pfRICH beam test at CERN PS / SPS in 2026

Alexander Kiselev

pfRICH DSC meeting, October 30, 2025

Background information

- Such beam tests have been discussed / requested a couple of years ago
  - Failed PED and eRD114 (pfRICH) proposals
  - Links to pfRICH meeting presentations: 01/18/2024 , 01/25/2024
  - Assumed Fermilab and HGCROC3 ASIC backplanes

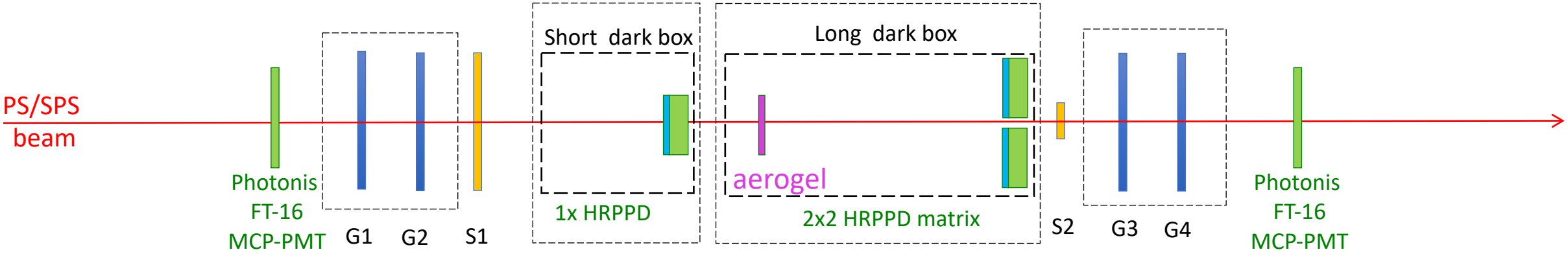
- FTBF @ Fermilab is going to be closed till 2030 or so
- CERN is going into a LS3 in Fall 2026
- Application for a 2026 CERN PS/SPS test beam is still possible
- There is no EIC Project money to fund such a trip
- There is no way we get 4-5k channels FCFD electronics on time
- We do not have much of a working experience at CERN within the pfRICH DSC

Essentially, it may be as simple as an "either now or never" situation

- So, what are we talking about?

Proposed pfRICH test beam setup @ CERN PS/SPS

- Request two weeks of running at either PS (low energy hadrons) or SPS (120 GeV protons)
- **Collaborate with dRICH people** (similar program, experience @ CERN, tracker, etc)
- Bring a simplified setup (no full-size vessel in particular): see plan C as discussed in 2024

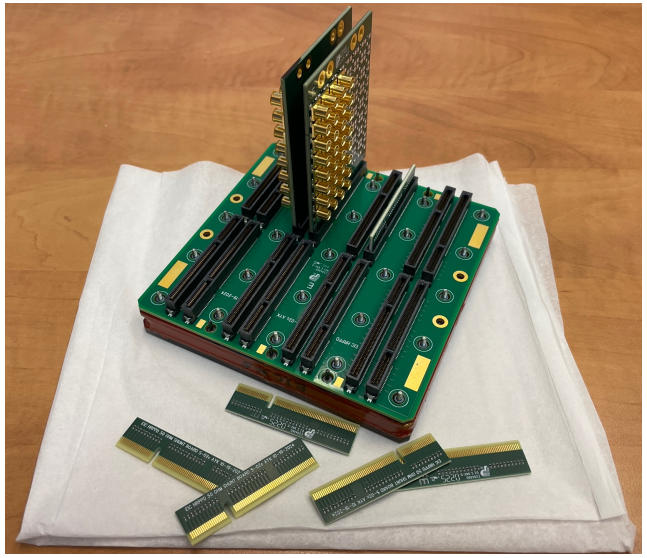


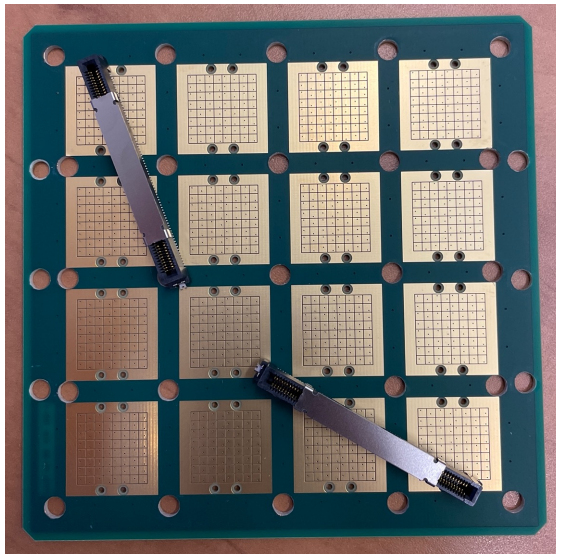
S1&S2: trigger scintillators; G1..G4: GEM trackers (may be problematic)

