Planning for the Photoelectron Laser Scope Review

April 2nd, 2020

1. Does the system have a well-justified role in safeguarding the far detectors and facilitating their operation, and if so, what is the minimum amount of system scope needed to carry out this role? (Cryogenic Instrumentation only)

- Although aimed at cryogenic instrumentation, photoelectron laser can provide quick diagnostics (within minutes) of the detector condition including:
  - Electron livetime
  - E-field distortions
  - Drift velocity
  - Vertex
- Routine daily or weekly runs – 3000 pulses in 5 minutes would suffice.
- Minimal scope would include several fibers in each of the four detector volumes.

Does the system have a well-justified role in facilitating the analysis of far detector data, and if so, what is the minimum amount of system scope required to fulfill this role?

- Quick diagnostics of the detector performance
- Vertex reconstruction

- Currently running simulations of drifting electron clouds from the phototargets on CPA and observing their signal on APA. Goals:
  - Reconstruct images of targets on APAs as a function of size of the electron cloud – check the precision of reconstruction
  - Study shifts of detection location as a function of space charge as a proxy for E-field distortions.
  - Need to tie it to high level physics
- *Not obvious how to deduce the minimum amount of system required to fulfill its roll. Should we follow the same surface granularity as the IO laser granularity? 30x30 cm^2? 75% CPA edge coverage?*

Have all technical issues related to the feasibility of the system (including those raised in the previous workshops) been resolved?

- This system requires high power NdYag laser → available
- Coupling efficiency of beam injection into fibers → needs test; high efficiency coupler ordered
- Coupling to the fibers and interface with ionization laser – feasible, but needs engineering
- Fiber attachment points on the APA planes identified
- Fiber holder being designed – prototype will be 3D printed at UH
- Angled diffusion from the fiber tips observed, but not fully characterized.
- Fiber routing and port allocation not finalized – but feasible
- Measurement photoelectric targets and Kapton quantum efficiency in liquid argon requires measurement – lab tests ongoing
- Locations and number of phototargets needs to be finalized
- Choice of conductive cryogenic glue for attaching targets to CPA required

→All are feasible, but some items need to be directly demonstrated.

→I could not find the report from last June.

Are there any risks to overall detector performance associated with the implementation of the system, and if so, is there a plan in place for mitigating these risks?

- This is a passive system.
- During use, there will be associated electronic noise that should be mitigated by proper grounding.
- There is no direct illumination of PDS
- Kapton also exhibits photoelectric effect with 2 orders of magnitude lower quantum efficiency – needs to be checked with lab test (ongoing)

Is there a credible plan in place for demonstrating system performance in ProtoDUNE-II?

- Plan under development. Requires:
  - Dedicated locations on the CPA planes to glue the targets (should be OK)
  - Attachment of fiber holders to APA planes (should be OK)
  - Routing of fibers (needs work)
  - Allocating (sharing) exit port for the fibers (needs more work))
  - Coupling to the laser system (needs work)
  - Laser (available)

Does the functionality of the system justify its overall cost?

- The cost of the system is modest.
- We will finalize the cost in the next couple of weeks.