eRD110: Photosensors for EIC Detectors

Photonis and Photek MCP PMTs
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SiPMs
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Photosensors for EIC Detectors

Already on the market
- Photonis (most mature, multi-anode MCP PMT), 10μm pore size, 5.3x5.3 cm^2
- Photek (new, multi-anode MCP PMT), 6μm pore size, 5.3x5.3 cm^2
- Incom LAPPD (new, capacitively-coupled multi-anode readout - needs validation for EIC), 20μm pore size, 20x20 cm^2
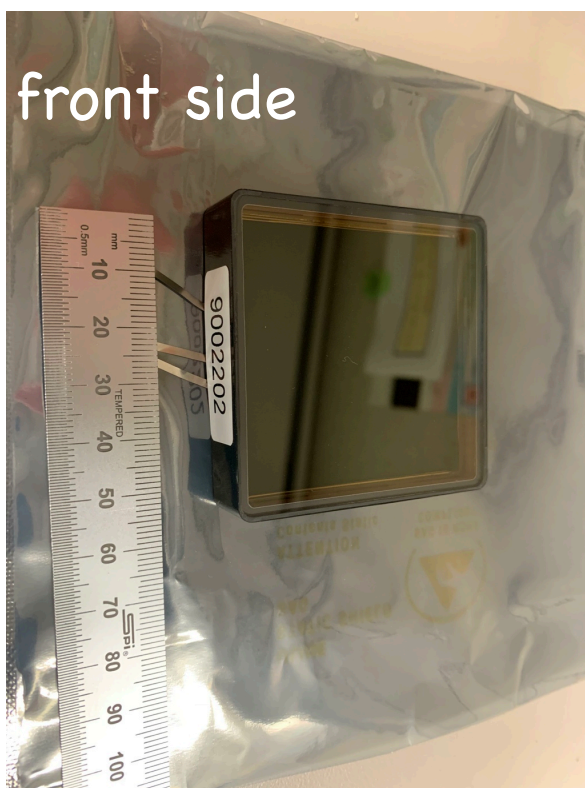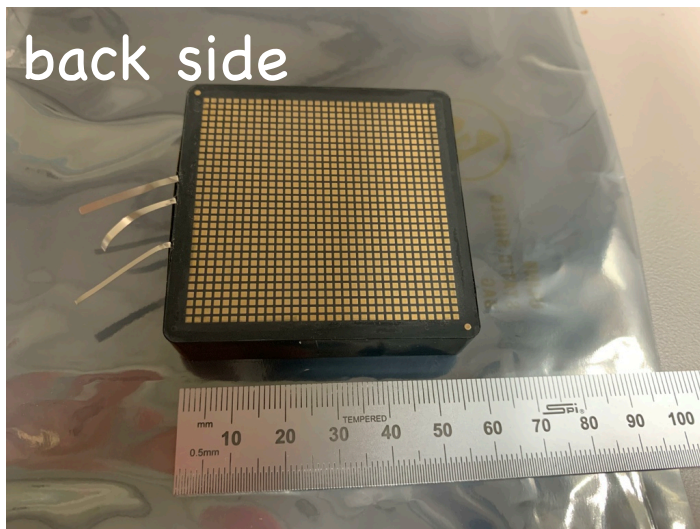
In development by manufacturer
- Incom HRPPD (multi-anode direct readout), 10μm pore size, 10x10 cm^2

On the market, but need some development for EIC
- SiPMs

Photonis MCP PMT

XP85122-S, HiCE

back side

front side

Specifications:
10 μm pore size
32x32 channels by design
16x16 configuration sufficient for EIC

