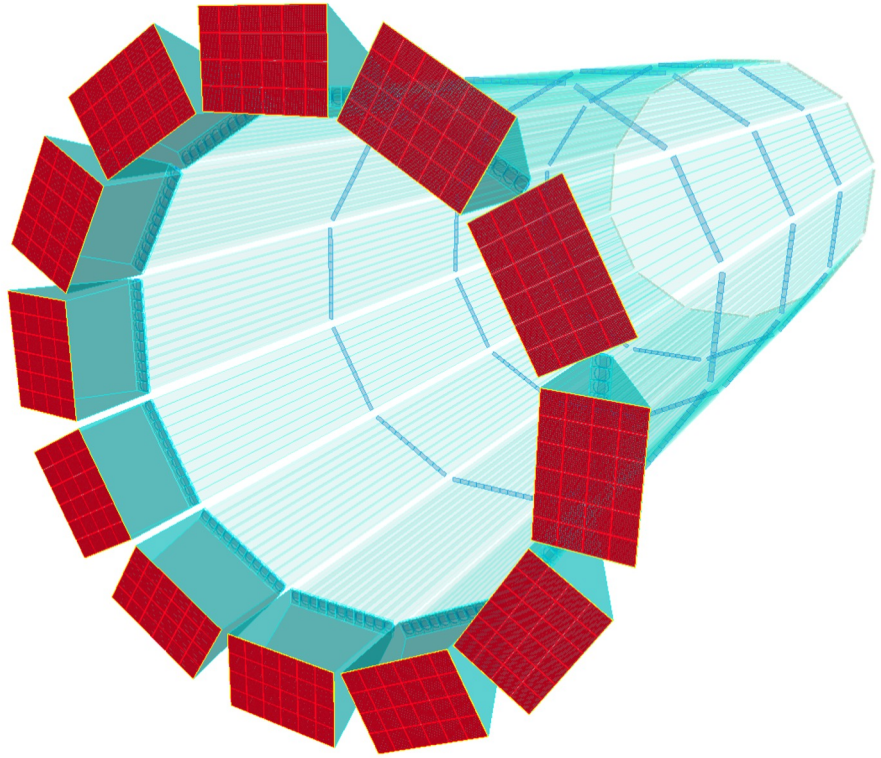
Tests and QA for ePIC hpDIRC Detector



Greg Kalicy

CUA

January 21st, 2026

ePIC Collaboration Meeting

CUA GSI Jefferson Lab Old Dominion Stony Brook University University of South Carolina Wayne State University William & Mary University of Glasgow

HPDIRC DESIGN

Radiator bars:

- Barrel radius: 780 mm, 12 sectors
- 10 long bars per sector, 4500 mm x 35 mm x 17 mm (L x W x T)
- Long bar: 4 bars, glued end-to-end,
- Short bars made from highly polished synthetic fused silica
- Flat mirror on far end

Focusing optics:

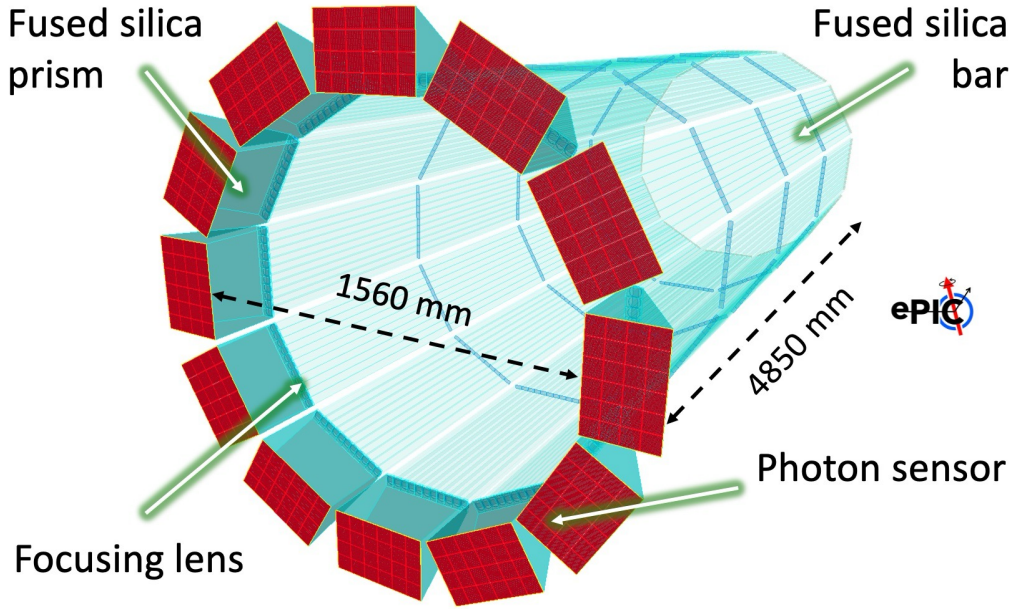
- Radiation-hard 3-layer spherical lens (sapphire)

