

Status at IFAE

Thorsten Lux

EL Chamber

- Poster presented at IWORID 2015 with Ar data
- Proceedings deadline: 30.9.2015
- Electronic boards repaired
- Tests afterwards showed 5 APDs broken
- No further tests planned and chamber will be dismantled in September
- Design of new HP chamber should be finished end of August
- Production hopefully will start in autumn until spring of 2016 (still have to fight for it)

A Noble Gas Detector with Electroluminescence Readout based on an Array of APDs
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Abstract
 We present the results of the construction and operation of an array of avalanche photodiodes (APDs) for the readout of an electroluminescence detector. The detector consists of an array with a pitch of 18 mm between them allowing energy and position measurements simultaneously. Measurements were performed in xenon and argon showing a good energy resolution of 5.3% FWHM at 50 keV in xenon. In argon gamma energies of 10 to 17 MeV could be clearly separated from the decays indicating that this kind of technology might be also interesting for dark matter detectors filled with argon. We also determined the point resolution achievable with such a system to be about 0.3 mm for cosmic muons. Based on a detailed MC simulation accurately describing our experimental results, we will discuss potential improvements for such readout.

Setup
 An EL TPC for medium pressures:
 • Gas: 3.3 bar Xe, 4.8 bar Ar
 • Light sensors:
 • Hamamatsu APD (B8664-BPL) [1]
 • size: 8x8 mm²
 • pitch: 18 mm
 • QV: ~70% @ 172 nm, ~110% @ 128 nm
 • GEM
 • Radioactive source: Am-241
 • Custom-made preamplifier + ADC V1740

Electroluminescence
 Electroluminescence (EL) light is produced in argon and xenon at high electric fields by collisions between electrons and gas atoms.

Control Plots
 APD Bias: 398 V
 EL: 3 kV/cmbar
 Ar: 4.8 bar

Results
 In a previous study, we measured an energy resolution of 5.2(2)% at 50 keV in Xe at 2.8 bar [2]. As expected the results for Ar at 4.8 bar do not show the same performance (5.4(2)%). Also a low energy threshold of well below 10 keV is achieved.

MC Predictions
 MC was developed to verify the experimental results. It predicts 5.2% for 50 keV for the Xe data, well agreeing with the data also shown. Extrapolate to other geometries and operation parameters.

Conclusions and Outlook
 We demonstrated that an array of Hamamatsu APDs B8664-BPL is suitable to detect directly the EL light emitted in xenon and argon without the need of wavelength shifter. We achieved an energy resolution of 5.3% FWHM in Xe at 5.5 keV and 5.4% (preliminary) in Ar and a detection threshold of well below 10 keV in Xe. We achieved point resolutions of 0.3 mm with 200 GeV.
 Our MC simulations reproduce well the energy resolution result for Xe and indicate that a significant improvement could be achieved by increasing the sensor coverage in the readout plane. We are currently studying our focus on the analysis of the low energy peaks in Ar, including X-ray fluorescence lines, and MC simulations also for this gas.
 To lower the detection threshold in Ar further, as it might be interesting for dark matter experiments, we consider an interesting option to replace the mesh by a THGEM [3].
 In addition we started to work on a cost-effective readout system which will allow to increase the coverage significantly overcoming the drawback of the relatively high costs.

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References
 1. Lux et al., JHEP 1210, 085 (2012)
 2. Lux et al., JHEP 1501, 020 (2015)
 3. C. B. Williams et al., JHEP 1511, 020 (2015)

TPB Coating at UAB

- Another meeting with Arturo Lozano from UB mid of June
- Still positive impression, both sides are interested
- This year not possible to join project
- Trying to work out a institutional agreement between IFAE and UB and to submit next year together a proposal
- Will restart this effort in September
- Beginning of September also planning to order TPB (just received ArDM provider from Roberto)
- Hopefully at some point in autumn can get first samples

Light Simulation

- Had a meeting with John about light simulation
- Common strategy defined including a common SVN repository
- Bruno on our side will work on it/ John for CTA
- First plans:
 - Simulate circular, hexagonal and square pads (later semi-elliptical)
 - John invests if Geant4 includes already WLS (seems so)
- Some differences: Ar light surface, CTA volume distributed
- SiPM response will not be simulated in Geant4 => John found SiPM simulation framework (GosSIP) from Uni. Heidelberg

Next Steps/Others

- First vacations
- New HP chamber: finishing design end of August with engineer
- Contact CERN electronic pool to investigate if modules for the readout of the 5 PMTs is available
- Federico will organize a meeting with institute in Tarragona with expertise in WLS development (September)
- Working on finding a way to send an engineer to CERN to work on WA105 => might be also be interesting for you at CIEMAT

