Photosensors and Electronics

Goals:

- To evaluate commercial photosensors for EIC PID detectors and to develop alternative, cost-effective photosensors (LAPPDs).
- To develop readout electronics for PID detector prototypes.

Activities:

- Evaluation of photosensors in high-B fields at JLab.
- Adaptation of LAPPDs to EIC requirements at ANL.
- Development of readout electronics (U. Hawaii and INFN-Ferrara) for Cherenkov Detectors prototype tests..

Sensors in High-B Fields

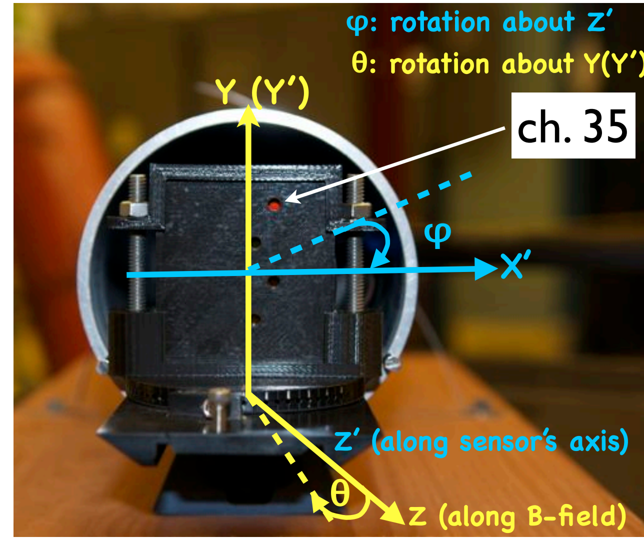
FY19 funded activities

- Planacon B-field studies of ion feedback: analysis of data completed
- Studies of Planacon gain evaluation with various amplifiers and amplifications: data taking completed; analysis in progress
- Studies of Planacon efficiency evaluation with different readouts: data taking completed; analysis in progress

FY20 proposed activities

- Evaluation of gain, ion feedback, and timing-resolution of latest-generation 10-mum Planacon, XP85122-S, as a function of B, HV, and sensor orientation relative to field direction.
- Comprehensive gain and timing studies of XP85122-S with changing $HV_{Cth\text{-}MCP1}$, $HV_{MCP1\text{-}MCP2}$, $HV_{MCP2\text{-}Anode}$.

Sensors in High-B Fiels



Goals:

- To evaluate commercial photosensors for EIC PID detectors in order to identify the limitations of current PMTs design and operational parameters for High-B operations

