems of future large LAr detectors, where scintillation light attenuation length in excess of meters will be desirable.

Primary author: Dr SANTORELLI, Roberto (CIEMAT Madrid)

Presenter: Dr SANTORELLI, Roberto (CIEMAT Madrid)

Session Classification: Friday Morning 1

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

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

Impact of the positive ion current on large size neutrino detectors and delayed photon emission

Saturday, 23 September 2017 12:45 (15 minutes)

Given their small mobility coefficient in liquid argon, the ions spend a considerably longer time in the active volume with respect to the electrons. We studied the effects of the positive ion current in a liquid argon time projection chamber, in the context of massive argon experiment for neutrino physics. The constant recombination between free ions and electrons produce a quenching of the charge signal and a constant emission of photons, uncorrelated in time and space to the physical interactions. The predictions evidence some potential concerns for multi-ton argon detectors.

Summary

The first part of the talks is bases on the results Published in Astropart.Phys. 92 (2017) 11-20, e-Print: arXiv:1609.08984 [physics.ins-det]
Newer results on the delayed light emission by secondary recombination will be also presented in the second part of the talk.

Primary author: Dr SANTORELLI, Roberto (CIEMAT Madrid)

Presenter: Dr SANTORELLI, Roberto (CIEMAT Madrid)

Session Classification: Saturday Morning 2

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

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

Optical Spectroscopy of Pure Liquid Argon and Liquid Argon-Xenon Mixtures

Sunday, 24 September 2017 10:00 (20 minutes)

Electron- and ion-beam induced emission spectra of argon and argon-xenon mixtures were studied. A wide wavelength range from the vacuum ultraviolet (VUV) to the near infrared (IR) was covered (115nm –3500nm). An intense emission at a peak wavelength of 1.173 µm has been discovered in a mixture of 10ppm xenon in liquid argon which can be of interest for detector development. The well-known 127 and 174nm excimer emission features of argon and xenon, respectively, were recorded together with some weaker structures. Particle-beam excitation has the advantage that spectroscopic studies can be performed with good wavelength resolution and statistics because intense light emission can be induced. Intensities of 22000 and 13000 photons/MeV were measured for the VUV and IR emission, respectively, for ~10 keV electron-beam excitation. It was found that the so called third excimer continuum is weak in liquid argon, also with ion-beam excitation which is not the case for argon in the gas phase. Absorption measurements in the VUV have revealed that xenon is a critical impurity in detectors working with pure liquid argon. An absorption due to Xe appears right in the middle of the Ar excimer emission band. For well purified pure argon, however, the attenuation length was found to be at least 1.6m for its own VUV emission. A getter material was used for chemical purification and xenon was removed by condensation. In a recent experiment it was studied whether the intensity ratio between the IR and VUV emission from a 10ppm Xe in Ar mixture can be used for particle identification and thereby also background reduction in a liquid rare gas detector. Various projectiles with various particle energies from the Munich Tandem Van de Graaff accelerator were used to model the detector situation. An attempt is made to understand the results on the basis of energy deposition per unit volume, not only LET (linear energy transfer). Important technical details of all experiments will be described.

Summary

Emission and absorption spectroscopy of liquid argon and argon-xenon mixtures has been performed. An attempt is made to use VUV vs IR emission for particle identification.

Primary author: Prof. ULRICH, Andreas (TU-Muenchen, Physik-Department)

Co-authors: Dr NEUMEIER, Alexander (Fa. Daexemaier); Mr HIMPSL, Andreas (TU-Muenchen Physik-Department); Dr HOFMANN, Martin (Fa. Ketek); Dr HEINDL, Thomas (Fa. Zeiss)

Presenter: Prof. ULRICH, Andreas (TU-Muenchen, Physik-Department)

Session Classification: Sunday Morning 1

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

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

Photon detection system for ProtoDUNE dual phase

Saturday, 23 September 2017 10:30 (15 minutes)

The Deep Underground Neutrino Experiment (DUNE) is a 40-kton underground liquid argon (LAr) time-projection-chamber (TPC) detector, for long-baseline neutrino oscillation studies and for neutrino astrophysics and nucleon decay searches. Photon detector systems embedded within the LAr TPC add precise timing capabilities for non-beam events. The ProtoDUNE dual phase detector will consist of a 6x6x6 m3 LAr TPC placed at CERN and the light readout will be formed by 8-inch cryogenic photomultipliers from Hamamatsu. The characterization of the 36 photomultipliers, the readout electronics, and the light calibration system will be described. In addition, preliminary results from a 3x1x1 m3 LAr double phase detector operating at CERN will be presented.

Primary author: CUESTA, Clara (Ciemat)

Presenter: CUESTA, Clara (Ciemat)

Session Classification: Saturday Morning 1

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

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

Signal Reconstruction for DEAP-3600

Saturday, 23 September 2017 11:30 (15 minutes)

DEAP-3600 is a Dark Matter experiment operating in SNOLAB. DEAP currently holds the leading weakly interacting massive particle (WIMP) cross-section exclusion for a LAr detector and continues to probe deeper. The expected 3-year sensitivity to the spin-independent WIMP-nucleon cross-section is 10^{-46} cm^2 at 100 GeV/c^2 WIMP mass. The PMT response, reflectivity of optical surfaces, timing of scintillators and wavelength shifter properties all need to be precisely characterized in order to accurately describe detector response. A high level of understanding the detector response allows for optimizations in pulse shape discrimination methods used to discriminate between WIMP candidate events and a variety of background events. This talk will discuss the efforts to precisely characterize the time and charge response of the detector.

Primary author: Mr MCELROY, Thomas (University of Alberta)

Presenter: Mr MCELROY, Thomas (University of Alberta)

Session Classification: Saturday Morning 2

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

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

Study of the Low-Energy ER/NR Discrimination and its Electric-Field Dependence with Liquid Argon

Friday, 22 September 2017 09:00 (15 minutes)

ANKOK project is a dark matter search experiment in Japan using the double-phase argon detector, specialized for the low mass WIMP (~10GeV) detection. Double-phase Argon detector is generally a good technique for WIMP dark matter direct search due to powerful rejection power against electron recoil BG events. However compared with xenon, the basic properties and discrimination power from S2 signal in the low energy region are not well-known and thus S2 signal has not been effectively used in current experiments with argon.

In this talk, we will present results on our evaluation of S2 properties at low energy region below 40 keVnr and its discrimination power between electron and nuclear recoils, based on a prototype LAr TPC and detectors dedicated for neutron tagging. The drift fields under study ranges from null to 3kV/cm and its search feasibility for lower mass WIMP with argon will be also discussed.

