**LAPPD / HRPPD magnetic field measurements at Argonne February 13-24, 2023**

Given the feedback provided to date, the focus of this series of measurements should likely be formulated around evaluating the most probable EIC photosensor candidate (DC-coupled HRPPD) under the conditions (field strength and orientation) presently anticipated for the EIC pf(m)RICH and DIRC detectors.

One proposal would be to first establish an HRPPD baseline running mode at a field strength B=0T such that it approaches the presently anticipated running conditions in the EIC experiment, with a single photon mode in mind:

* Photocathode voltage required to achieve high resolution timing, namely 75-100V
* Other voltage settings corresponding to a low to moderate gain around ~106, which would still allow a meaningful performance evaluation using available DRS4 electronics

Strictly speaking, none of the essential picosecond laser parameters (repetition rate, attenuation) should be changed after this tuning. These parameters should be taken such to clearly provide a meaningful single photon measurement, with at least ??% of pedestal (zero photoelectron) events.

Photocathode voltage can be somewhat reduced for DIRC (and dRICH) if needed, since single photon TTS better than ~75-100ps is not really required for these detectors.

Parameters of interest are:

* pulse height distribution (summed up over 4x4 pads?)
* width of the timing distribution as defined by a leading edge fit or any other means and determined by a convolution of the sensor TTS and the laser timing jitter
* width of the spatial distribution in X&Y (using amplitudes across 4x4 pads)
* position of the XY-centroid as determined by a weighted mean across 4x4 pads
* Dark Count Rate (DCR)
* Relative efficiency (count of events where HRPPD had a visible pulse, at a constant laser repetition rate), as well as event count above some reasonable threshold, defined as a fraction of MPV

We understand that the *spatial resolution* cannot be reliably evaluated in this setup because of the lack of focusing optics or other means to collimate the photon source.

The P00i HRPPD readout board used in this setup has also 4x4 pad fields, with pads wired together, fed into a single MCX connector, and essentially looking like a single large 12.8mm x 12.8mm pad. One may think of using these fields for more meaningful (simple) amplitude and / or timing measurements.

The ultimate goal of the measurement program is to restore the selected working conditions by tuning the HV settings, for a representative set of the field strengths and field-to-normal orientations at the location of EIC detectors, in a way the selected baseline performance at B=0T is fully restored. If a full restoration is not feasible, quantify the implications. Representative field settings can be taken from Zhengqiao’s presentation uploaded on <https://indico.bnl.gov/event/18436/>, and to first order can be reduced to one “extreme” point per detector type:

* pfRICH: B = ???, a = ???0 to normal
* mRICH: should be fine, as long as pfRICH setting is verified, otherwise B = ???, a = ???0 to normal
* DIRC: B = ???, a = ???0 to normal
* dRICH (for completeness): (1) B = ???, a = ???0 to normal, and (2) B = ???, a = ???0 to normal, maximizing either the field strength or the angle to normal as listed in Zhengqiao’s presentation

It is important to verify that in these “extreme” points the HV settings can be chosen such to not only guarantee the performance *in the center* of the ~100mm x 100mm HRPPD active area, but *in all corners at the same time*, since in particular the field *orientation* can vary by several degrees across the sensor surface.

In case of pfRICH installation in EIC, it will likely be beneficial to keep all HRPPDs in the sensor plane oriented the same way (HV leads sticking out on the same side of all tiles), in order to simplify the integration. Therefore, it is now desirable to verify the performance in all four tile orientations with respect to the solenoid axis (00 , 900 , 1800 , 2700 ), as oriented inside of the sheet metal box.

Differential curves (performance metrics as a function of field orientation at a few fixed field magnitude values), both with and without HV adjustments, are of interest as well, in particular the practically achievable angular limits of restoring the performance for a dRICH-like configuration (relatively small field, but very large angle to the sensor normal).

Would be interesting to quantify which of the HV settings are essential for restoring the performance (amplification dV across the MCPs or transfer voltages in the gaps), in particular for purpose of minimizing the expected Lorentz effect at large angles.

Measurements with the LAPPDs should probably be considered more of an academic interest, with a focus on the one of them (which one?) mostly close to the anticipated possible Gen II tile configuration in the EIC (10 mm pores, short stack). In the latter case the same set of measurements as outlined for the HRPPD should probably be conducted, since at this moment there is no real decision taken on whether Gen II or DC-coupled variety will be used for m(pf)RICH detector.