- **Funding**: look for “in-kind” contributions
- Would prefer late spring or early summer 2026 (but should be ready to take whatever available)

pfRICH test beam setup @ CERN PS/SPS

- **Frontend electronics**: use available 512 DRS4 channels
  - Equip about 1/8 of the “imaging” HRPPD pads (3-4 pad wide band along a saturated ring circumference)
    - Will require custom passive backplanes and more MCX adapters (<$10k total)





See also slide 7

- **Main deliverable** is a direct simultaneous demonstration of
  - Just <N_{pe}> and saturated ring radius resolution (if SPS), with and without an acrylic filter
  - π/K separation at ~7 GeV/c via imaging (if PS)
  - HRPPD performance as a t_0 reference sensor for ePIC ToF subsystems
    - Timing resolution using aerogel Cherenkov photons (2x2 HRPPD ring “imaging” dark box)
    - Timing resolution using Cherenkov photon flashes in HRPPD window (optional single HRPPD “timing” dark box)
- Also make use of a first iteration of FCFD frontend (few channels; proof of principle exercise)
- May want to add items of interest for hpDIRC

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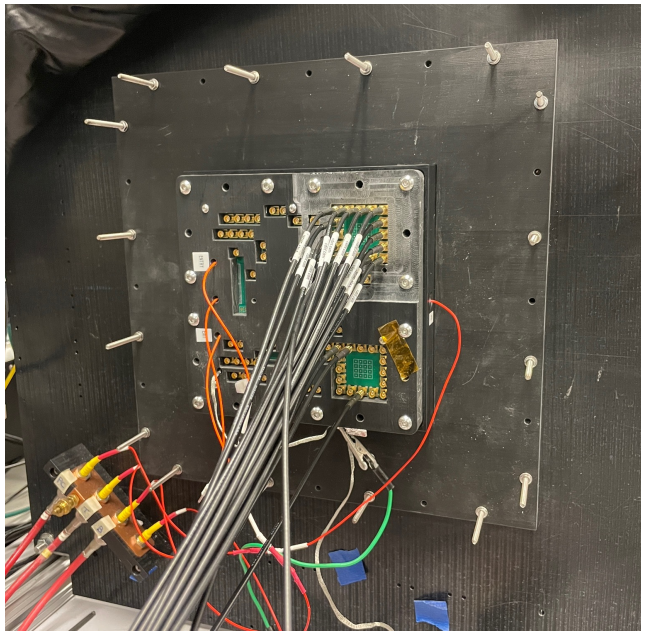
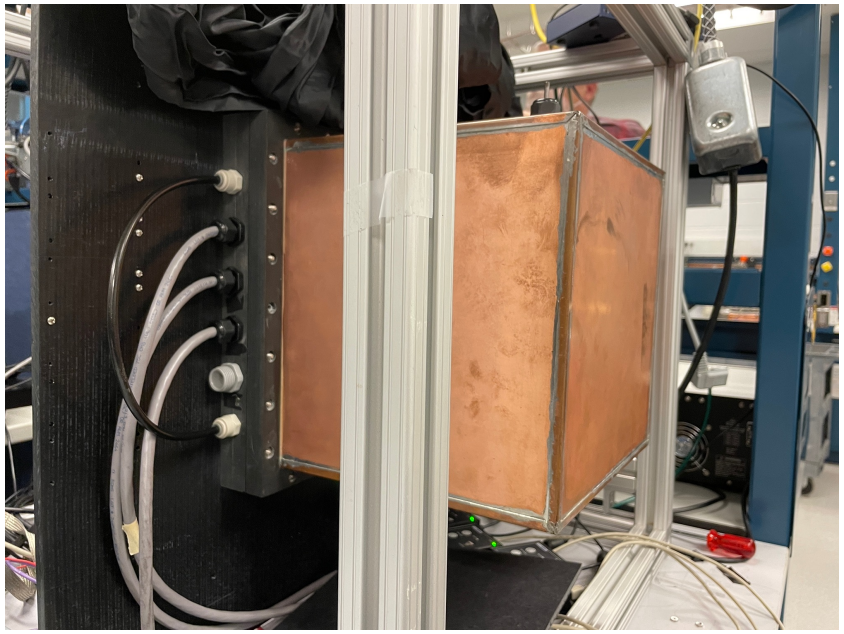
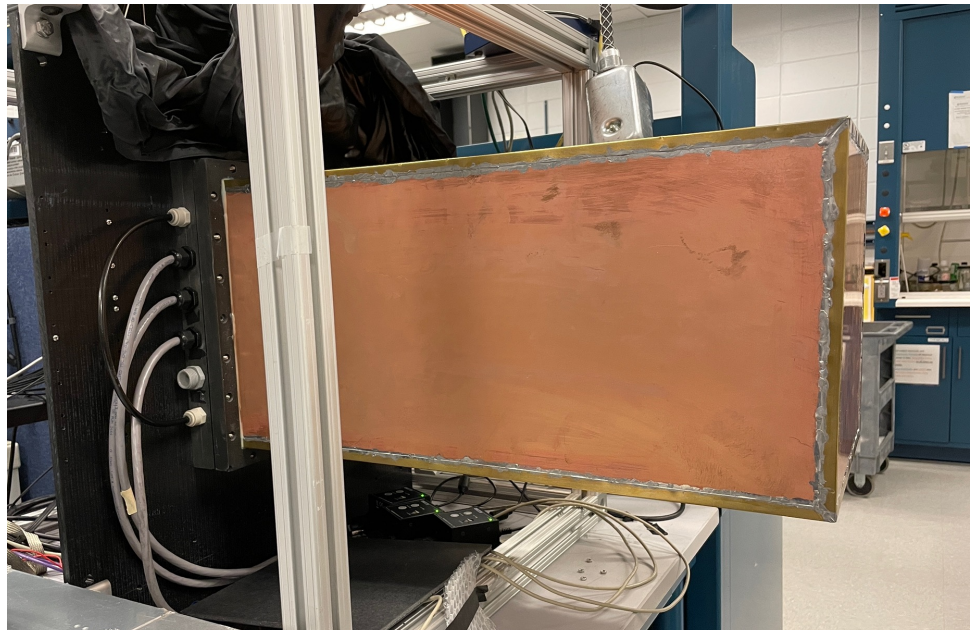
Existing dark boxes & mechanical assemblies