Primary author: Mr WASHIMI, Tatsuki (Waseda university)

Presenter: Mr WASHIMI, Tatsuki (Waseda university)

Session Classification: Friday Morning 1

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

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

The Noble Element Simulation Technique v2

Saturday, 23 September 2017 11:45 (15 minutes)

The Noble Element Simulation Technique (NEST) software, introduced in 2011, provided a method to calculate light and ionization yields for noble element-based detectors. Since then, results from a variety of experiments have enabled improvements to NEST's underlying model. This talk introduces NEST2, a new version of NEST that implements the improved model as well as several software improvements for ease-of-use. This talk also demonstrates NEST2's validation against several experiments. NEST2 is available now for xenon in all three phases, for recoils from 0.1-5,000 keV and fields from 0-5,000 V/cm, and can handle an increased variety of interaction types including calibration and background sources.

Primary author: Dr BRODSKY, Jason (LLNL)

Co-author: Prof. SZYDAGIS, Matthew (SUNY Albany)

Presenter: Dr BRODSKY, Jason (LLNL)

Session Classification: Saturday Morning 2

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

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

Liquid-Noble Bubble Chambers for WIMP and CENNS Detection

Sunday, 24 September 2017 09:00 (20 minutes)

Our group at Northwestern recently demonstrated the world's first scintillating bubble chamber, observing simultaneous scintillation and bubble nucleation by nuclear recoils in superheated liquid xenon (arXiv:1702.08861). These detectors already promise unmatched background rejection in searches for canonical WIMP dark matter, and we are beginning to explore the low-threshold (<=1 keV recoil) capabilities of these devices. Our goal is to establish sensitivity to GeV-mass WIMPs and to coherent elastic scattering of reactor neutrinos. I'll describe the current state of our R&D program and plans for the coming year.

Primary authors: Prof. DAHL, C Eric (Northwestern University); Dr ZHANG, Jianjie (Northwestern University)

Presenter: Prof. DAHL, C Eric (Northwestern University)

Session Classification: Sunday Morning 1

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

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

A Pixelated Charge Readout for Liquid Argon Time Projection Chambers

Saturday, 23 September 2017 10:00 (15 minutes)

Liquid argon time projection chambers (LArTPCs) are ideally suited to perform long baseline neutrino experiments aiming to measure CP violation in the lepton sector, and determine the ordering of the three neutrino mass eigenstates.
LArTPCs have used projective wire readouts for charge detection since their conception in 1977.
However, wire readouts are notoriously fragile and therefore a limiting factor in the design of any large mass detectors.
Furthermore, a wire readout also introduces intrinsic ambiguities in event reconstruction.
Within the ArgonCube concept—the liquid argon component of the DUNE near detector—we are developing a pixelated charge readout for LArTPCs.
Pixelated charge readout systems represent the single largest advancement in the sensitivity of LArTPCs.
They are mechanically robust and provide direct 3D readout, serving to minimise reconstruction ambiguities, enabling more advanced triggers, further reducing event pile-up and improving background rejection.
This talk will present first results from a pixelated LArTPC prototype built and operated in Bern.

Summary

First results of a pixelated charge readout for a LArTPC are presented.
This novel readout aims to solve the limitations projective wire readouts impose on the design of future LArTPCs.

Primary author: Mr GOELDI, Damian (University of Bern)

Presenter: Mr GOELDI, Damian (University of Bern)

Session Classification: Saturday Morning 1

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

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

New Results on the Near-Infrared Scintillation of Liquid Argon

Friday, 22 September 2017 09:15 (15 minutes)

After a short review of previous attempts to observe and measure the near-infrared scintillation in liquid argon, we present new results obtained with a dedicated cryostat at the Fermilab Proton Assembly Building (PAB). The new results give confidence that the near-infrared light can be used as the much needed light signal in large liquid argon time projection chambers and we present first ideas on how to design and build a photon detection system utilizing the near-infrared light.

Primary author: Dr OURIVIO ESCOBAR, Carlos (FERMILAB)

Co-author: Dr RUBINOV, Paul (FERMILAB)

Presenter: Dr OURIVIO ESCOBAR, Carlos (FERMILAB)

Session Classification: Friday Morning 1

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

Contribution ID: **15** Type: **Presentation**

Calibrating Inner-Shell Electron Recoils in a Xenon Time Projection Chamber

Friday, 22 September 2017 12:30 (15 minutes)

Liquid noble detectors, used for dark matter and neutrinoless double beta decay searches, rely heavily on calibrations to understand each detector's response to predicted electron recoil backgrounds. These calibrations often use beta- or gamma-decay sources to approximate all electron recoil backgrounds. Existing models assume that interaction topology does not affect detector response below 10keVee despite the more local energy deposition profile from the released binding energy of an inner shell electron compared to a typical ionization track, such as from beta decay. We have constructed a xenon time projection chamber at Fermilab to compare the light and charge yields of Xe-127 electron capture to those of tritium beta decay. In a small enough detector, any gammas associated with the electron capture decay are lost, leaving only energy deposited by the released binding energy of the captured electron, allowing a direct comparison of the charge and light yields for the two energy deposition profiles.

Primary author: Mr BAXTER, Daniel (Northwestern University)

Presenter: Mr BAXTER, Daniel (Northwestern University)

Session Classification: Friday Morning 2

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

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

Production and Characterization of Full Scale Light Guides for Future Large LArTPCs

Saturday, 23 September 2017 15:15 (15 minutes)

Efficient collection of scintillation produced in liquid argon time projection chambers (LArTPCs) is critical for the success of upcoming neutrino experiments using this technology such as proto-DUNE, DUNE, and SBND. To optimize photocoverage, a system comprising flat panel light guides read out at the ends with silicon photomultipliers will be used. In order to convert the UV LAr scintillation light to the visible, these guides are coated with a wavelength shifting TPB solution. Current production guides have reached our initial goal of consistently attaining multi-meter attenuation lengths when measured in air. We have furthermore demonstrated the scalability of the process to larger guides than reported previously. This presentation will discuss the development, production methodology, and performance characterization in both air and LAr of these guides.

