Parallel session: New technologies, ideas, R&D priorities

Lidine 2022, Warszawa Sep 23rd 2022

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Are we done with other noble elements?

The discussion was mainly articulated around Kr doped with Xe for PET. It's cheaper than Xe, it's heavier than Ar so has larger photoefficiency.

- The discussion derived towards PET discussion

The need of new PET developments from the physics perspective was questioned, and lack of conversation with MDs and industry was diagnosed. Arguments in favour were risen, arguing different potentials

- Reducing dose in patients
- Larger (towards 4pi) coverage full-body PETs
- Finding cheaper solutions that allows for larger production and reaching more people, even if not outperforming state-of-the-art

What about solids?

The initially discussed advantage is the reduced diffusion would help with the Rn emanation problem.

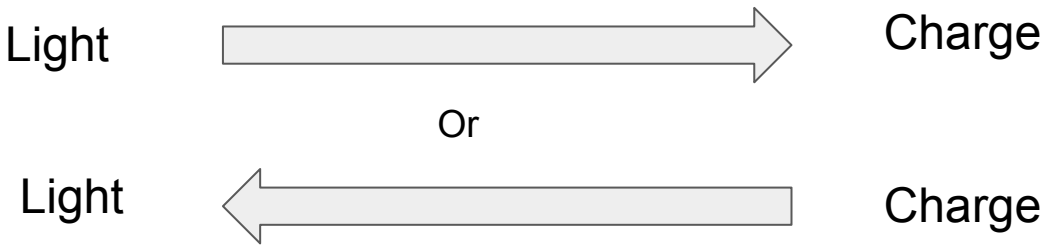
There was a discussion about the potential problem of space charge and ion drift.

The main concern was technical when trying to go to large to be competitive.

The interest in localizing the 0vbb decay in Xe to have the Ba tagged a posteriori was pointed out.

The ultimate advantage discussed is the possibility of bolometry and having the “ultimate” 3 channel detector.

Changing the light/charge logic



Dual phase convert charge to light, we saw a fair amount of talks on solutions that convert light to charge using CsI and GEM-like solutions.

For DM, the combination of initial QE in the photocathode and the multiplication needed to fight against the few quanta might be the challenge.

The exploration of other paths was discussed: ionization in TPB exploitable?

Overcoming current problems I (spurious electrons)

40-70% is thought to be understood.

Purity is critical

It is not clear to what extent it can actually be mitigated.

Material assay requirements may need to be extended to other parameters to reduce

Recirculation/purification needs might be not achievable.

Can you recirculate fast enough to remove steady-state production of spurious electron sources?

Only RnD and measurements can set the ultimate realistic threshold.

Overcoming current problems II (Thresholds)

Several talks on SiPMs cross-talk.

-> What is the impact of this for DM?

-> Accidental coincidence potential when below 3 PD coincidence

Low threshold => Few quanta from event

The combination of initial QE in the photocathode and the multiplication needed to fight against the few quanta might be the challenge.

Need high efficiency amplification before detection efficiency

The exploration of other paths was discussed: ionization in TPB exploitable?

Overcoming current problems III (Long term stability)

PMTs, TPB... are technologies thoroughly proven and still we saw several examples of loss of performance in the long term.

What can we do on the new proposed solutions (SiPMs, photocathodes...) in order to understand long-term performance?

Do we have ways of evaluating long-term stability in the short term? You can do something to evaluate degradation due to VUV exposure with VUV lamps.

Are there other fronts that could be tackled in the lab and we should start looking?

- Simulated mechanical stress?
- Repeated cryogenic cycling?

Can we speed up aging?

All in all, more questions than answers. Lots of interesting things going on and lots of interesting paths ahead.

Thanks all for the interesting discussion!

Backup

Opening questions

- No talk beyond Ar and Xe RnD. Are we in a preconstruction phase and focusing on the short term, are these paths exhausted or are we becoming more conservative?
- Dopings. Increasing yield.
- Other concepts: scintillating bubble chambers
- Solidified Noble elements. Interest from a radiopurity perspective

The main RnD ideas discussed

- Overcoming limitations
  - liquid/gas interphase (sagging +
  - charge to scintillation vs scintillation to charge:
    - photocathodes: aSe, CsI...
  - SiPMs cross talk. Tagging or mitigation techniques.
  - Effects on threshold. Threshold expectations for next generation.
  - Thresholds for S2-only. drifts. Single electron capture and delay release. What is the ultimate limit?
- Precision
  - New calibration concepts (n,y) and techniques (bunched highish E n)
- Long term performance.
  - Can it be tested in the short term?
- Optical surfaces

Notes

Youssef: good NR charge yields at low E. Quantum correlations? Interpretation of Nex/NI? Good model for energy transfered to the e-?

Teal: High E (E < 430 keV) recoils, depleted wrt to expected count rate.

Chami: What do we need to do in the nuclear front? Is it our job?

Chris: pillar metalenses need to be significantly smaller than your WL. Technically difficult to go down to 100 nm

Ale: SiPMs cross talk consequences.

David: eCT. Nph/av 15