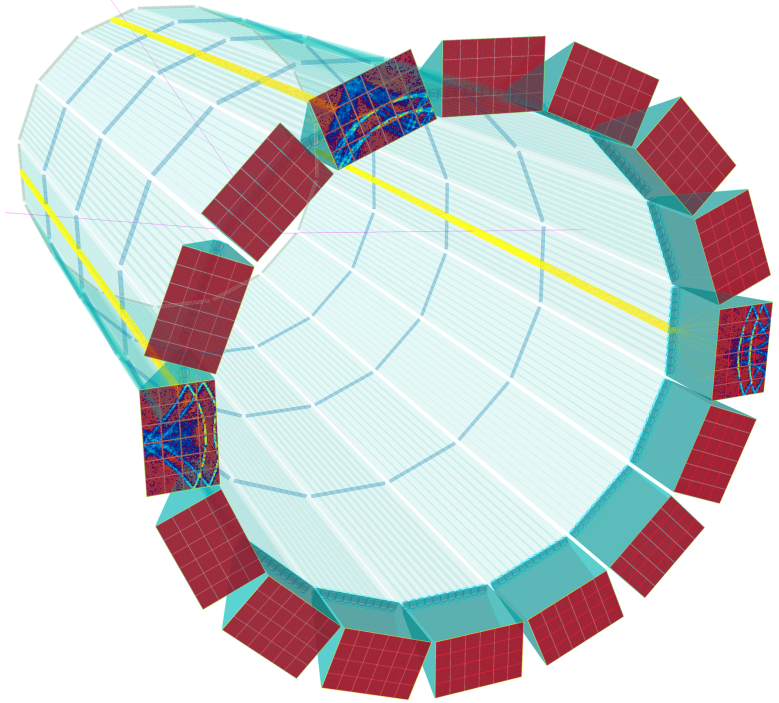
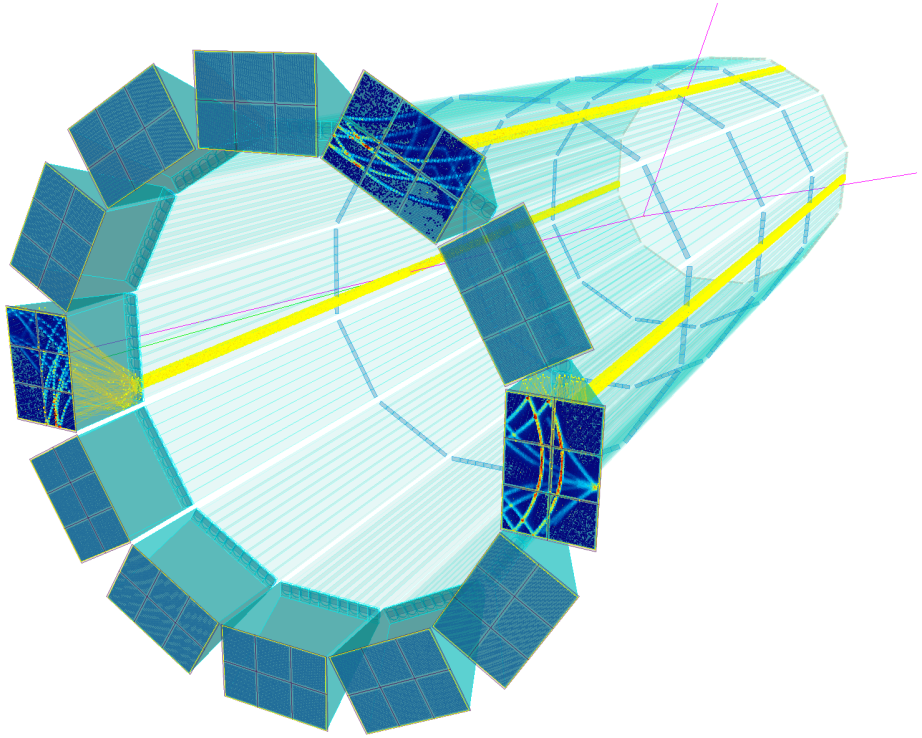
ePIC hpDIRC