Primary author: Mr MOON, Jarrett (MIT)

Presenter: Mr MOON, Jarrett (MIT)

Session Classification: Saturday Afternoon

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

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

Liquid xenon scintillation measurements and pulse shape discrimination in the LUX dark matter detector

Friday, 22 September 2017 10:15 (15 minutes)

The Large Underground Xenon (LUX) experiment is a 250kg, dual-phase xenon time projection chamber (TPC) located in the Sanford Underground Research Facility in Lead, South Dakota, USA. The experiment searches for nuclear recoils (NR) that may be caused by Weakly Interacting Massive Particles (WIMPs), a leading candidate for the dark matter content of the universe. Residual backgrounds due to gamma rays and beta decays inside the detector create electronic recoils (ER) that must be identified to maximize sensitivity to rare NR events. Typically, particle-type identification is accomplished using the ratio of collected ionization charge to scintillation light. We present here an analysis of LUX calibration data that studies the time structure of the liquid xenon scintillation pulse in an attempt to improve ER/NR separation by adding pulse shape discrimination (PSD). Using a template-fitting algorithm for photon counting and timing, we reconstruct average pulse shapes for ER/NR pulses. Our spectra are fit to an analytic model of liquid xenon scintillation emission, allowing us to infer the ratio of singlet/triplet state emission for both NR and ER at energies relevant to dark matter searches. In addition, we calculate the pulse-shape discrimination power in LUX as a function of the size of the scintillation pulse. Our analytic model can inform simulation packages used by the larger liquid xenon community, and our measurements will inform future analyses of LUX data. We will discuss our results, as well as the challenges and applications of PSD in current and future liquid xenon TPC dark matter experiments.

Primary author: LENARDO, Brian (LLNL / UC Davis)

Presenter: LENARDO, Brian (LLNL / UC Davis)

Session Classification: Friday Morning 1

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

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

Status of the SiGHT hybrid photodetector development

Saturday, 23 September 2017 09:30 (15 minutes)

The Silicon Geiger Hybrid Tube (SiGHT) is a novel photosensor designed for use in ultra low background experiments operating at low temperatures.

Thanks to an electric drift field, electrons, produced by the conversion of the incoming photons onto a hemispherical photocathode, are accelerated and focused onto a Silicon Photomultiplier which provides single stage electron multiplication.

The concept of SiGHT detector will be presented together with the results both from the feasibility study for its production and from the first developed prototype.

Primary authors: Dr PANTIC, Emilija (UC Davis); Dr WANG, Hanguo (UCLA); Dr PAGANI, Luca (UC Davis); Dr WANG, Yi (UCLA)

Presenter: Dr PAGANI, Luca (UC Davis)

Session Classification: Saturday Morning 1

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

Contribution ID: **19** Type: **Presentation**

The Argon Response to Ionization and Scintillation (ARIS) experiment

Friday, 22 September 2017 09:30 (15 minutes)

The Argon Response to Ionization and Scintillation (ARIS) experiment was constructed to characterize the response of single-scatter nuclear and electronic recoils in liquid argon for support of direct dark matter detection experiments with a liquid argon target. A 0.5 kg active volume scintillation cell of liquid argon was exposed to the highly collimated and quasi-monoenergetic LICORNE neutron source at the Institute de Physique Nuclaire Orsay in Orsay, France. An array of liquid scintillator detectors was used to tag scattered neutrons and select nuclear recoil energies, with average energies between 6.99 and 119.4 keV measured. The relative scintillation efficiency of nuclear recoils was measured to high precision for both zero field and a range of applied electric fields in the liquid argon. The array of scintillator detectors was also used to tag Compton scattered gammas from the 478 keV de-excitation of excited Li produced in the beamline, resulting in a range of single-scatter electronic recoil events. These gamma-tagged events were analyzed to extract the recombination probability as a function of energy and measure the linearity of the light yield for electronic recoil events. Results from all studies described above will be presented.

Summary

On behalf of the ARIS collaboration.

Primary author: Dr JOHNSON, Tessa (UC Davis)

Presenter: Dr JOHNSON, Tessa (UC Davis)

Session Classification: Friday Morning 1

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

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

Global Quantum Efficiency Simulations

Saturday, 23 September 2017 12:00 (15 minutes)

Wavelength shifting plates coated with Tetraphenyl butadiene (TPB) are used to convert vacuum ultra violet photons into visible spectrum photons in order to make detection by Photomultiplier tubes (PMTs) in liquid argon scintillator experiments possible. To accurately use the combined plate-PMT system, calibrations motivated by geometric factors and optical properties of materials must be performed. This talk will outline how an optical simulation incorporating these effects can accompany a measurement of observed photoelectrons in a plate-PMT test stand system, and how the results may be used to determine a "global quantum efficiency"for this combined system.

Primary author: Mr WESTER, Thomas (Massachusetts Institute of Technology)

Presenter: Mr WESTER, Thomas (Massachusetts Institute of Technology)

Session Classification: Saturday Morning 2

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

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

Secondary scintillation yield and energy resolution of Xe-CO2/CH4/CF4 mixtures for the NEXT electroluminescence TPC

Sunday, 24 September 2017 11:55 (15 minutes)

The NEXT experiment aims at searching for the hypothetical neutrinoless double-beta decay (0νββ) of the 136Xe isotope using a High-Pressure Xenon (HPXe) Time Projection Chamber (TPC). Efficient discrimination of background events through pattern recognition of the topology of primary ionisation tracks is a major requirement for the experiment. However, the spatial resolution of the NEXT TPC is limited by the large diffusion of electrons in pure Xenon. The addition of a small fraction of a molecular gas to xenon may significantly reduce diffusion through electron cooling as new vibrational and rotational states are made available for electron energy transfer. On the other hand, the electroluminescence (EL) yield and energy resolution are degraded, which contributes to a reduction of the NEXT background discrimination capability. Nevertheless, a compromise between electrons diffusion reduction and EL degradation could yield an overall improvement of NEXT sensitivity to the 0νββ.

We have studied the effect of adding several molecular gases to xenon (CO2, CH4 and CF4) on the EL yield and energy resolution using a small prototype of a driftless Gas Proportional Scintillation Counter (GPSC). Our experimental results are compared with simulation of EL yield performed for the same additive concentrations.

Discussion on the technical advantages and disadvantages of each mixture is presented, as well as on the energy resolution contributions for each case. CH4 seems the most promising additive, but experimental studies on the pressure dependence, effect on primary scintillation and charge production, and electron diffusion are needed. This work will be carried out soon in a larger prototype (NEXT-DEMO).

