

Highlights of a pfRICH DSC meeting with the EIC Project on 2024/10/16

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ePIC TIC Meeting, October 28, 2024

Background information

- Invitation
 - “... we would like to meet with you this week, to discuss mechanical and electronics / readout integration questions, topics are services, cooling envelop issues and so on ...”
- Attendance on 2024/10/16
 - AK and Brian
 - Elke, Rolf, Beni and several other EIC Project scientists & engineers
- This presentation
 - Slides 3..12: authentic ones shown in the October 16th meeting
 - Slide 13: a post-meeting summary

Summary slide

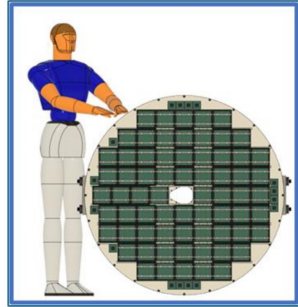
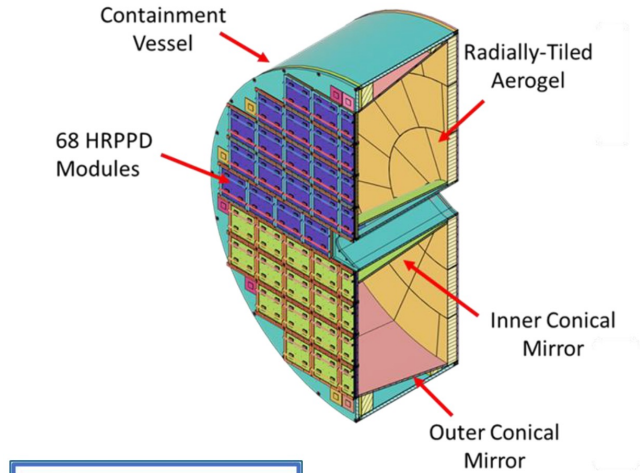
	Current status	Open questions / comments
Mechanical integration	Well understood	Rail system details; universal transportation cart; survey
High Voltage	Design exists*	HV divider or 5x HV levels?; HRPPD modifications; cabling
Low Voltage	Design exists*	Assumes EICROC in a 256ch configuration
Cooling system	Design exists*	Assumes 256ch EICROC with <3mW/ch
Gas system	Design exists*	Assumes purified nitrogen
Light monitoring	Conceptual design	Need a small PED investment to clarify the conceptual details
Readout electronics	Work in progress	EICROC vs FCFD; FEB layout; RDO design and placement

(*) means a CD-2 level readiness, under certain assumptions

Other topics / meetings

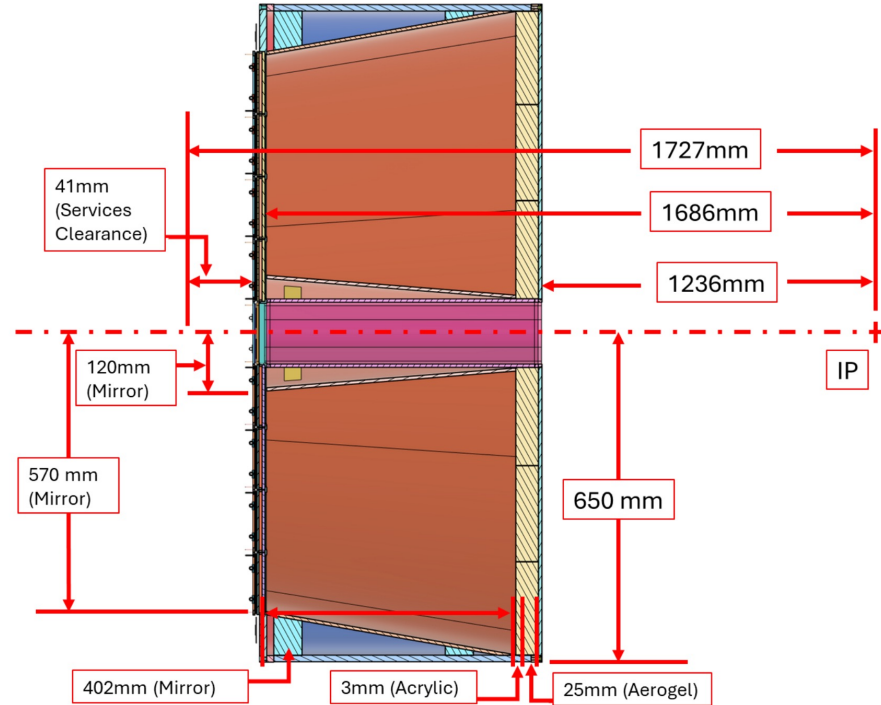
- Weekly Monday 1pm pfRICH engineering meetings
 - Alex E., Daniel, Beni, Sushrut, several other Stony Brook & BNL colleagues
- 2024/09/11 (EIC HRPPD evaluation & path forward)
 - Stimulating feedback obtained
 - Actively looking for other options of performing aging & B-field studies, etc
 - Talks by Tim, Raymond, Gerard: HRPPD electronics & HV distribution scheme
- 2024/10/15 (Fernando, Artur, AK): FCFD ASIC option for pfRICH
- 2024/10/15 (Alex E., Fernando, Beni, Prakhar, AK): pfRICH grounding & shielding

