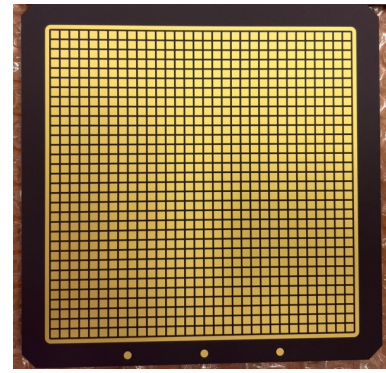
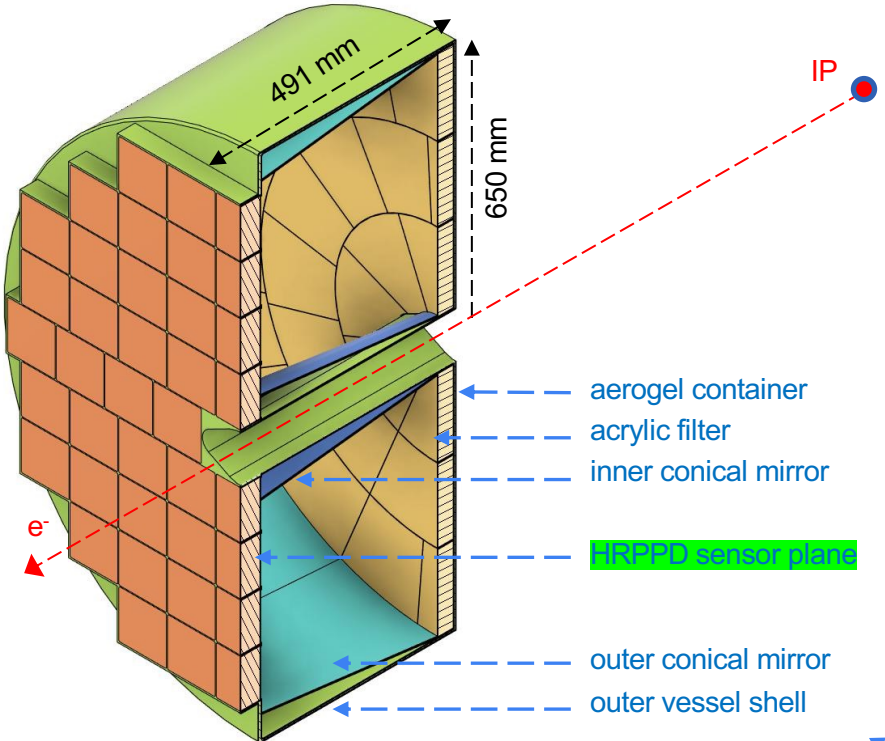


pfRICH photosensors: status & risk mitigation

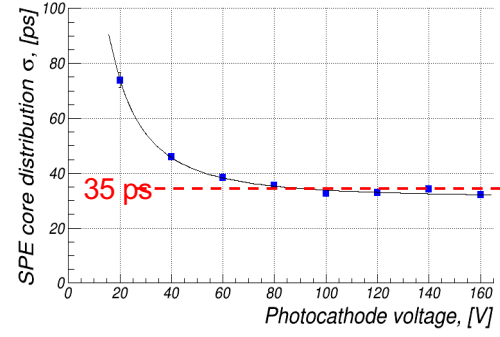
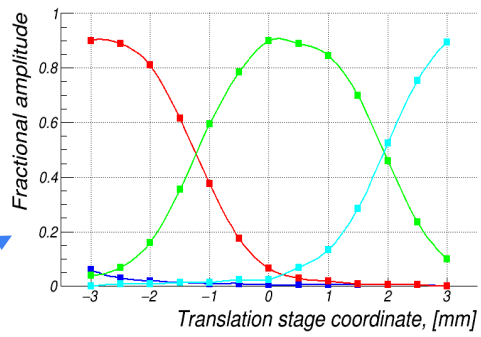
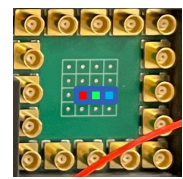
Alexander Kiselev (BNL)

ePIC TIC Meeting, November 6, 2023

ePIC pfRICH and its photosensors



DC-coupled HRPPDs by Incom Inc.