Primary author: Mr HENRIQUES, Carlos (LIBPhys, Departamento de Fisica, Universidade de Coimbra, Rua Larga, 3004-516 Coimbra, Portugal)

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Presenter: Mr HENRIQUES, Carlos (LIBPhys, Departamento de Fisica, Universidade de Coimbra, Rua Larga, 3004-516 Coimbra, Portugal)

Session Classification: Sunday Morning 2

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

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

A Path to the Direct Detection of sub-GeV Dark Matter Using Calorimetric Readout of a Superfluid He-4 Target

Sunday, 24 September 2017 10:20 (20 minutes)

Superfluid helium has many merits as a detector target material to probe sub-GeV dark matter, including good kinematic matching with light dark matter, excellent intrinsic radiopurity, and ability to be cooled down to milli-Kelvin temperature to enable phonon readout using transition edge sensor. At the same time, this uniform liquid may be used to make a monolithic detector. We propose to readout the rotons and phonons in superfluid helium by using quantum evaporation of helium atoms, with an array of calorimeters suspended in vacuum above the helium, aiming to achieve below 10 eV energy threshold in a first generation detector. The scintillation photons can be read out either by placing cryogenic photodetectors submerged in the liquid or placing them outside and using wavelength shifter. Using the amplification of the roton/phonon signal via the helium atom evaporation/absorption process, such a detector should be able to probe very low-mass dark matter. Taking into account the radioactive background and the detector discrimination power, sensitivity projections show that a small detector (~kg scale) can already explore new parameter space in the dark matter - nucleon elastic scattering cross-section. An experimental effort to measure the scintillation light yield of superfluid helium under nuclear recoil excitation is also discussed.

Primary author: Dr HERTEL, Scott (University of Massachusetts Amherst)

Co-authors: BIEKERT, Andreas; MCKINSEY, Daniel; LIN, Junsong; VELAN, Vetri

Presenter: LIN, Junsong

Session Classification: Sunday Morning 1

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

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

Supernova Neutrino Detection in LZ

Saturday, 23 September 2017 11:15 (15 minutes)

In the first 10 seconds of a core collapse supernova, almost all of its progenitor's gravitational potential, O(10^{53} ergs), is carried away in the form of neutrinos. These neutrinos, with O(10 MeV) kinetic energy, can interact via elastic neutrino-nucleus scattering depositing O(1 keV) in detectors. Low background dark matter detectors, such as LUX-ZEPLIN (LZ), optimized for detecting low energy depositions, are capable of detecting these neutrino interactions. A 11 $M_{\odot}$ supernova at 10 kpc, will produce 50-100 neutrino interactions in the 7-tonne liquid xenon active volume of LZ. We adopt a simplified neutrino flux model for a supernova, and use NEST and Geant4-based BACCARAT simulation engines to study energy deposition from and detection of elastic neutrino-nucleus scattering in LZ. Within the first 200 milliseconds after the onset of core collapse, the progenitor undergoes neutronization. This produces a large flash of electron neutrinos. During this time, $\sim$10% of the total number of neutrino interactions are detected. We simulate the response of the LZ data acquisition system (DAQ) and demonstrate its capability and limitations in handling this interaction rate. At later times, the neutrino flux is composed of all flavors equally. We present an overview of the LZ detector, focusing on the benefits of liquid xenon for supernova neutrino detection. We discuss energy deposition and detector response simulations and their results. We present an analysis technique to reconstruct the total number of neutrinos and the time of the onset of the electron neutrino flash.

Primary author: Mr KHAITAN, Dev Ashish (University of Rochester)

Presenter: Mr KHAITAN, Dev Ashish (University of Rochester)

Session Classification: Saturday Morning 2

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

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

The SBND High Efficiency Light Collection System

Saturday, 23 September 2017 15:00 (15 minutes)

The SBND detector is a Liquid Argon Time Projection Chamber (LArTPC) being constructed on the Booster Neutrino Beamline at Fermilab as a part of the Short Baseline Neutrino Programme, which aims to definitely resolve the question of the existence of light sterile neutrinos. SBND's goals also include the development of liquid argon technology for future large scale detectors such as DUNE. One of the key areas of this development is the detection of scintillation light, specifically demonstrating how a high efficiency light detection system (LDS) could enhance the physics capabilities of LArTPCs for neutrino physics. The SBND LDS will contain a large array of PMTs and light guide bars as detectors located behind the APAs. We have also investigated possible further enhancement with reflective foils coated in wave-length shifter installed on the cathode plane. We will present the current status of the SBND light collection system as well as the result of simulations that demonstrate the performance of this system in enhancing the overall performance of the LArTPC in terms of timing, calorimetry and position resolution.

Primary author: Dr GARCIA-GAMEZ, Diego (The University of Manchester)

Presenter: Dr GARCIA-GAMEZ, Diego (The University of Manchester)

Session Classification: Saturday Afternoon

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

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

Overview of the CAPTAIN detector and preliminary results from neutron run.

Saturday, 23 September 2017 10:15 (15 minutes)

The CAPTAIN (Cryogenic Apparatus for Precision tests of Argon Interactions with Neutrinos) experiment is a five-ton liquid Argon Time Projection Chamber at Los Alamos National Laboratory. CAPTAIN is designed to make measurements of liquid argon interactions relevant to neutrino physics in particular for the proposed DUNE (Deep Underground Neutrino Experiment) underground detector. In addition to the wire planes on the TPC, CAPTAIN is instrumented with a cold photon detection system (PDS) to capture the Argon scintillation. The information from the PDS will help with event-timing reconstruction as well as complement the energy measurement from the TPC. A prototype detector called Mini-CAPTAIN, 400 kg of liquid Argon with 24 6cm^2 PMTs, collected data at the neutron beam at LANL this summer. In this talk, we discuss the performance of the PDS in the Mini-CAPTAIN run and the challenges ahead of the full scale CAPTAIN detector.

Primary author: CHAVES, Jorge (University of Pennsylvania)

Presenter: CHAVES, Jorge (University of Pennsylvania)

Session Classification: Saturday Morning 1

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

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

Improved measurements of the absolute wavelength shifting efficiency of Tetraphenyl Butadiene

Saturday, 23 September 2017 14:30 (15 minutes)

A key enabling technology for many liquid noble gas (LNG) detectors is the use of the common wavelength shifting medium Tetraphenyl Butadiene (TPB). TPB thin films are used to shift ultraviolet scintillation light into the visible spectrum for detection and event reconstruction. The effective wavelength shifting efficiency and emission spectrum of TPB have been previously measured down to 120 nm. Improved precision in this measurement would allow a better understanding of LNG detectors, resulting in improved sensitivity; measurements to lower wavelengths, closer to 80nm, would allow construction of LNG scintillator detectors with lighter elements (Ne, He) to target light mass WIMPs.

This work focuses on developing a microphysical optical model of TPB in order to extract out the true quantum efficiency. The current status and preliminary results of the absolute wavelength shifting efficiency measurements in the range of 45 to 250 nm will be presented.

