High-B Sensor Program
eRD14 FY21 Proposal

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Goals:

- Identify the limitations of current MCP-PMTs and provide guidance for development of new photo-sensors.
- Find the optimal location and orientation of sensors in the EIC detector.
  - Example: tilt angle with respect to the local B-field; different sensor options
- Investigate suitable parameters for operations in high magnetic fields.

Sensors in High-B Fields

FY20 Activities in FY20 eRD14 Proposal

- Evaluation of the gain, ion-feedback, and timing resolution of a multi-anode 10-μm pore-size Planacon XP85122-S as a function of (B, θ, φ, HV).
- Comprehensive gain and timing studies of XP85122-S with changing HVCathode-MCP1, HVMCP1-MCP2, HVMCP2-Anode

Progress in 2nd half of 2019 - May 2020:

- Study of different readout solutions on the gain assessment of a 10-μm Planacon MCP-PMTs in a B-field **(complete).**
  - New: for fast timing (no internal pre-amplifier, 5m RG188 coax cables.
  - Old: ×20, 250-MHz internal preamp, 7.62m micro-coax ribbon cable.
- Purchase of a 25-ps timing resolution (LSB) CAEN TDC V1290N for timing measurements **(complete).**
- Purchase of a 32x32 XP85122-S, HiCE Planacon **(complete, expected delivery August).**
- Preparation of a signal readout of a few channels at JLab **(in progress).**

Sensors in High-B Fields

Proposed FY21 activities

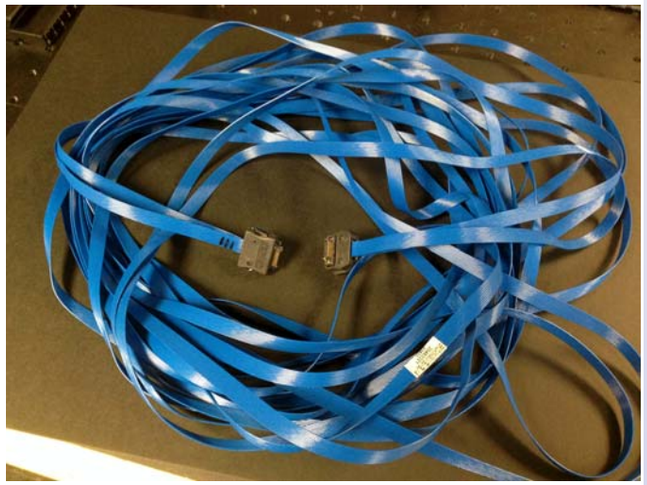
- Full scan of 10-μm XP85122-S, HiCE Planacon: timing, gain, ion feedback (HV, θ, φ).
- If time permits: studies with changing $HV_{Cathode-MCP1}$, $HV_{MCP1-MCP2}$, $HV_{MCP2-Anode}$.
- Full scan of a 6-μm Photek: timing, gain, ion feedback (HV, θ, φ).