Mechanical integration

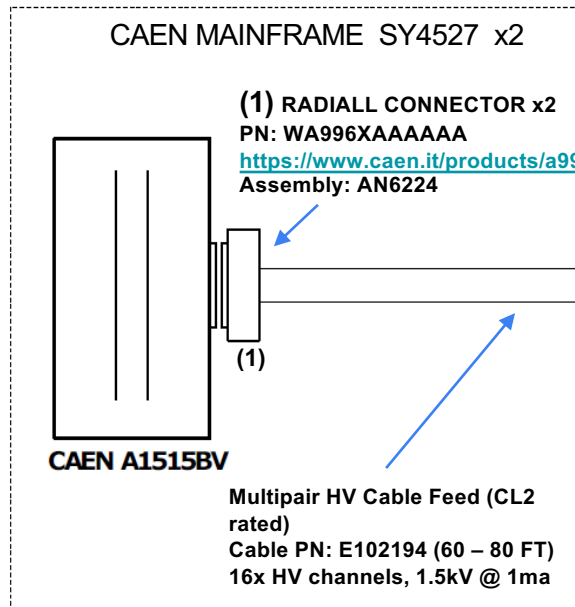


Major Components:

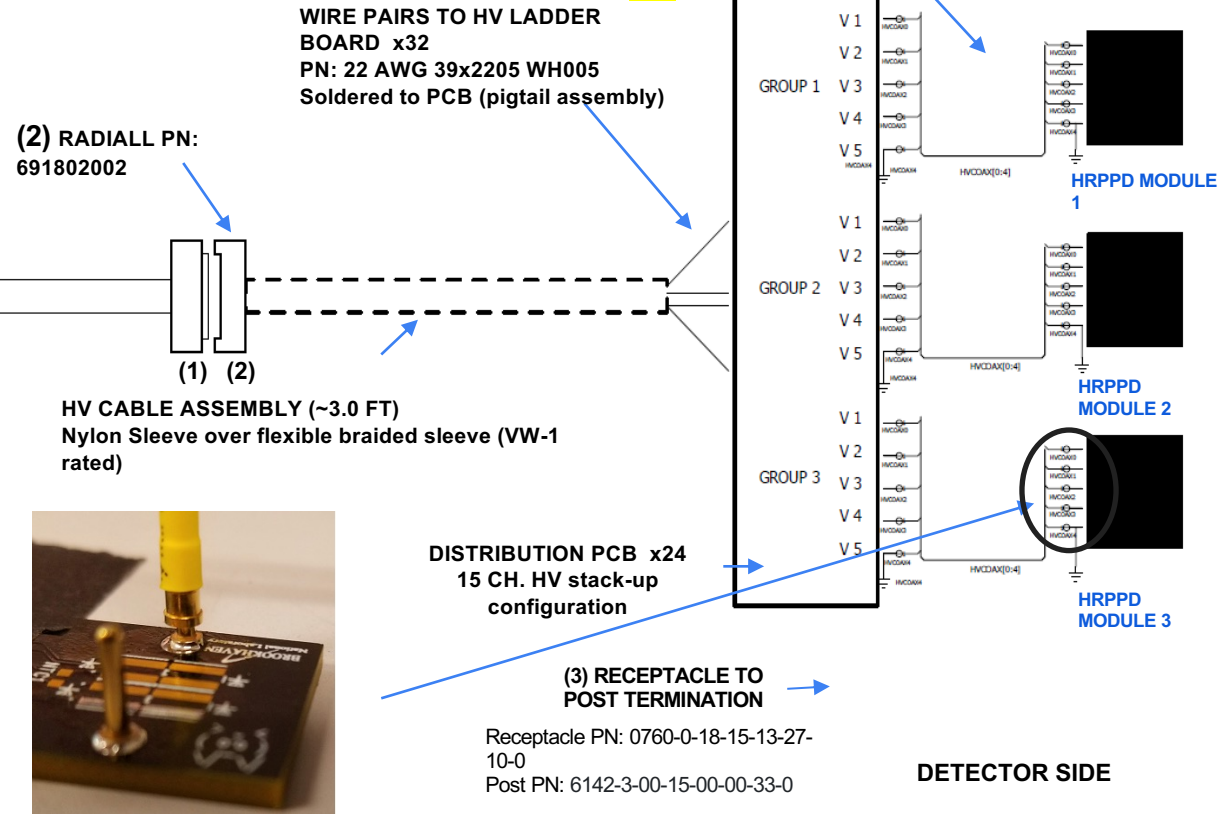
- Vessel
- Sensor Plane
- Mirrors
- Aerogel Wall