Charge spread & SPE timing resolution

EIC HRPPD order status and expectations

- PED contract between EIC (JLab) and Incom was signed end of June 2023
 - Phase #1 (moderate re-design to meet EIC needs): ~finished
 - Phase #2 (production of the first five tiles): ~started

- First five anode base plates are expected from Kyocera on November 15th
- The other five by the end of November (expect >50% sealing yield)
- **Samtec interposers: delayed, expected by December 6th**
- All other components are in place, at least for the first few tiles
 - **Sapphire windows are not happening in this iteration (even that they were received already)**

- An intermediate “Techtra HRPPD” is in works now (non-trivial base plate; gapped MCPs)
 - For this one we have proper interposers and a passive interface already
- The five EIC HRPPD production schedule looks like “mid December – mid March”

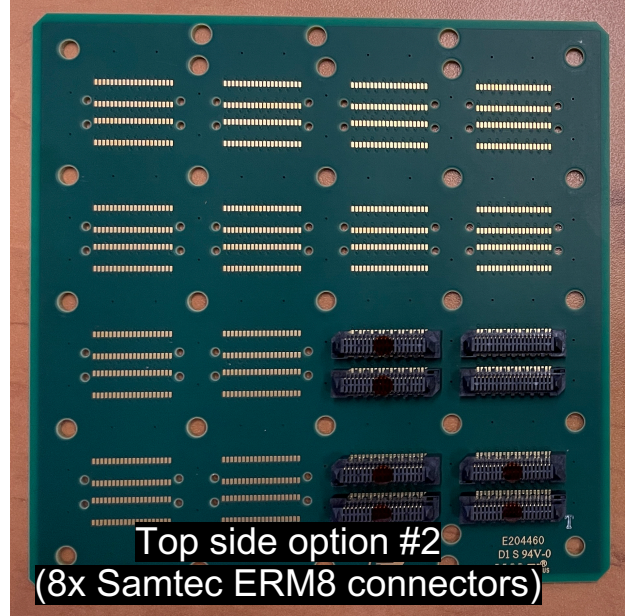
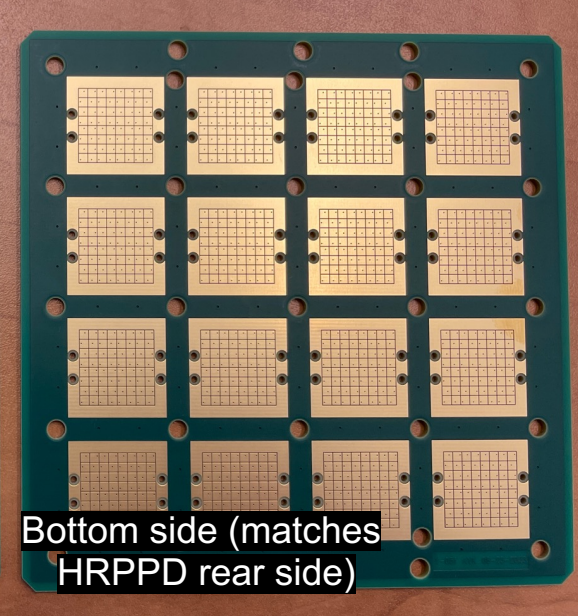
HRPPD evaluation activities & funding

| eRD110 / eRD114 / PED proposal topics | Status | Prospects |
|---------------------------------------|--|---|
| Samtec interposers | Ordered using FY23 money | |
| Passive interface | Not funded | Order using other resources and as part of MCP-PMT interfaces |
| ASIC backplane | Not funded | Ask for PED funding |
| B field studies at Argonne | HRPPDs removed; perform MCP-PMT evaluation instead | HRPPDs: do parasitically with the MCP-PMT studies |
| B field studies at INFN | Not funded | Ask for PED funding |
| Beam tests at Fermilab | Non-pfRICH part is funded | |
| Ageing studies at INFN | FY24 funding granted | |
| QE evaluation at Argonne | Not funded | |
| PDE evaluation at BNL | Not funded | Assemble a poor man's setup? |
| Timing upgrade at BNL | FY24 funding granted | |
| QA station at Yale | Not funded | |

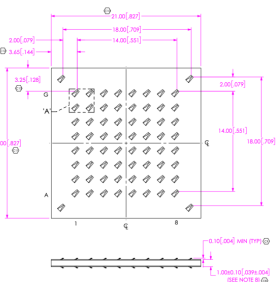
HRPPD evaluation procedure

- Should follow the specifications provided in the SOW
- Boundary conditions:
 - No time to ship any of the tiles to Europe and receive them back by pFRICH beam test in May 2024 (?)
 - Any work at INFN & in Glasgow can only start afterwards
 - Realistically, a primary evaluation (in spring 2024) can only happen at BNL (or JLab? or Yale?)
 - Magnetic field tests at Argonne: summer 2024
- A discussion in the eRD110 meeting last week
 - See what PED funds can we get
 - Come up with a plan on a time scale of a couple of weeks
- A full comprehensive study should not be expected
 - But a reasonable semi-automated spot check of all basic parameters we can certainly perform