Primary author: BENSON, Christopher

Co-authors: Prof. OREBI GANN, Gabriel (UC Berkeley / LBNL); GEHMAN, Victor

Presenter: BENSON, Christopher

Session Classification: Saturday Afternoon

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

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

Informing the next generation of dark matter and neutrino detectors with MiniCLEAN

Sunday, 24 September 2017 12:10 (15 minutes)

Single phase, zero field, liquid noble gas scintillator detectors are a simple, scalable and cost effective approach for dark matter and neutrino detection. The operation of MiniCLEAN, a dark matter detector currently commissioning with a liquid argon target at SNOLAB in Canada, will help inform the design of a future multi-ton experiment. The status and technical objectives of MiniCLEAN's role as a technology demonstrator will be discussed. New measurements of the triplet state lifetime in ultra-pure argon gas and its dependence on impurity level will be presented.

Primary author: BENSON, Christopher

Presenter: BENSON, Christopher

Session Classification: Sunday Morning 2

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

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

Search for CEvNS with a liquid argon scintillation detector

Friday, 22 September 2017 11:15 (15 minutes)

The COHERENT collaboration is deploying a suite of low-energy detectors in a low-background corridor of the
ORNL Spallation Neutron Source (SNS) to measure coherent elastic neutrino nucleus scattering (CEvNS) on an array
of nuclear targets employing different technologies. A measurement of CEvNS on different nuclei will test the
N^2-dependence of the CEvNS cross section and further the physics reach of the COHERENT effort. The first step
of this program has been realized recently with the observation of CEvNS in a 14.6 kg CsI detector. Operation and
deployment of Ge and NaI detectors are also underway. A 22 kg, single-phase, LAr detector (CENNS-10) started
data-taking in Dec. 2016 and will provide results on CEvNS from a much lighter nucleus. The design and performance
of the CENNS-10 detector will be presented.

Primary author: TAYLOE, Rex (Indiana University, Dept. of Physics)

Presenter: TAYLOE, Rex (Indiana University, Dept. of Physics)

Session Classification: Friday Morning 2

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

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

light detection with SiPM in nEXO experiment

Saturday, 23 September 2017 09:15 (15 minutes)

The nEXO collaboration is designing a 5-tonne xenon time projection chamber (TPC) using enriched Xe-136 isotope to search for neutrinoless double beta decays. Both the light and charge signals from interactions in the TPC will be collected. The light signals are planned to be detected with silicon photomultipliers (SiPMs). Comprehensive efforts have been made on SiPM performance characterization, reflectivity measurement and other R&D work. In this talk, I will present the latest status and progress from these work.

Primary author: Dr LI, Gaosong (Stanford University)

Presenter: Dr LI, Gaosong (Stanford University)

Session Classification: Saturday Morning 1

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

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

Investigation of Two-Phase Xenon Detectors with PIXeY

Friday, 22 September 2017 10:00 (15 minutes)

The Particle Identification in Xenon at Yale (PIXeY) experiment is a small, two-phase (liquid and gas) xenon detector. PIXeY has been designed and built to investigate and optimize properties of this class of detectors with an applied drift field of 0.5 to 2.0 kV/cm and an extraction field as high as 13.3 kV/cm in the xenon gas. This talk will discuss analyses of data collected from PIXeY concerning LXe energy resolution, electron extraction efficiency, and response to low-energy electron recoils from ^{37}Ar and ^{83m}Kr.

Primary author: Ms BOULTON, Elizabeth (Lawrence Berkeley National Lab)

Co-authors: Dr EDWARDS, Blair (Yale University); Mr TENNYSON, Brian (Yale University); Dr WAHL, Chris (Yale University); Dr MCKINSEY, Daniel (University of California - Berkeley); Dr BERNARD, Ethan (Lawrence Berkeley National Lab); Dr HORN, Markus (Yale University); Dr GAI, Moshe (University of Connecticut); Dr DESTEFANO, Nicholas (University of Connecticut); Dr LARSEN, Nicole (Yale University); Dr HERTEL, Scott (Yale University)

Presenter: Ms BOULTON, Elizabeth (Lawrence Berkeley National Lab)

Session Classification: Friday Morning 1

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

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

Radon Background in Liquid Xenon Detectors

Saturday, 23 September 2017 12:15 (15 minutes)

In many liquid xenon experiments the radioactive noble gas radon is an important background source. It emanates continuously from the detector materials and can reach the sensitive detection region. The successive decays of its daughter isotopes can mimic the signals from dark matter interactions. This talk focuses on measurement methods to determine the radon level before detector assembling, allowing a careful material selection. A few selected results will be shown. Furthermore, radon removal techniques will be presented to achieve a further background reduction.

Primary author: Mrs RUPP, Natascha (MPIK Heidelberg)

Co-author: Dr SIMGEN, Hardy (MPIK Heidelberg)

Presenter: Mrs RUPP, Natascha (MPIK Heidelberg)

Session Classification: Saturday Morning 2

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

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

Metallic wire grid behavior and testing in low pressure gaseous noble elements detector.

Friday, 22 September 2017 12:00 (15 minutes)

This talk is about the light production and testing of metallic grids in a gaseous noble element detector. At SLAC, a small setup was built to study the grid behavior in various type of liquid noble gaseous environments. In this setup, prototype grid for LZ will be studied, as well as the influence of the electropolishing and passivation technique. The light production from electron emission resulting from surface fields on the wires and other possible sources is studied. Also, the relationship between light response and electron drift distance and electric field in different gaseous conditions is evaluated. This talk is also to going to discuss future studies of the relationship between testing the grid in gaseous and liquid detectors.

Primary author: JI, Wei

Presenter: JI, Wei

Session Classification: Friday Morning 2

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

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

Scintillation from Xenon-Doped Liquid Argon

Sunday, 24 September 2017 09:40 (20 minutes)

We report the results of an experiment which collected scintillation light induced by cosmic ray muons in xenon-doped liquid argon within the Blanche cryostat at Fermilab. Doping the liquid argon with xenon at concentrations of 7 ppm and greater resulted in a two-fold increase in the amount of scintillation photons incident on the detectors. Examination of the time-resolved scintillation profile indicates that the prompt signal from the singlet argon excimer state was substantially suppressed and the majority of the 128 nm scintillation signal was converted to wavelengths longer than 150 nm.