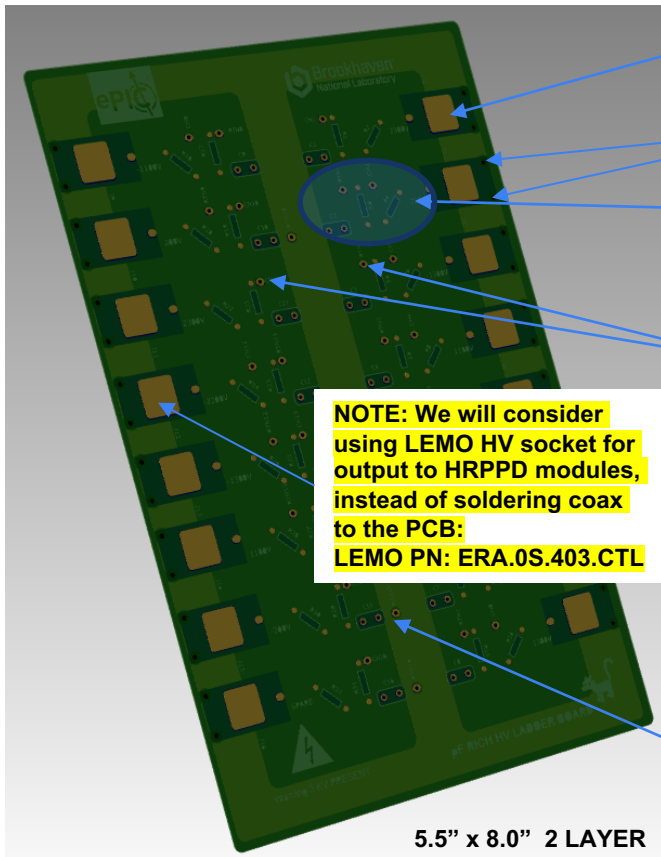
HV system



S. PLATFORM



HV system



**NOTE: We will consider using LEMO HV socket for output to HRPPD modules, instead of soldering coax to the PCB:
LEMO PN: ERA.0S.403.CTL**

5.5" x 8.0" 2 LAYER
PCB

Purpose: interface from CAEN HV cards on S.Platform to HRPPD modules

Next slide will show interconnection flow...

HV OUT J1 – J16
To HRPPD modules

Coax cable strain relief

Input RC filter

Input Cable Assembly

- HV Silicone wires solder from PCB bottom through-hole pads
- 22 AWG 39X2205 WH005 or Equ. VW-1 rated
- Wires are covered by braided foil and sleeving (1)
- Through hole solder joints get solder ball



HV Coax cable soldered to pad
Teledyne PN: 167-2896 26AWG



VW-1 rated outer
sleeving

- (1)
- Inner copper braided shield
 - Connects to A1515BV Module
 - 2 Ft length with Radiall connector disconnect