Greg Kalicy

CUA

HPDIRC PHOTOSENSORS

hpDIRC sensor: Microchannel-Plate PMT

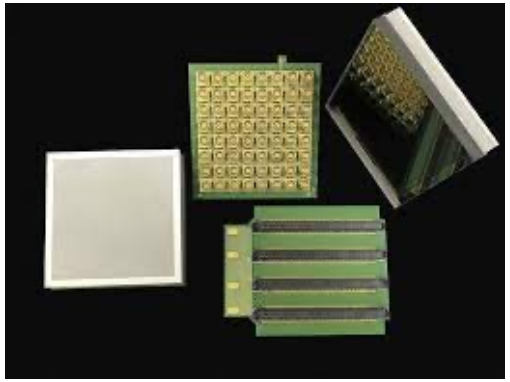
- Baseline sensor for hpDIRC: 2'' MCP-PMTs from Photonis* or Photek

  Potential solution: DC-coupled Incom HRPPD
  - Evaluation studies in preparation for both solutions (eRD110 + Jlab and pfRICH)
  - In the future hpDIRC Prototype at CRT can be used for prototype sensor studies
- MCP-PMTs in principle capable of meeting all hpDIRC requirements *(A. Lehmann@RICH2022)*
- Successful application in Belle-II TOP (Hamamatsu 1'' MCP-PMTs) and PANDA/EIC DIRC beam tests (Photonis 2'' MCP-PMTs)
- Lifetime-enhanced 2'' MCP-PMTs commercially available from Photonis* and Photek with suitable DC-coupled anode configurations
- Good performance of 8x8 anode versions in PANDA MCP-test stands *(see S. Krauss, RICH2022),* configuration with smaller anodes to be validated
- Ongoing development at Incom: 12 cm-sized Gen III HRPPDs, 32x32 anodes

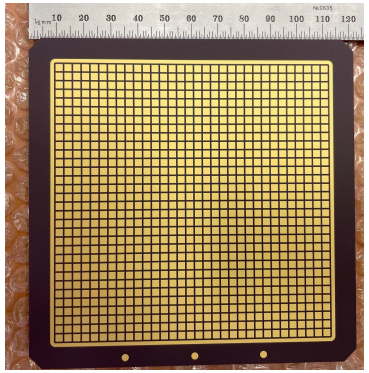
  Active project, supported by EIC PED funds, baseline sensor for ePIC pfRICH

PHOTONIS XP85122-S

Photek MAPMT 253



INCOM Gen III HRPPD prototype (front/back view)

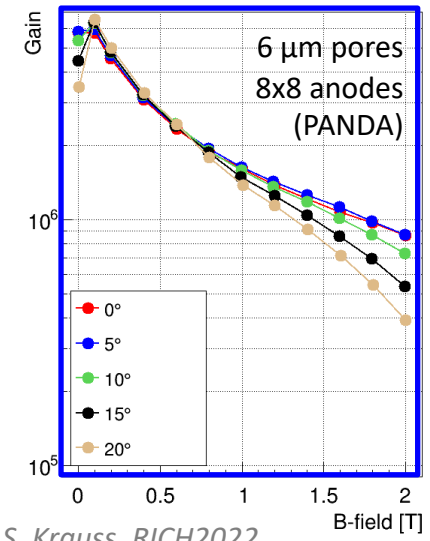


PHOTOSENSORS

hpDIRC sensor requirements

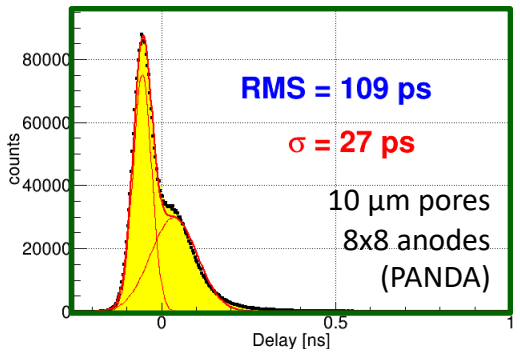
- Single photon sensitivity in ePIC magnetic field: 10^6 gain at ~ 1T
- Fast timing for single photons: timing precision (rms) < 100 ps
- Large active area ratio for tiled sensors: goal > 75%
- High PDE in visible range: goal > 25% at 400 nm
- Small pixels: anode pixel size < 3.5 mm
- Tolerance for high photon rates: goal > 0.5 MHz/cm^2
- Tolerance for high occupancies: up to 200+ photoelectrons per particle, need DC-coupled anodes
- Long lifetime: goal > 10 C/cm^2