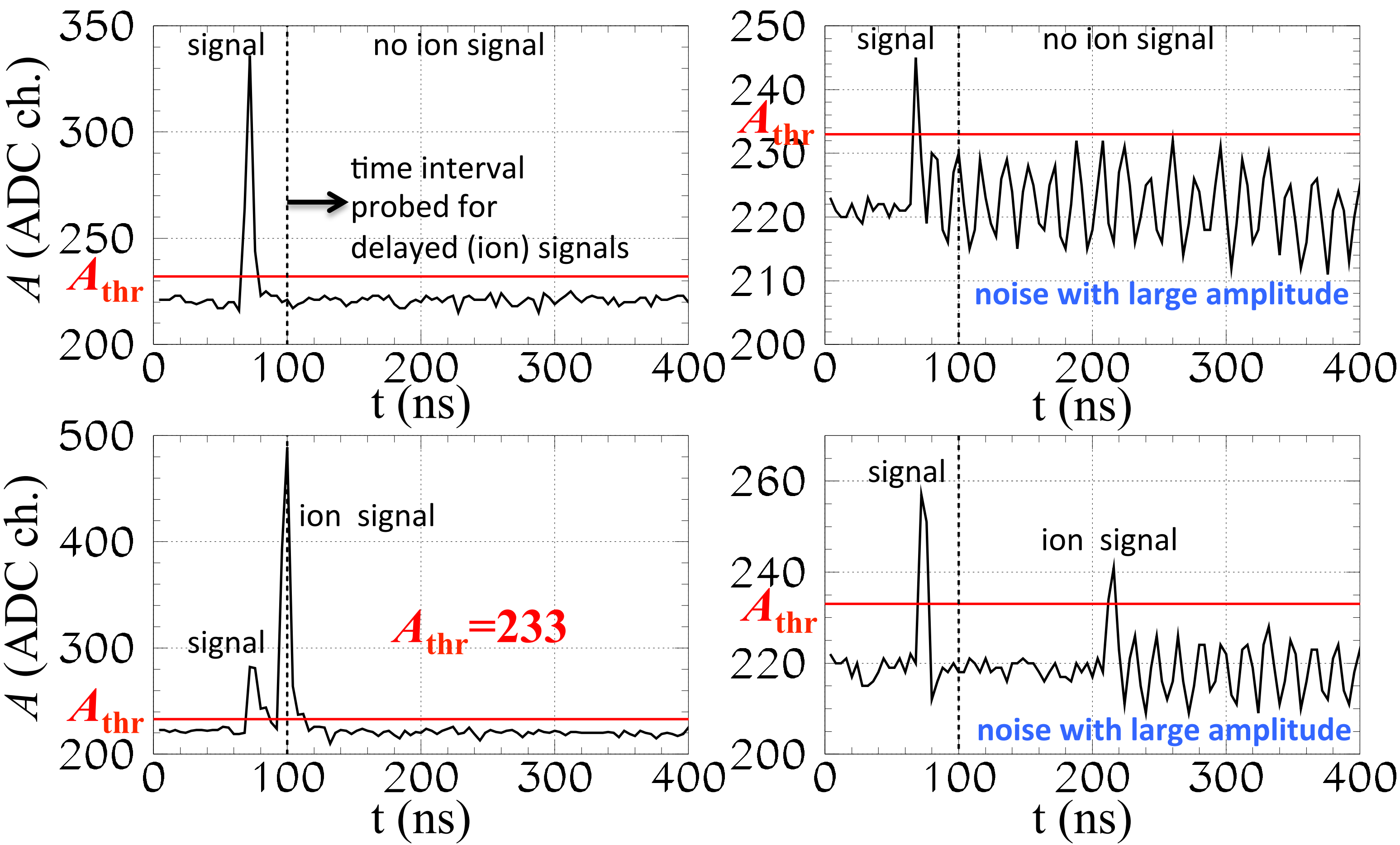
FY20:

- Detailed studies of gain, ion feedback, and timing-resolution of latest-generation 10-mum Planacon as a function of B, HV, and sensor orientation relative to field direction.

Results from FY19 Ion-Feedback Studies

10-µm Planacon: Ion Feedback

The accuracy of the extracted ion-feedback rate strongly depends on the **noise** of the signal line. The value of the **threshold amplitude defining a signal, A_{thr},** critically affects the estimate of ion feedback rate.



$N_{signals}$:

$A_{\max} \geq A_{thr}$

$t < 24$ ns

N_{ions} :