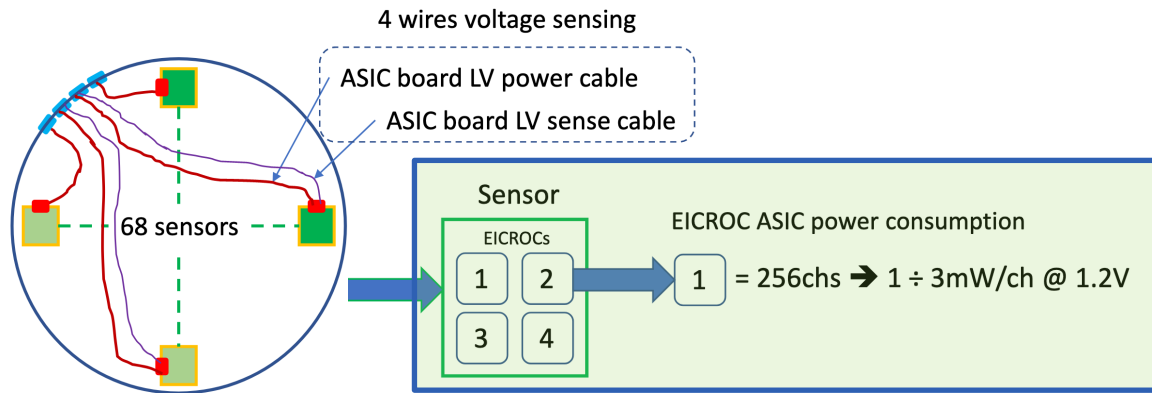
PCB

Details:

- Informal coating: IPC-CC-830A Chemtronics CTAR-12
- 3 mil (~ 2.3mm) thick coating
- Core material: ISOLA FR4 406
- 0.093 MIL thick board
- 2 LAYERS

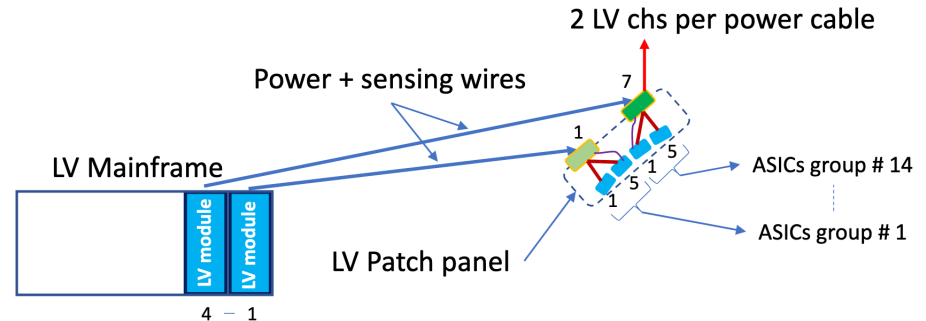
pfRICH HV Distribution “stack-up” Board

LV system



Wiener LV mainframe and modules

- Each Sensor
 - 4EICROCs x 256chs = 1024chs/sensor \rightarrow @3mW/ch \rightarrow ~3W/se
- Whole detector
 - 68sensors x 2.5A \rightarrow 170A@1.2V \rightarrow 204W
 - Add 20% extra current for the ancillary electronic components
 - 170A + 20% = 204A@1.2V \rightarrow 245W
 - Add 20% extra current for safety margin
 - 204A + 20% = **245A@1.2V \rightarrow 294W**



Cooling system

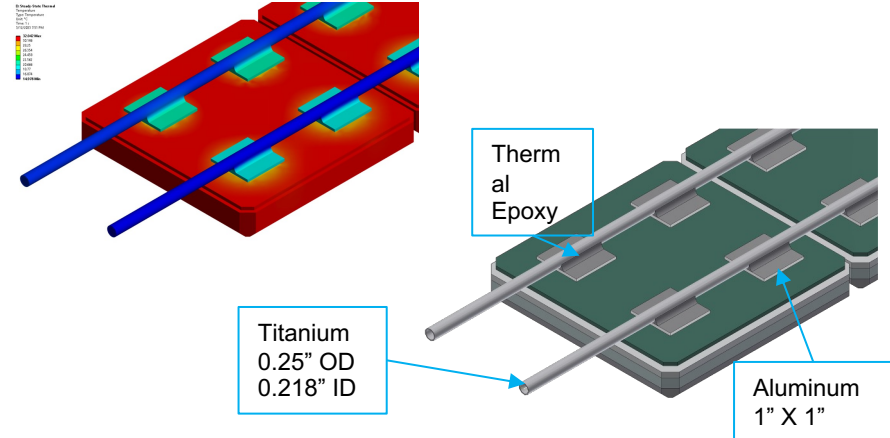
Off Detector

- Chillydyne Circulator
 - 8 lpm
 - -10 psi
 - 5°C to 40°C
- Polyscience Chiller
 - 9.8 l/min @ 43.4 psi
 - -20°C to 40°C $\pm 0.1^\circ\text{C}$
 - 800 W @ 10°C
- Distribution Panel
 - Flowmeters
 - Flow Transmitters