Passive interface



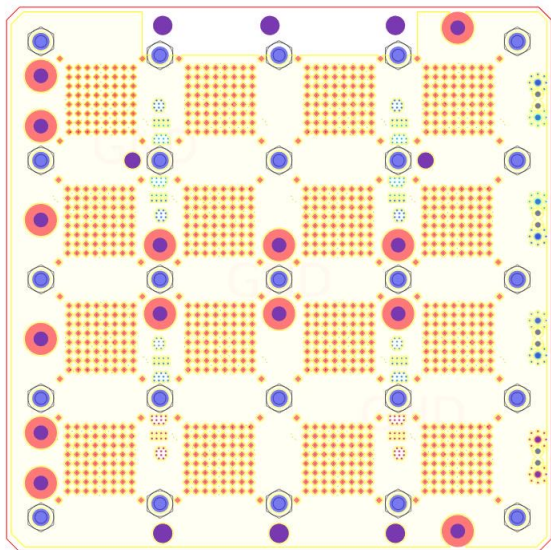
Enables ASIC interface to MCP-PMTs



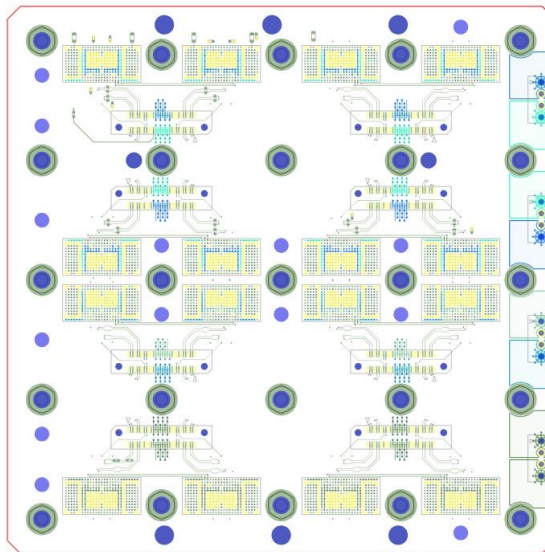
- Got 4 (option #1) + 1 (option #2) sets assembled
- Connectivity for any of the sixteen 8x8 pad fields (PO was not placed yet):
 - A set of [2x Samtec ERM8 -> MMCX] adapters, 32ch (4x8) connected at a time
 - A set of ERM8-based grounding caps for all other 8x8 fields

HGCROC3 ASIC / FPGA backplane

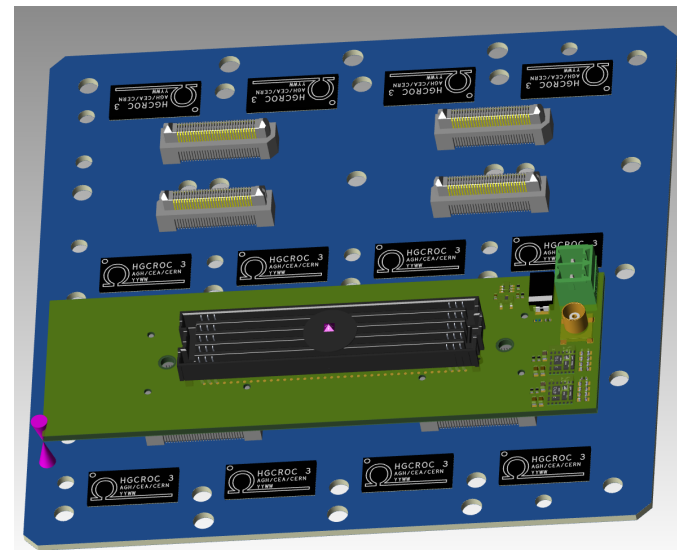
IN2P3 (OMEGA), Uni Debrecen, BNL, Oak Ridge