Primary author: Prof. WHITTINGTON, Denver (Syracuse University)

Co-authors: Dr REBEL, Brian (Fermi National Accelerator Laboratory); HOWARD, Bruce (Indiana University); Mr MACIAS, Christopher (Indiana University); Prof. MUFSON, Stuart (Indiana University)

Presenter: Prof. WHITTINGTON, Denver (Syracuse University)

Session Classification: Sunday Morning 1

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

Contribution ID: **34** Type: **Presentation**

Characterization of Pb-206 Nuclear Recoils in Liquid Xenon

Saturday, 23 September 2017 12:30 (15 minutes)

There is a particular class of unavoidable backgrounds that plague Xenon (Xe) dark matter searches: decaying daughters of the Uranium-238 nuclear decay chain, which result from Radon plate-out on detector materials. One such daughter isotope, Polonium-210, undergoes alpha decay and produces a recoiling 103 keV Pb-206 nucleus. Such nuclear recoils can emulate low-energy dark matter interactions in liquid Xe, and thus should be directly characterized to improve background models. At DAX, the Davis Xenon R&D testbed system, we have developed a dual-phase Xe time projection chamber (TPC) for performing light and charge yield measurements of Pb-206 nuclear recoils. By coating a PIN diode with Po-210 and mounting it on the cathode of the TPC, we can trigger on the alpha emitted by the Po-210 decay in order to tag Pb-206 recoils. We will discuss our most recent results for this Pb-206 characterization.

Primary author: CUTTER, Jacob (UC Davis)

Presenter: CUTTER, Jacob (UC Davis)

Session Classification: Saturday Morning 2

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

Contribution ID: **35** Type: **Presentation**

Development of SensL SiPM Arrays

Saturday, 23 September 2017 09:45 (15 minutes)

In this talk, I will present work being done at Davis to develop and utilize SensL silicon photomultiplier (SiPM) arrays. First, I will talk about the development of a UV-sensitive SiPM system suitable for deployment in noble element time projection chambers. We show that device performance is not compromised in high electric fields nor at low temperatures.

Second, I will talk about arrays coupled to stilbene crystals to perform neutron-gamma pulse shape discrimination (PSD) as part of a larger project to develop a neutron scatter camera for fission neutrons. On this end, our interests are twofold: a) Ensuring strong neutron-gamma PSD and b) Providing fast time of arrival resolution in order to measure the scattered neutron's time of flight. We propose using both the standard and the capacitively coupled fast (SOUT and FOUT, respectively) outputs on the SensL arrays to simultaneously accomplish both of these tasks. Updates on the status of this work and preliminary design studies will be presented.

Primary author: GODFREY, Benjamin (UC Davis)

Co-authors: BREEDON, Earl (UC Santa Barbara); OSORNIO, Leo (California State University, Dominguez Hills); Dr TRIPATHI, Mani (UC Davis); DALAGER, Olivia (UC Davis); WILSON, Ryan (UC Santa Barbara)

Presenter: GODFREY, Benjamin (UC Davis)

Session Classification: Saturday Morning 1

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

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

Updated Results from the LZ System Test Platform At SLAC

Friday, 22 September 2017 11:30 (15 minutes)

LZ is a next generation dark matter experiment designed to significantly extend our sensitivity to WIMP dark matter candidates. As such it presents a significant challenge to the dual-phase Xe TPC technology. A 100kg scale test platform has been constructed at SLAC in order to test multiple systems at scales approaching or comparable to LZ. The platform focuses on the high voltage performance of the TPC and on the Xe circulation and purification system but also provides an opportunity to test the integration of other subsystems. The test platform discovered non-HV processes that lead to high photon rates while studying the extraction region that are being addressed in an ongoing upgrade. In addition, instabilities were discovered in the Xe flow path that have prompted design changes in LZ to ensure proper circulation. The system test will continue to validate the LZ design in an ongoing run and additional test efforts are being launched including full scale LZ grid validation and the early commissioning of the final LZ Xe handling system.

Primary author: Dr BIESIADZINSKI, Tomasz (SLAC)

Presenter: Dr BIESIADZINSKI, Tomasz (SLAC)

Session Classification: Friday Morning 2

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

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

Krypton-85 Removal for LZ Using Gas Charcoal Chromatography

Friday, 22 September 2017 12:15 (15 minutes)

Most radioactive backgrounds in liquid xenon TPCs arise from external sources and are mitigated by xenon's self-shielding properties combined with event position reconstruction and vetoes. Background sources that instead arise from substances dissolved throughout the active region, such as krypton-85, present a distinct challenge. This talk will describe our novel system for separating krypton from xenon using gas charcoal chromatography. Commercial research grade xenon contains on the order of 10,000 ppt of krypton and we require a concentration of < 0.300 ppt krypton for LZ. We have demonstrated a krypton concentration of <0.06 ppt with our R&D system and expect to achieve our ultimate goal of <0.015 with the production system, which will begin construction next year.

Primary author: Dr IGNARRA, Christina (SLAC)

Presenter: Dr IGNARRA, Christina (SLAC)

Session Classification: Friday Morning 2

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

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

Progress towards barium daughter tagging in Xe^{136} decay using single molecule fluorescence imaging

Sunday, 24 September 2017 11:40 (15 minutes)

The existence of Majorana fermions is of great interest as it may be related to the asymmetry between matter and anti-matter particles in the universe. However, the search for them has proven to be a difficult one. Neutrino-less Double Beta decay (NLDB) offers a possible opportunity for direct observation of a Majorana Fermion. The rate for NLDB decay may be as low as ≈ 1 $count/ton/year$ if the mass ordering is inverted. Current detector technologies have background rates between 4 to 300 $count/ton/year/ROI$ at the 100kg scale which is much larger than the universal goal of 0.1 $count/ton/year/ROI$ desired for ton-scale detectors. The premise of my research is to develop new detector technologies that will allow for a background-free experiment. My current work is to develop a sensor that will tag the daughter ion Ba^{++} from the Xe^{136} decay. The development of a sensor that is sensitive to single barium ion detection based on the single molecule fluorescence imaging technique is the major focus of this work. If successful, this could provide a path to a background-free experiment.

Primary author: MCDONALD, Austin (UTA)

Presenter: MCDONALD, Austin (UTA)

Session Classification: Sunday Morning 2

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

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

Measurements of Wavelength Shifters' conversion efficiency in the Vacuum Ultraviolet region using Synchrotron Light

Saturday, 23 September 2017 14:15 (15 minutes)

The Time Projection Chambers with noble gases are a powerful neutrino detector. The light emitted by the scintillation process is mostly invisible to the most common light detection systems. The vastly used solution to this problem is to use wavelength shifters to downshift the high energy scintillation photons into less energetic ones.