Summer 2019 Activities

Assessment of new readout solution for timing studies

Micro-coax ribbon cable was used for gain evaluation until 2019

25 ft micro coax ribbon

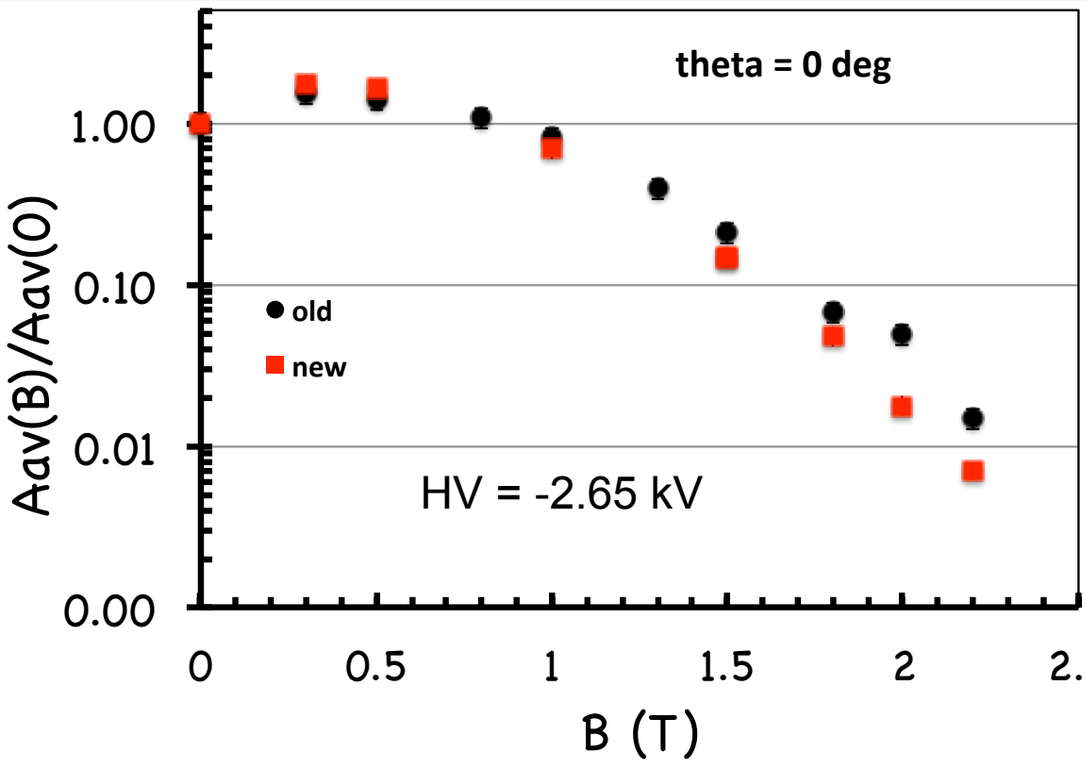


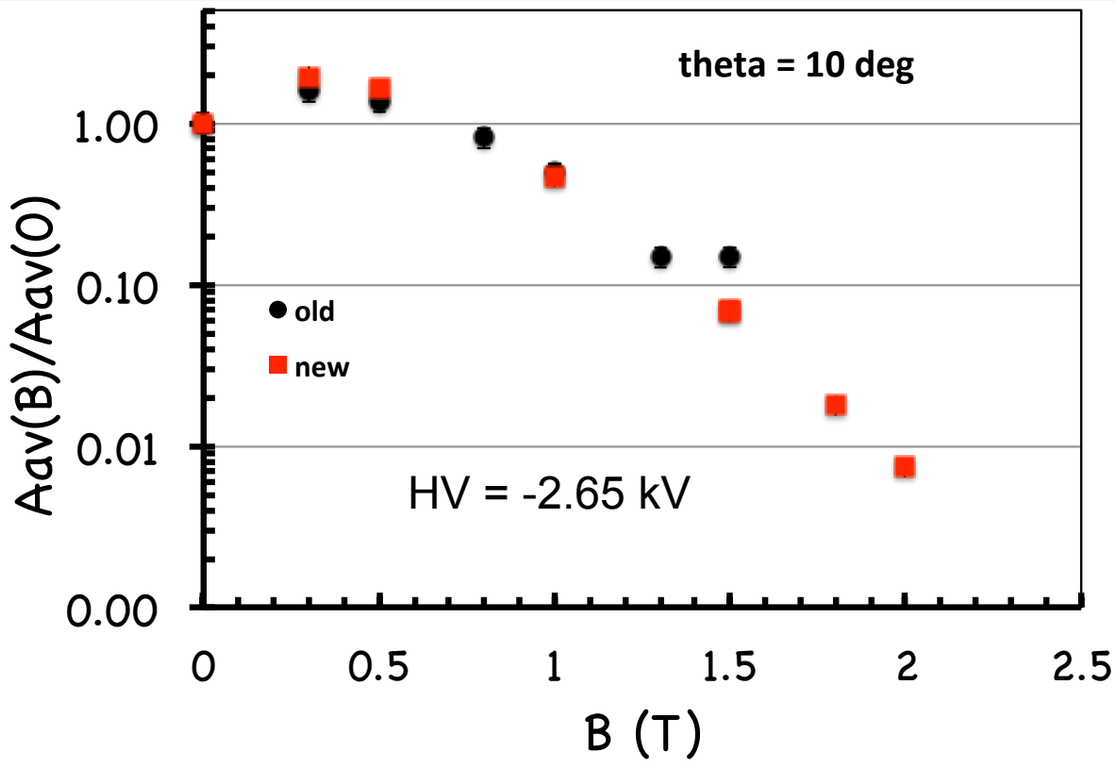
Pulse Height Loss	−40%
Rise Time Increase	+70%
Fall Time Increase	+25%
Pulse Width Increase	+40%