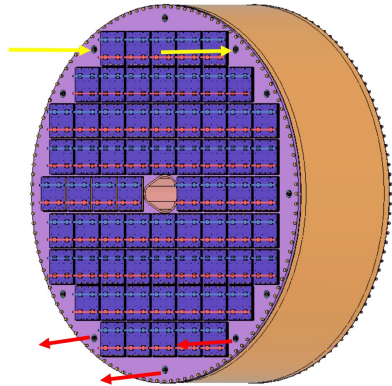
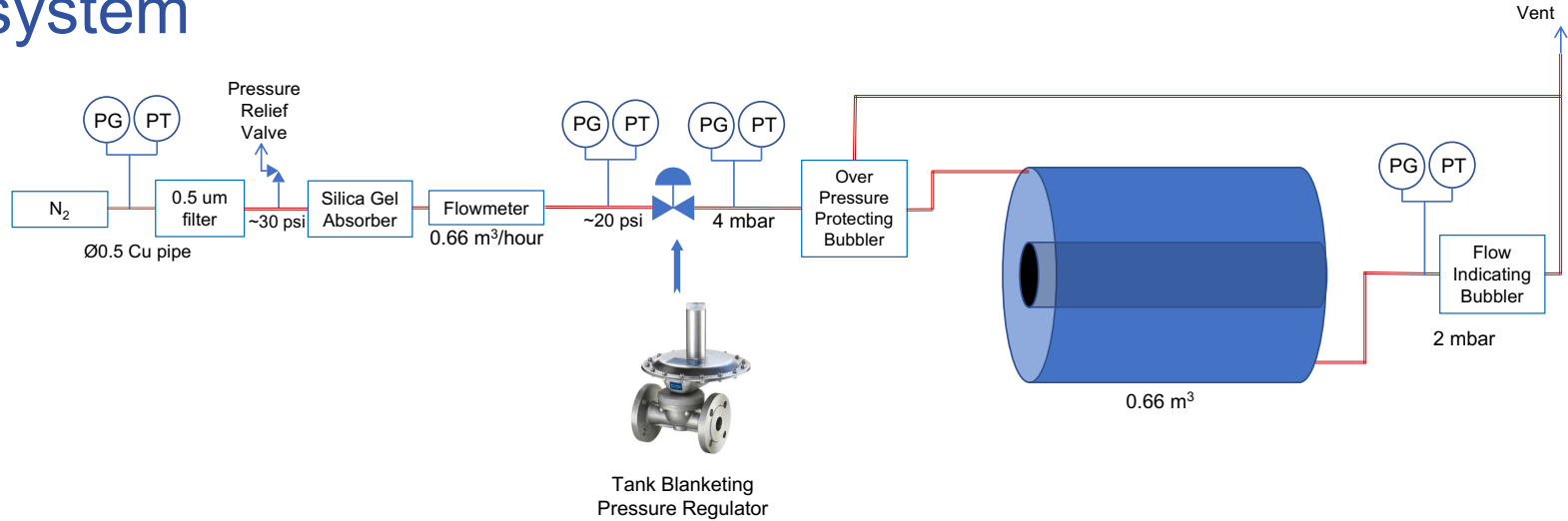


On Detector

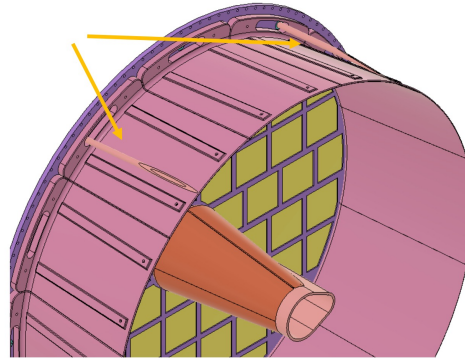
- Heat dissipation: 400W
- Tube @ $\Delta 2^\circ\text{C}$: ~3 lpm
- ΔP ~0.25 psi
- 9 Modules:
 - ~50W,
 - ~ $\Delta 17^\circ\text{C}$
 - Water ~ $\Delta 1.2^\circ\text{C}$