Some Wavelength shifters' characteristics are not yet precisely measured. This work shows the most important results from the measurement of one of those characteristics, the integrated emission spectra. The excitement light range was chosen to include all noble gases emission peaks, and was achieved using synchrotron light provided in collaboration with Toroidal Grating Monochromator line (TGM) team at Brazilian Synchrotron Light Laboratory (LNLS).

Primary author: Mr GELLI, Bruno (Universidade Estadual de Campinas - UNICAMP)

Co-authors: Dr MACHADO, Ana Amelia (Universidade Federal do ABC - UFABC); Prof. SEGRETO, Ettore (Universidade Estadual de Campinas - UNICAMP); Ms RODRIGUES, Gabriela (Universidade de São Paulo - USP)

Presenter: Mr GELLI, Bruno (Universidade Estadual de Campinas - UNICAMP)

Session Classification: Saturday Afternoon

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

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

PTFE Reflectance for Xenon Scintillation Light

Friday, 22 September 2017 12:45 (15 minutes)

Many rare event searches including dark matter direct detection and neutrinoless double beta decay experiments take advantage of the high VUV reflective surfaces made from polytetrafluoroethylene (PTFE) reflector materials to achieve high light collection efficiency in their detectors. As the detectors have grown in size over the past decade, there has also been an increased need for ever thinner detector walls without significant loss in reflectance to reduce dead volumes around active noble liquids, outgassing, and potential backgrounds. The dependence of the reflectance on thickness of two PTFE samples at wavelengths near 175 nm using the Michigan Xenon Detector (MiX) will be presented. We will also discuss reflectance measurements of Kapton, and PEEK performed with the same apparatus.

Primary author: Prof. LORENZON, Wolfgang (University of Michigan)

Presenter: Prof. LORENZON, Wolfgang (University of Michigan)

Session Classification: Friday Morning 2

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

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

Developing LAr Scintillation Light Applications at Neutrino Energies with LArIAT

Sunday, 24 September 2017 11:10 (15 minutes)

LArIAT (Liquid Argon in a Testbeam) is a small liquid argon time projection chamber set to calibrate and develop the LArTPC technology. LArIAT has completed 3 Runs on a charged particle beamline at the Fermilab Test Beam Facility and has acquired a large dataset of particle interactions on liquid argon which is currently being analyzed. An important feature of LArIAT, is the light collection system, which uses wavelength shifting foils to enhance the light collection efficency and uniformity. We will present the results of using this enhanced light collection for calorimetric and particle identification measurements as well as prospects for future applications in larger scale detectors.

Primary author: Dr SZELC, Andrzej (University of Manchester)

Presenter: Dr SZELC, Andrzej (University of Manchester)

Session Classification: Sunday Morning 2

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

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

The LArIAT light detection system

Saturday, 23 September 2017 14:00 (15 minutes)

The LArIAT experiment utilizes a Liquid Argon Time Projection Chamber (LArTPC) at the Fermilab Test Beam Facility to study the response of LArTPCs to charged particles of energies relevant for planned neutrino experiments. In addition, it will help to develop and evaluate the performance of the simulation, analysis, and reconstruction software used in other LAr neutrino experiments. Particles from a tertiary beam detected by LArIAT (mainly pions, electron, protons, kaons and muons) are identified using a set of beam-line detectors. In its effort towards augmenting LArTPC technology for other neutrino experiments, LArIAT also takes advantage of the scintillating capabilities of LAr and is testing the use of light signal to help reconstruct calorimetric particle identification information. Two cryogenic photomultiplier tubes (PMTs) and several varieties of silicon photomultipliers (SiPMs) mounted to custom preamplifier boards are suspended behind the LArIAT TPC's wire planes. Reflective foils coated in tetraphenyl butadiene (TPB) line the field cage walls to down-shift scintillation vacuum-ultraviolet (VUV) photons into detectable visible light. Additionally, in the most recent data taking period, a new light detection device (the ARAPUCA) was deployed for R&D studies. In this presentation we will highlight analyses underway which use the visible light to identify and reconstruct Michel electrons, improve particle identification, and present results from the ARAPUCA light device.

Primary author: Prof. KEMP, Ernesto (University of Campinas (BR) and Fermilab)

Presenter: Prof. KEMP, Ernesto (University of Campinas (BR) and Fermilab)

Session Classification: Saturday Afternoon

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

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

X-ARAPUCA a new development of the ARAPUCA device

Saturday, 23 September 2017 15:45 (15 minutes)

The X-ARAPUCA is an improvement of the concept of the original ARAPUCA device. The original idea remains the same in term of photon trapping inside an highy reflective box. The acceptance window is constituted by a dichroic window, which has the property of being highly transparent for wavelengths below a certain cutoff, while being highly reflective above it. The filter is coated with two wavelength shifters on its two sides: the one the external side converts the VUV 127 nm light to the region where the filter is transparent, while the internal one shifts the light to the region where it is reflective. In this way light enters the device, but can not exit.
The improvement consists in installing a waveshifting light guide inside the box, in the form of a slab with the same dimensions of the acceptance window. The dichroic filter, in this case, should be coated only on the external side. A photon trapped inside the X-Arapuca will be detected in two different ways by the SiPM array: guided by the waveshifting light guide or reaching it after few reflections on the internal surfaces (as standard ARAPUCAs do). This could lead to a substantial increase of the ARAPUCA collection efficiency.

Primary authors: Prof. MACHADO, Ana Amelia (UFABC); Prof. SEGRETO, Ettore (UNICAMP)

Co-authors: Prof. FAUTH, Anderson (UNICAMP); Mr GELLI, Bruno (UNICAMP); Dr WARNER, David (Colorado State University); Prof. MARINHO, Franciole (UFSCAR); Prof. PAULUCCI, Laura (UFABC); Mr MAXIMO, Renato (UNICAMP)

Presenter: Prof. MACHADO, Ana Amelia (UFABC)

Session Classification: Saturday Afternoon

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

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

XeBrA: Characterizing Dependence of Electric Field Breakdown on Electrode Area in Noble Liquids

Friday, 22 September 2017 11:45 (15 minutes)

The Xenon Breakdown Apparatus (XeBrA) is a detector containing 5 liters of liquid argon or liquid xenon designed to study high voltage behavior in noble liquids located at the Lawrence Berkeley National Laboratory. Experimental evidence suggests a correlation between breakdown field and electrode area in liquid argon. XeBrA is designed to explore this relationship in liquid xenon with its ability to test electrodes up to 30 cm2 in area, while varying cathode-anode separation from 0 to 10 mm, with cathode voltages up to -75 kV. XeBrA's design will also allow for a direct comparison between measurements in liquid xenon and liquid argon. XeBrA is currently in the assembly phase with first results expected by the end of 2017. This talk will present the motivation for this detector and highlight the detector design and electric field simulations.