Bottom (HRPPD) side



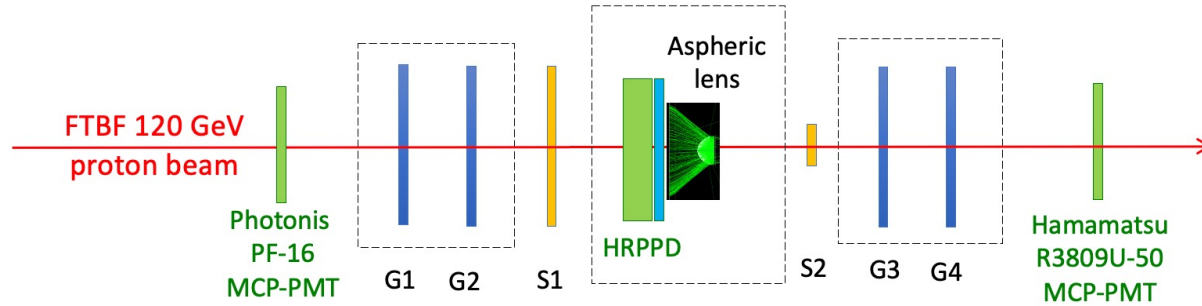
Top (ASIC) side



Passive interface to a KCU105 kit

- V0: expect ASIC & passive interface board designs to be finished by November 10
- V0: FPGA board PO will be submitted with a delay of ~2 weeks
- Assume there is still enough time for a second iteration (V1) before May 2024 pFRICh beam test

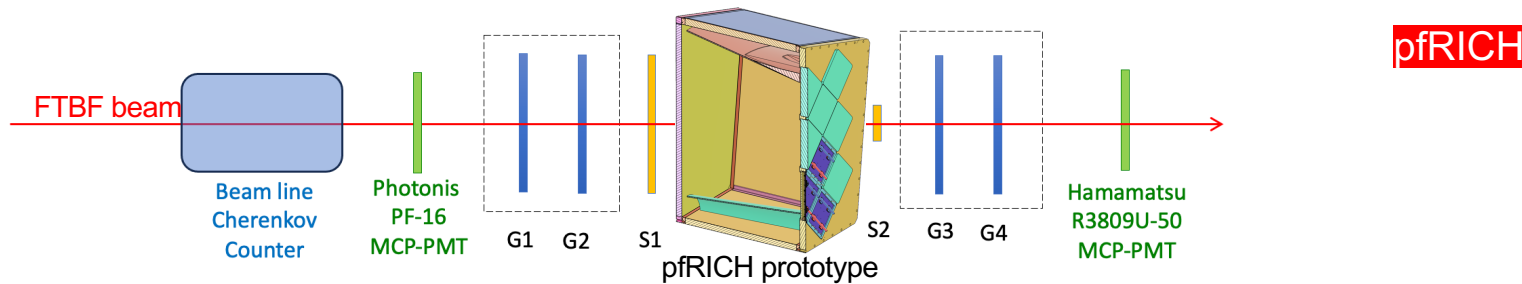
Beam test at Fermilab in May 2024: week #1



eRD110

- Use well-established technique and equipment, in a bare minimum setup with a single HRPPD
 - GEM tracker (G1 .. G4), scintillators (S1, S2) & reference MCP PMTs
 - High performance scope & 512 channels of V1742 DRS4 electronics
 - [Passive HRPPD interface board with MCX connectivity]
- **Main objectives:**
 - First beam test experience with the new EIC HRPPDs:
 - Excitation of a single sensor by multiple coherent single photons, evaluation of timing distribution tails (hpDIRC)
 - Performance in a mixed single- and multi-photon environment (pfRICH)
 - A direct assessment of HRPPD timing performance

Beam test at Fermilab in May 2024: weeks #2-3



- Recycle an already debugged “week #1” tracker & reference MCP-PMT setup, except for
 - Make use of a low momentum MT6 hadron beam (and a beam line Cherenkov counter)
 - Install a fully fledged pfRICH prototype (aerogel, mirrors, five HRPPDs as a “sensor plane”)
 - Make use of ~5k channels of newly built HGCROC3 ASIC electronics
- **Main deliverable** is a direct simultaneous demonstration of
 - $>3\sigma$ π/K separation reach up to ~ 7 GeV/c via aerogel Cherenkov photon imaging
 - HRPPD performance as a t_0 reference sensor for ePIC ToF subsystems
 - <50 ps timing resolution using aerogel Cherenkov photons
 - $O(10\text{ps})$ timing resolution using a sapphire window Cherenkov photon flashes

Risk mitigation (other MCP-PMTs)

| Item | Current status |
|-------------------------------|---|
| Photek Auratek | Ordered by JLab, passive interface being ordered |
| Photonis Planacon | Exists (?), passive interface to be developed by January 2024 |
| Test stand upgrade in Glasgow | Funded in full, contract in works |