rear side plate with a single HRPPD



front side with a short dark box

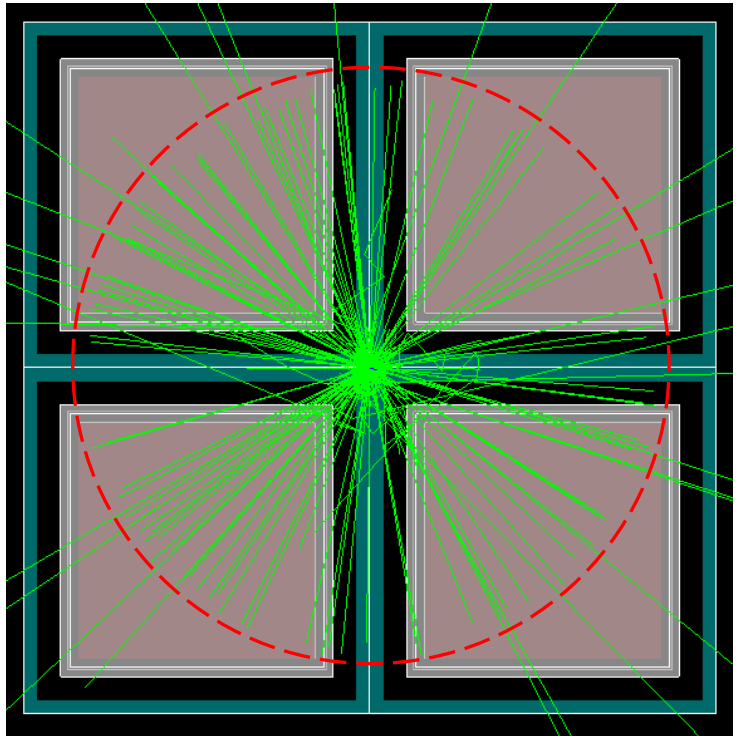


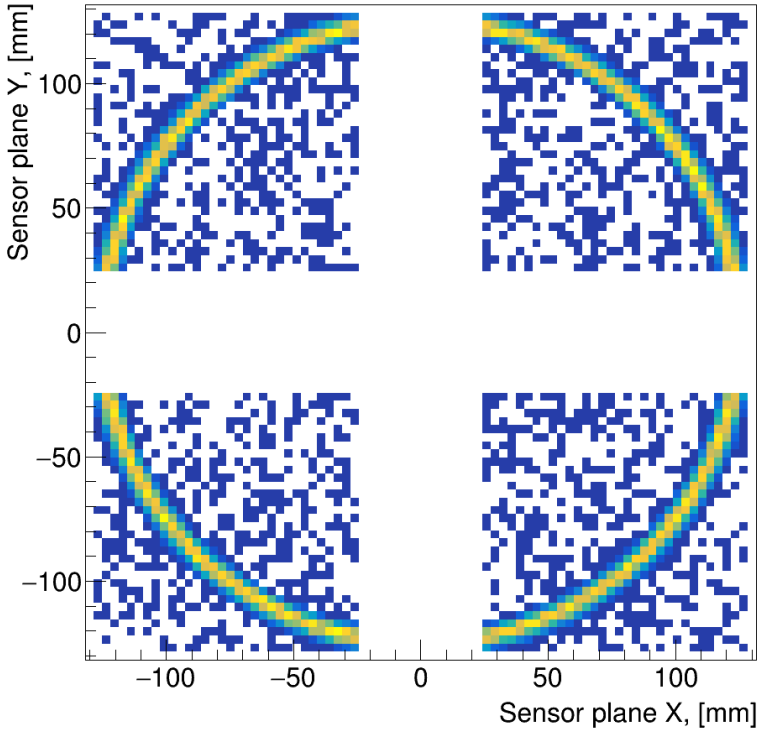
front side with a long dark box

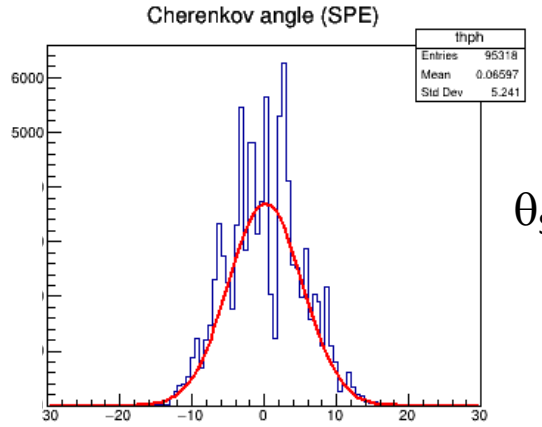
- A long dark box cover has length >20” and a square opening of 262mm x 262mm
  - Obviously sufficiently wide to place a 2x2 matrix of 120mm x 120mm HRPPDs …
  - … and see an un-obscured ring with a ~230mm nominal diameter
  - Obviously sufficiently long to imitate a ~400mm long pfRICH expansion volume