PHOTONIS MAPMT 253

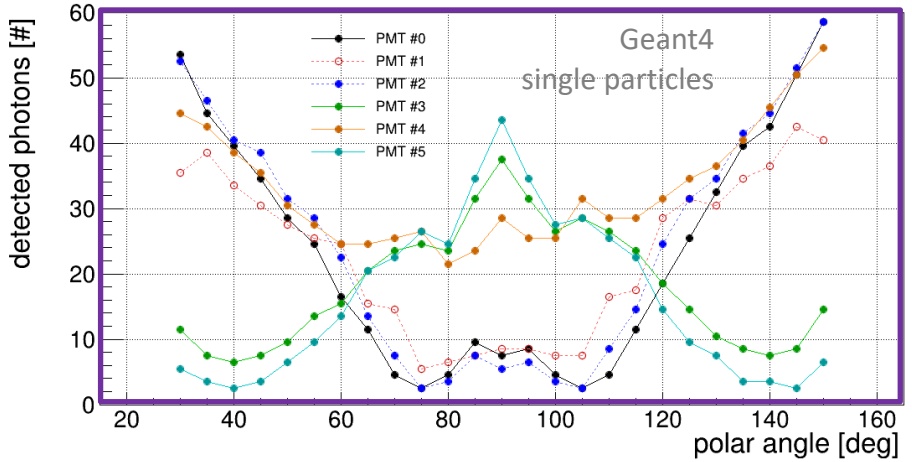


S. Krauss, RICH2022

PHOTONIS XP85012-S



Expected number of photoelectrons per particle per 12 cm x 12 cm sensor



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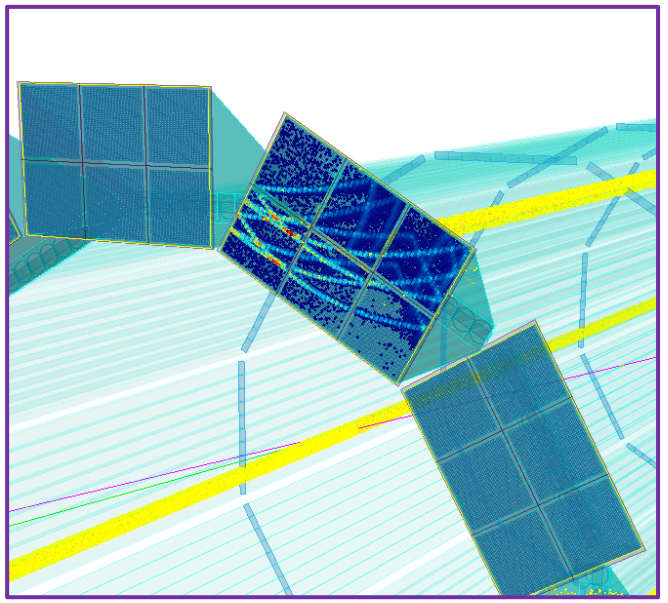
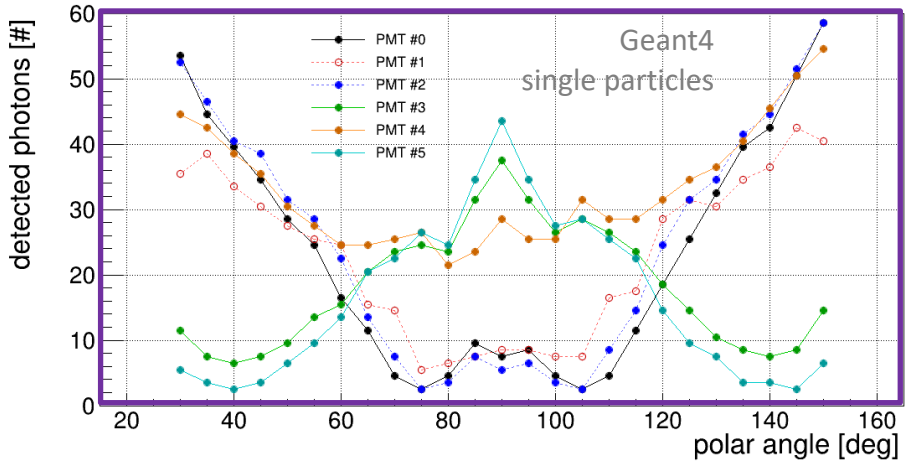
hpDIRC Simulation with Incom HRPPD