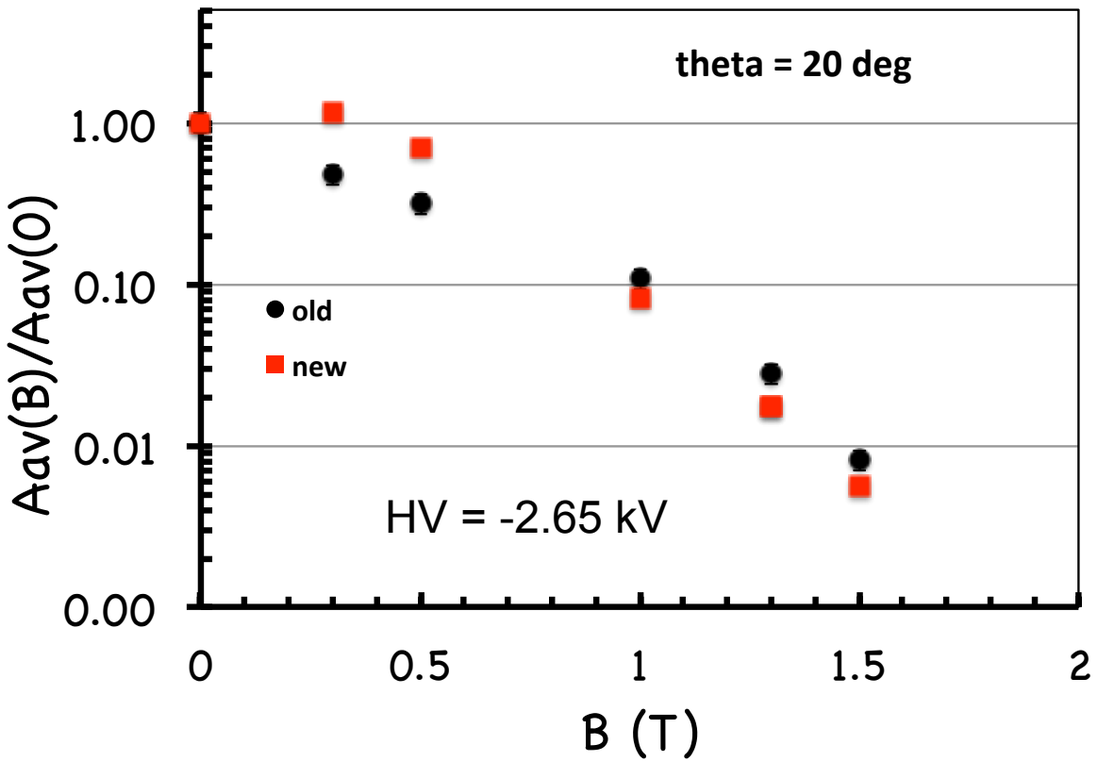
To first order, the total pulse area is preserved.

Results from Summer 2019

Assessment of the effect of different readout on gain characterization







- Below 1 T, the new readout yields overall higher relative gain.
- Above 1 T, the new readout yields overall smaller relative gain: could be systematics.

- Dedicated study: during opportunistic travel to JLab (December 2020, Spring 2021).
- Studies of effective amplification: needed for publication of 2015 - 2018 data.

High-B Sensor Activities in FY20

- **Reduced funding in FY20**: priority given to the procurement of XP85122-S (funds from DIRC rerouted to High-B)
- Expected delivery of XP85122-S: **end of August**
- On-loan agreement with Photek initiated before JLab closure (update on current status pending)
- USC Magellan scholarship awarded to Benjamin Moses to work on High B at JLab (student salary (5 weeks) and transportation covered)
- Jack has started working on readout solution for XP85122-S

- **Pre-COVID19 plans:** Measure in B-field in June 2020
- **Current plans:**
  - No measurements this summer (Photek resolution pending)
  - Finalize readout solution for XP85122-S (Samtech connector or Condalign film, new preamp)
  - If possible, install the new TDC in July-August and test with old Planacon
  - Carry over all R&D remaining funds (~9k) to FY21

High-B Sensor Activities in FY21

Scenario assuming normal access to JLab and safe travel situation

- **Optimistic scenario: two runs with cold magnet**
  - **2 weeks in December**
  - **2 - 3 weeks in Summer 2021 (MCP-PMT not needed for DIRC), ok to be at JLab**
- **Pessimistic scenario**
  - **2 - 3 weeks in Summer 2021**

High-B Budget Items in FY21

FY21 budget request

- LHe (500 L): for one run
- Small components for sensor readouts (cables, connectors, preamp, etc.)
- undergraduate-student salary (3 weeks): to supplement USC scholarship, for a total of 8 weeks research
- partial travel to realize optimistic scenario: 2-weeks of travel in December 2020
- procurement of a small-pixel MCP-PMT from Photek or Incom