- Need to design and 3D print a 2x2 HRPPD mounting plate (considered a trivial task)

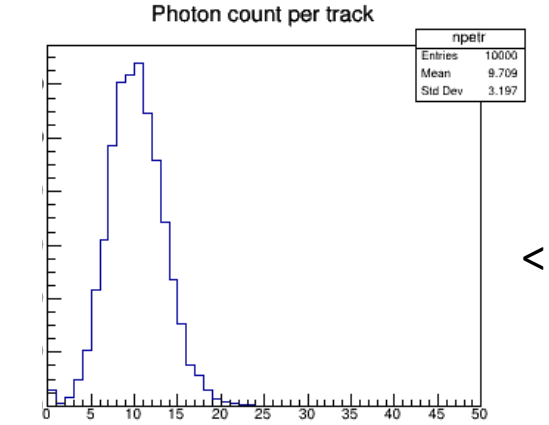
Expected performance



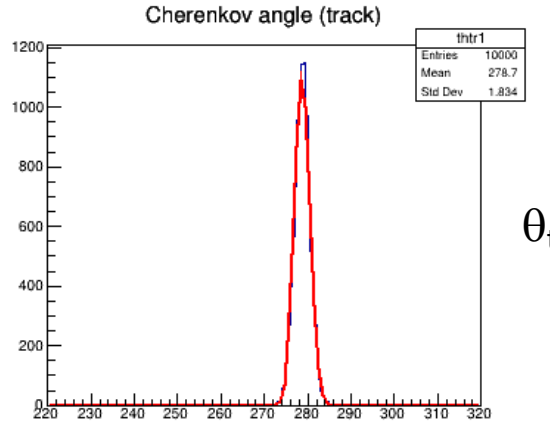




θ_{SPE} ~ 5.2 mrad



$\langle N_{pe} \rangle$ ~ 10 (?)



θ_{track} ~1.8 mrad

- A saturated ring barely fits into the box acceptance, but it fits
- $\langle N_{pe} \rangle$ ~ 10, assuming that HRPPD CE is ~0.7 (our safety factor)
- Track-level Cherenkov angle resolution ~1.8 mrad
  - Compare to ~7.5 mrad π/K separation at 7 GeV/c for <n> ~ 1.04