Gas system



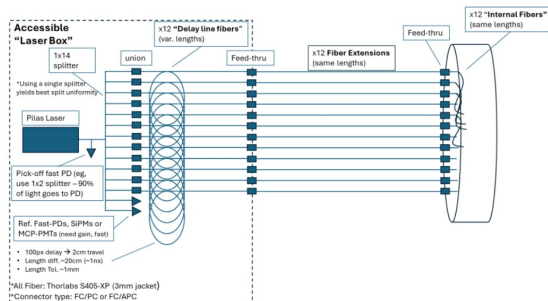
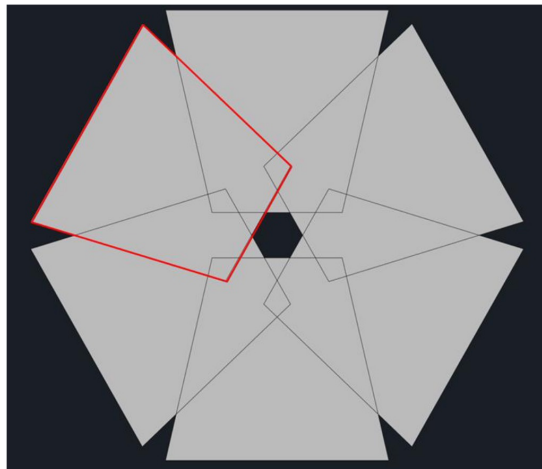
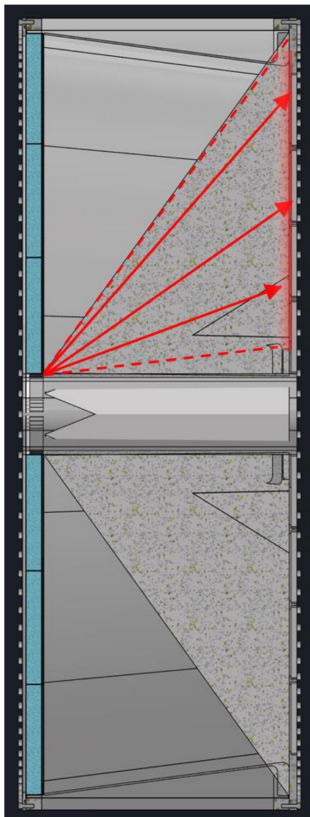
Two 3/8" ID Inlets, Three 3/8" ID outlets



Inlets have two long 3/8" ID tubes at the top with taper pointing to cylindrical vessel walls

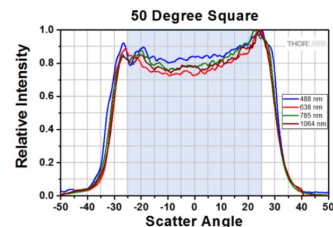
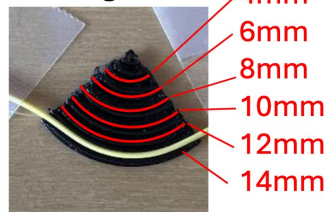
- Assume nitrogen only configuration
- One volume exchange per hour at a pressure 2-4 mbar
- Gas quality (industrial, ultra-pure,...) needs to be finalized