$A_{\max} \geq A_{thr}$

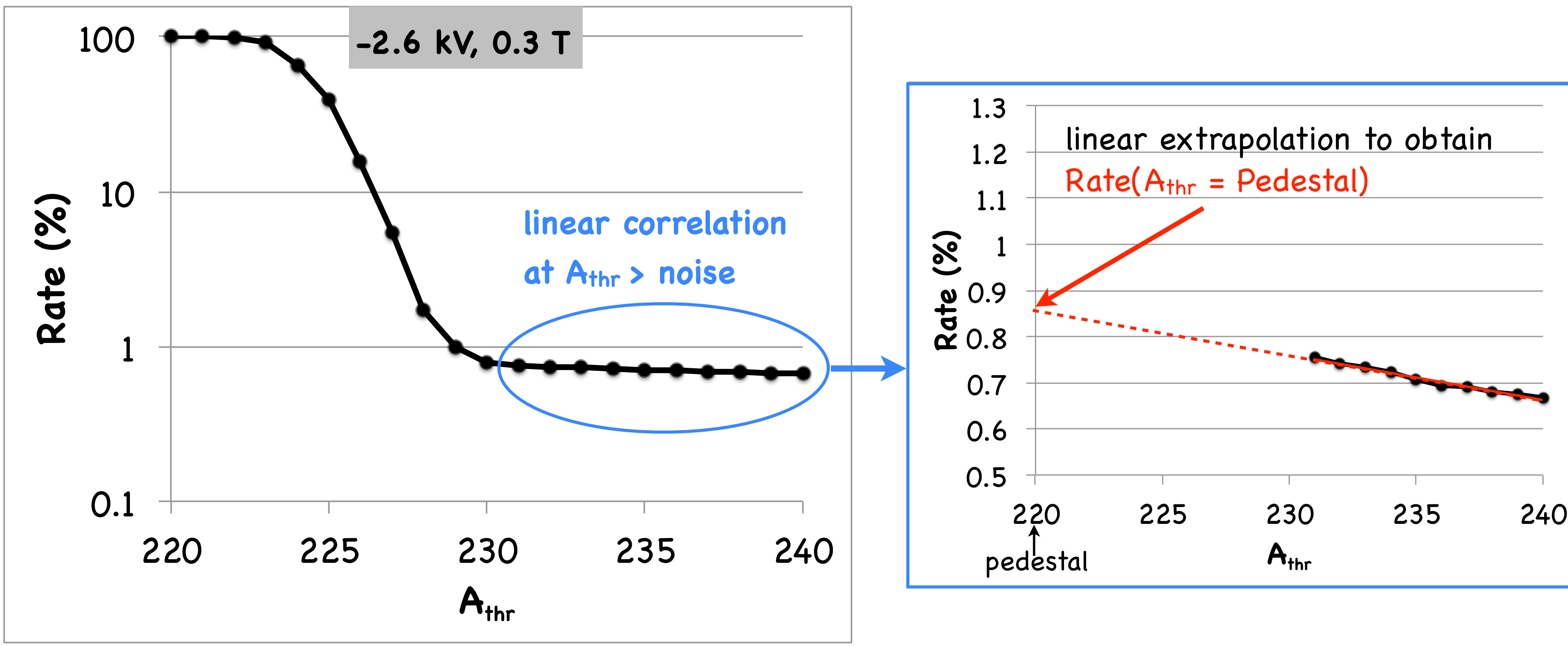
$t > 100$ ns)