B-field gain characterization:
completed in FY21 for two channels in 16x16 geometry
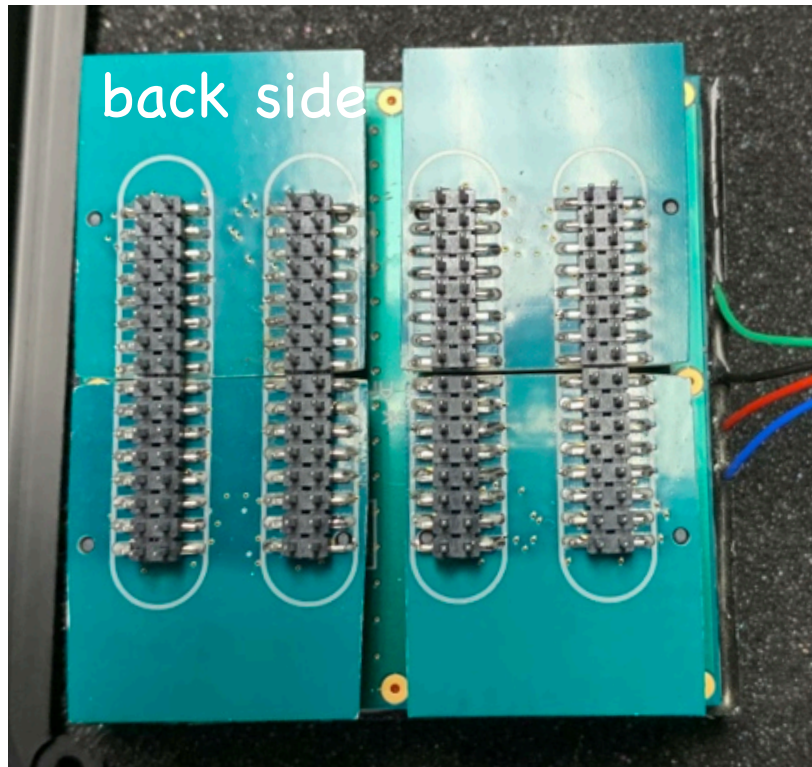gain is within the specs up to 1.5 T

FY22 R&D:

tube response in full operation in **16x16 config**: cross talk, collection efficiency (B-field), gain uniformity, timing resolution

Good candidate for DIRC in all detectors
Good candidate for mRICH if B<=1.5 T

Photek MCP PMT

MAPMT253

back side

front side

Specifications:
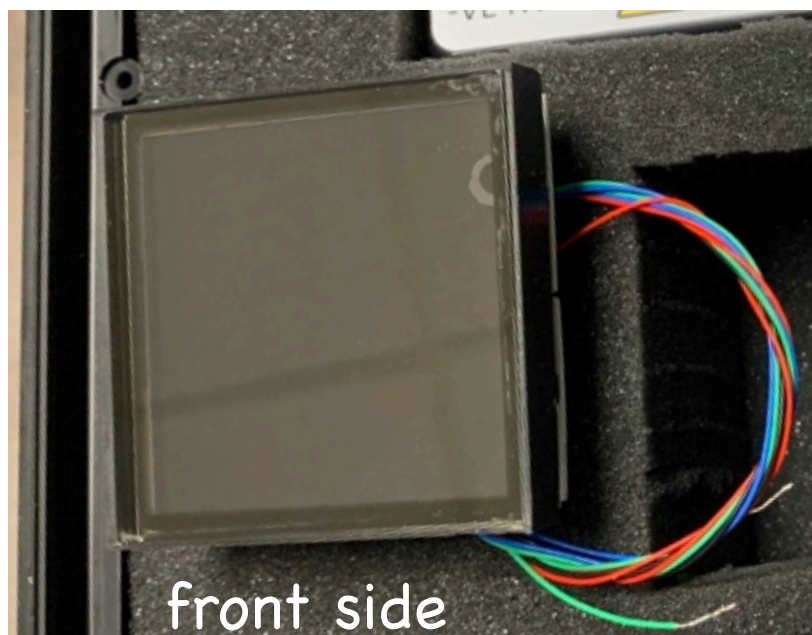6 µm pore size (good for high B-fields)
16x16 channels by design - good for EIC

B-field gain characterization:
completed in FY21 for two channels in 8x8 geometry
gain is within the specs up to 2 T

FY22 R&D:
tube response in full operation in **16x16 config**: cross talk, collection efficiency (B-field), gain uniformity, timing resolution; needs **reliability track record**

Good candidate for mRICH if B<=2 T
Good candidate for DIRC in all detectors

Commercial MCP PMTs

FY22 R&D effort
- Risk assessment of collection efficiency, timing resolution, cross talk and gain uniformity in B-fields over the full range of PMT response

Critically depends on complete readout solution in 16x16 configuration for each PMT (funding of HU efforts on PMT readout is crucial - part of DIRC proposal)

FY22 Budget (no overhead included) $54k total
Covers 4 weeks of B-field data taking and 4 weeks of setup and bench tests
JLab
- Cryogens $11k
- Small components $3k
USC
- Salary of 1 undergraduate student $5k
- 2-month travel to JLab for faculty and two students: $14k
- cost of one unit Photek MAPMT253 $16k
- rental scope $5k

FY23, FY24 R&D effort
- Any risk mitigation characterization that still needs to be performed