Light monitoring system



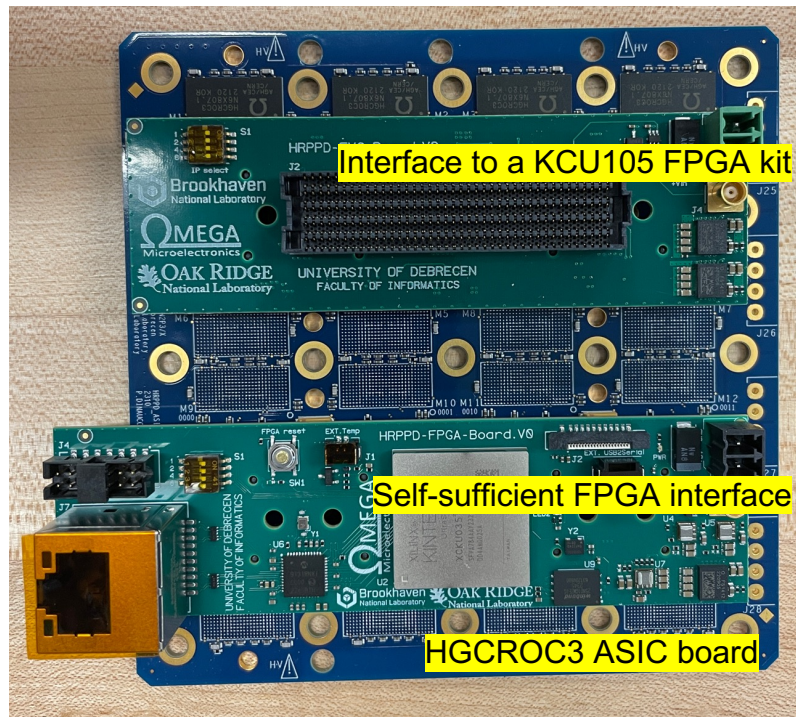
- ❑ Want a way to monitor HRPPD timing performance, signal amplitude, QE, and mirror reflectivity over the lifetime of the experiment
- ❑ Introduce an array of 12 optical fibers from the aerogel side of the vessel: 6 illuminate the photosensors directly and 6 bounce light off mirrors first
- ❑ Distance from fiber to photosensor determines timing and overlapping illumination areas are distinguished by time via fiber delays
- ❑ Appropriate square diffuser identified and fiber bending radius tests need to be performed

90 deg. bend

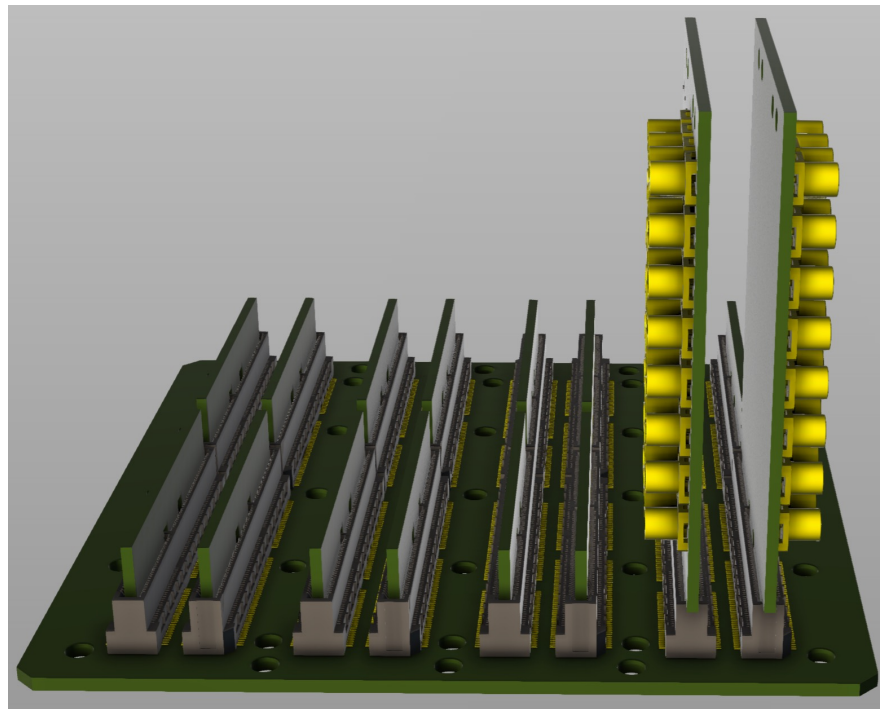


Readout electronics

Present concept: ASIC backplane



Alternative layout: passive backplane + plugin cards



- Present focus: using HGCROC3, prove that TOA/ADC architecture works well for HRPPDs; beam test
- Longer term topics: *some* EICROC flavor vs FCFD, on-board ASICs vs plugin cards, RDOs

Watch items list [based on a post-meeting summary]

- Need to resolve the remaining issues in the readout
 - HV distribution
 - EICROC vs FCFD [also power consumption]
- Cooling system layout
- Overall electronics and cabling layout
- Make sure the current ePIC model has the latest pfRICH implementation
 - All clearances correctly integrated?