$$Rate = \frac{N_{ions}}{N_{signals}}$$

Results from FY19 Ion-Feedback Studies

10-µm Planacon: Ion Feedback

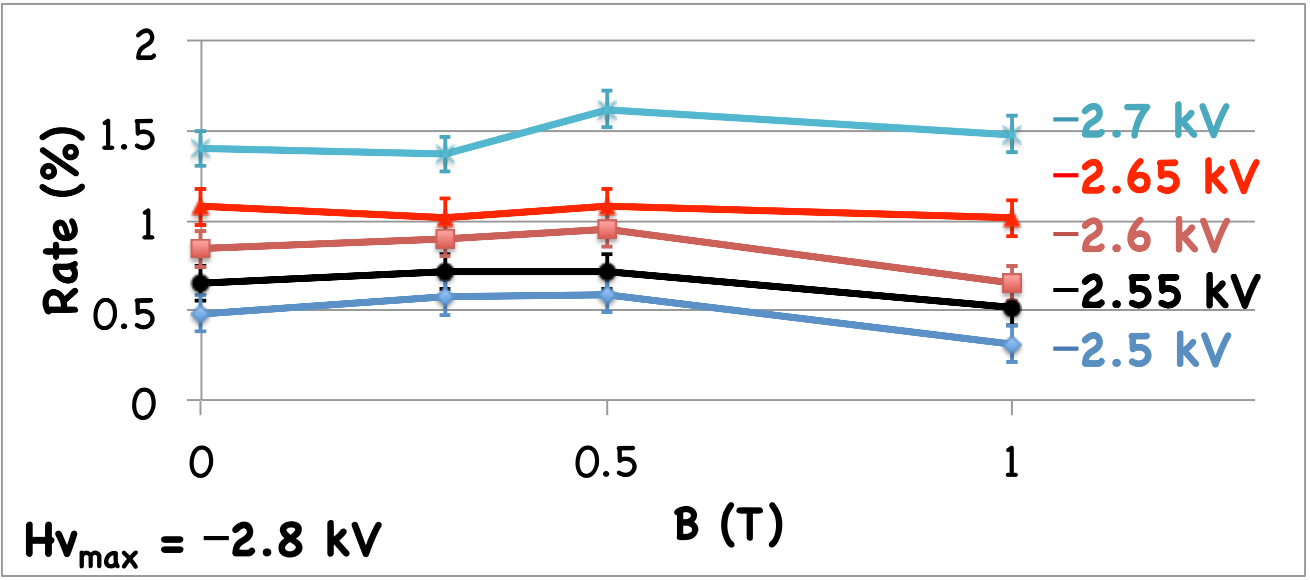
- Too low A_{thr} leads to an overestimate of the ion-feedback rate due to some noisy waveforms. A_{thr}=233 is the best empirically found value for Summer 2018 data.
- **Problem:** Waveforms where $A_{signal} < A_{thr}$ or/and $A_{ions} < A_{thr}$ are not taken into account.

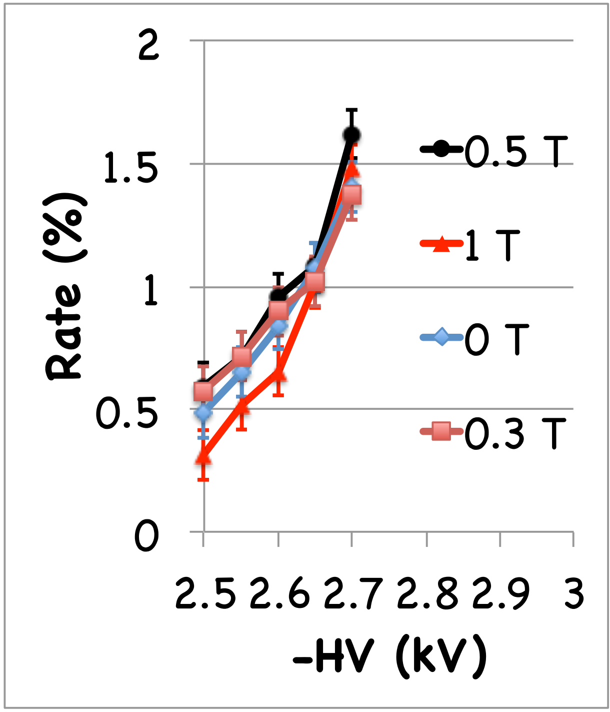


- *Rate* is evaluated over a range of $A_{thr.}$ *Rate*(A_{thr}=Pedestal) is obtained from a linear fit to the high-A_{thr} tail. This is the best estimate of the true ion rate, i.e. as would be obtained if there were no noise on the waveform, but only signal(s).

Results from FY19 Ion-Feedback Studies

10-μm Planacon: Ion Feedback





$\Delta = Rate(A_{thr}=\text{Pedestal}) - Rate(A_{thr}=233)$. $\bar{\Delta} = 0.13$. Reported above: $Rate(A_{thr}=233) + \bar{\Delta}$

- At all voltages the ion rate is below 2%.
- Results suggest that ion-feedback is primarily driven by HV.
- Ion-feedback rate dependence on B-field magnitude is relatively weak.