Primary author: TVRZNIKOVA, Lucie

Co-authors: MCKINSEY, Daniel; BERNARD, Ethan

Presenter: TVRZNIKOVA, Lucie

Session Classification: Friday Morning 2

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

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

Increasing the sensitivity of LXe TPCs to dark matter by doping with helium or neon

Sunday, 24 September 2017 09:20 (20 minutes)

Next generation liquid xenon TPCs are poised to increase our sensitivity to dark matter by more than an order of magnitude over a wide range of possible dark matter candidates. In this talk I will describe an idea to expand the reach and flexibility of such detectors even further, by adding helium and neon to the xenon to enable searches for very light dark matter and combining high and low Z targets in the same detector. Adding helium or neon to LXe-TPCs has many advantages. First, the helium or neon target benefits from the excellent self-shielding provided by a large liquid xenon detector. Second, the same instrumentation, PMTs, and data acquisition can be used. Third, light nuclei are more robust to the systematic uncertainties that affect light WIMP searches. Fourth, helium and neon recoils will likely produce larger signals in liquid xenon than xenon recoils, achieving lower energy thresholds, and further increasing the sensitivity to light WIMPs. Lastly, by adding He/Ne in sequence after a Xe-only run, the source of any observed signal can be isolated.

Primary author: LIPPINCOTT, Hugh (Fermilab)

Presenter: LIPPINCOTT, Hugh (Fermilab)

Session Classification: Sunday Morning 1

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

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

Measurement of Electronic Recoil Response and Electronic/Nuclear Recoils Discrimination of low energy in XENON100

Friday, 22 September 2017 10:30 (15 minutes)

The XENON100 detector uses liquid xenon time projection chamber to search for nuclear recoils(NR) caused by hypothetical Weakly Interacting Massive Particles (WIMPs). The backgrounds are mostly electronic recoils(ER), thus it's crucial to distinguish NR from ER. Using high statistical calibration data from tritiated methane, AmBe and other sources in XENON100, the ER/NR discrimination under different electric fields and photon detection efficiency are measured. The Photon yield and recombination fluctuation of low energy electronic recoils under different fields will also be presented and compared to results from NEST and other experiments, which is crucial to understanding the response of liquid xenon detectors in the energy regime of searching dark matter.

Primary authors: Mr YE, Jingqiang (UC San Diego); Prof. NI, Kaixuan (UC San Diego); Dr LIN, Qing (Columbia University)

Presenter: Mr YE, Jingqiang (UC San Diego)

Session Classification: Friday Morning 1

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

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

Increasing the efficiency of photon collection in LArTPCs: the ARAPUCA light trap

Saturday, 23 September 2017 15:30 (15 minutes)

The Liquid Argon Time Projection Chambers (LArTPCs) are the best choice for the next generation of large neutrino detectors due to their optimal performance in particle tracking and calorimetry. The detection of Ar scintillation light plays a crucial role in the event reconstruction as well as time reference for nonbeam physics such as supernovae neutrinos detection and baryon number violation studies. In this contribution, we present the current R&D work on the so called ARAPUCA, a light trap device to enhance Ar scintillation light collection and thus the overall performance of LArTPCs. The ARAPUCA working principle is based on a suitable combination of dichroic filters and wavelength shifters to achieve a high efficiency in light collection. We discuss the operational principles, the last results of laboratory tests and the application of the ARAPUCA as the alternative photon detection system in the protoDUNE detector.

Primary author: Prof. KEMP, Ernesto (University of Campinas - UNICAMP)

Presenter: Prof. KEMP, Ernesto (University of Campinas - UNICAMP)

Session Classification: Saturday Afternoon

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

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

Prospects of the Carleton Cryogenic Facility

Sunday, 24 September 2017 12:25 (15 minutes)

In recent years, the interest in large liquid noble detectors, up to hundreds of tonnes in scale, has gained momentum. Such detectors would facilitate the required sensitivity for future low-background physics searches of interest such as dark-matter detection and the observation of neutrinoless double-beta decay. In order to achieve such sensitivity, R&D is essential. A new cryogenics facility at Carleton will allow for a range of table-top sized argon or xenon based measurements to address a series of requirements for future detectors. These include; background mitigation, optical response, the collection and detection of light and charge, and demonstrating the performance of novel silicon photomultiplier devices. The scope of the facility is discussed alongside recent results and knowledge gained from DEAP-3600, a current-generation liquid argon-based dark matter detector.

Primary author: Dr STAINFORTH, Robert (Carleton University)

Presenter: Dr STAINFORTH, Robert (Carleton University)

Session Classification: Sunday Morning 2

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

Contribution ID: **50** Type: **not specified**

Round Table Summary: Large future detectors

Sunday, 24 September 2017 10:40 (10 minutes)

https://docs.google.com/presentation/d/18qWoVQ60wBvtoQnsWr8qLzTS1tl3Xd2qptwG_4SUdoU

Session Classification: Sunday Morning 1

Contribution ID: **51** Type: **not specified**

Round Table Summary: New Technologies

Sunday, 24 September 2017 12:40 (10 minutes)

https://docs.google.com/presentation/d/1T7_5Mvz2ki919pkZdC3TDZ-zyuJJ3Usj_aVc6FJBxsQ

Session Classification: Sunday Morning 2

Contribution ID: **52** Type: **not specified**

Conclusions, Proceedings, Announcements

Sunday, 24 September 2017 12:50 (10 minutes)

Session Classification: Sunday Morning 2

Contribution ID: **53** Type: **not specified**

Noble Liquid detectors for Dark Matter

Friday, 22 September 2017 14:00 (40 minutes)

Primary author: Prof. SHUTT, Tom (SLAC)

Presenter: Prof. SHUTT, Tom (SLAC)

Session Classification: Keynote: Overview Talks

Contribution ID: **54** Type: **not specified**

Neutrino detection with Noble Elements

Friday, 22 September 2017 14:40 (40 minutes)

Presenter: Dr JONES, Ben (UTA)

Session Classification: Keynote: Overview Talks

Contribution ID: **55** Type: **not specified**

Logistics, Announcements

Friday, 22 September 2017 10:45 (5 minutes)

Presenter: MONZANI, Maria Elena (SLAC)

Session Classification: Friday Morning 1