Expected number of photoelectrons per particle per 12 cm x 12 cm sensor



PHOTOSENSORS

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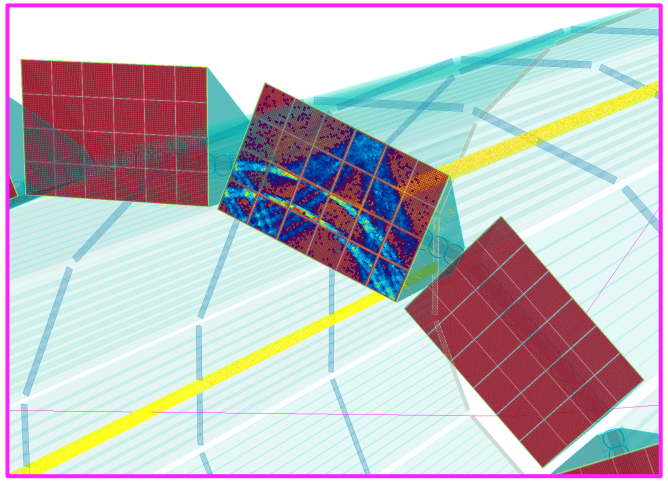
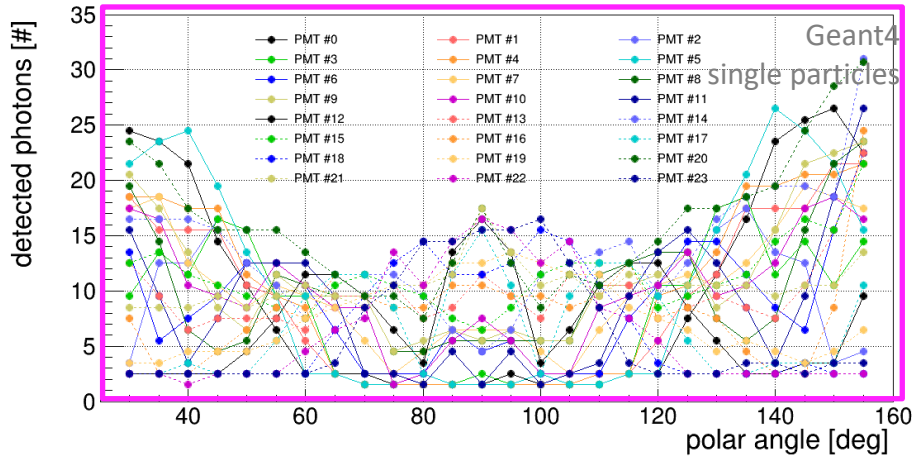
hpDIRC Simulation with baseline 2'' MCP-PMTs



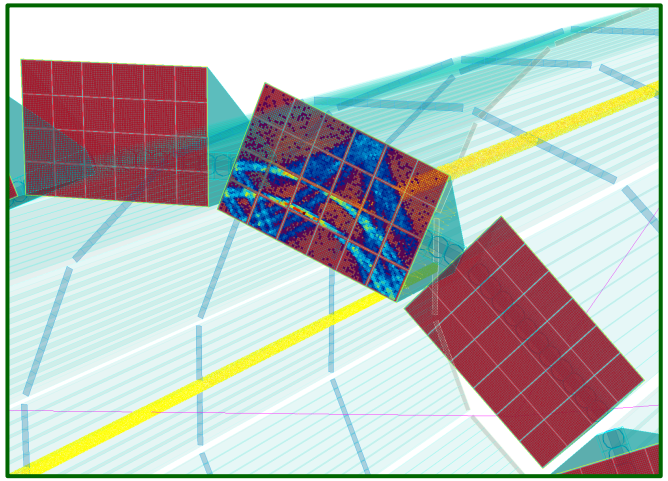
Expected number of photoelectrons per particle per 6 cm x 6 cm sensor



HPDIRC PHOTOSENSORS

- Measurements of all three types of sensors are in preparation by Glasgow group
- Main goals:
  - Demonstrate that the tubes do not suffer from coherent oscillations at high intensities
  - Single-photon timing precision (both transit time spread and rms timing)
- Photek tube and adapter board purchased by Jlab
- Photonis tube potentially available from eRD14 effort
- HRPPDs purchased for tests, will need scheduling to be shared between groups
- Future tests:
  - Collection and Quantum efficiency
  - Uniformity
  - Integration with EICROC

hpDIRC Simulation with baseline 2'' MCP-PMTs



hpDIRC Simulation with Incom HRPPD