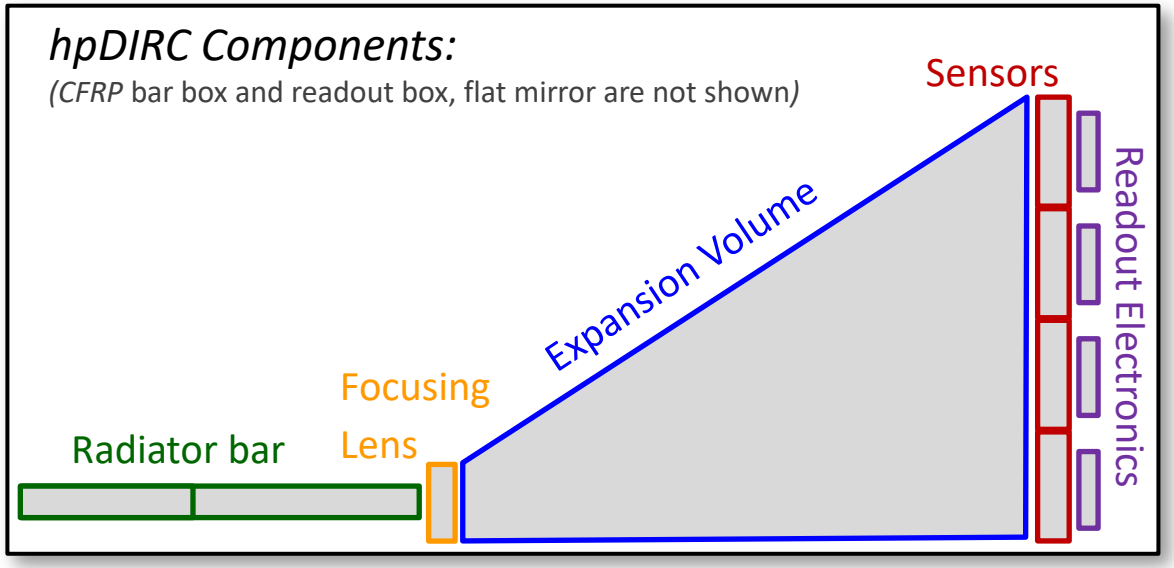
Expansion volume:

- Solid fused silica prism: 25 x 35 x 30 cm^3 (H x W x L)

Readout system:

- MCP-PMT Sensors (Photek/Incom)
- ASIC-based Electronics (FCFD)

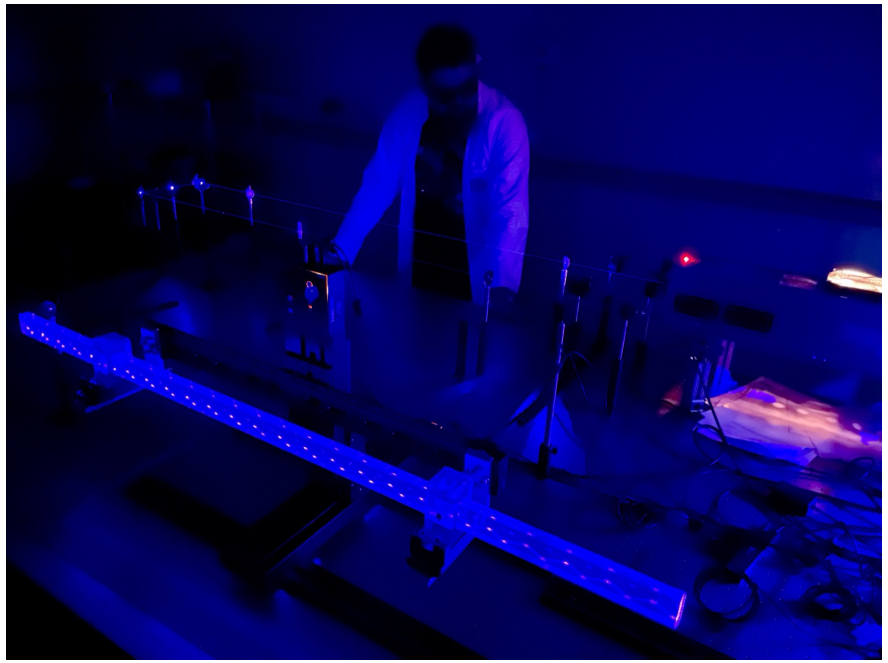


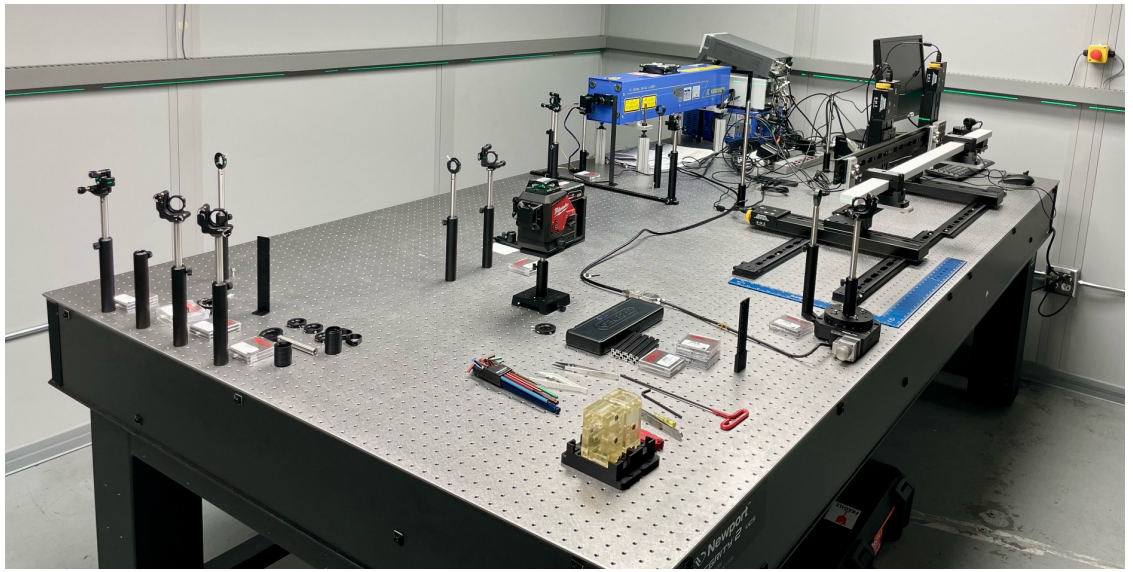


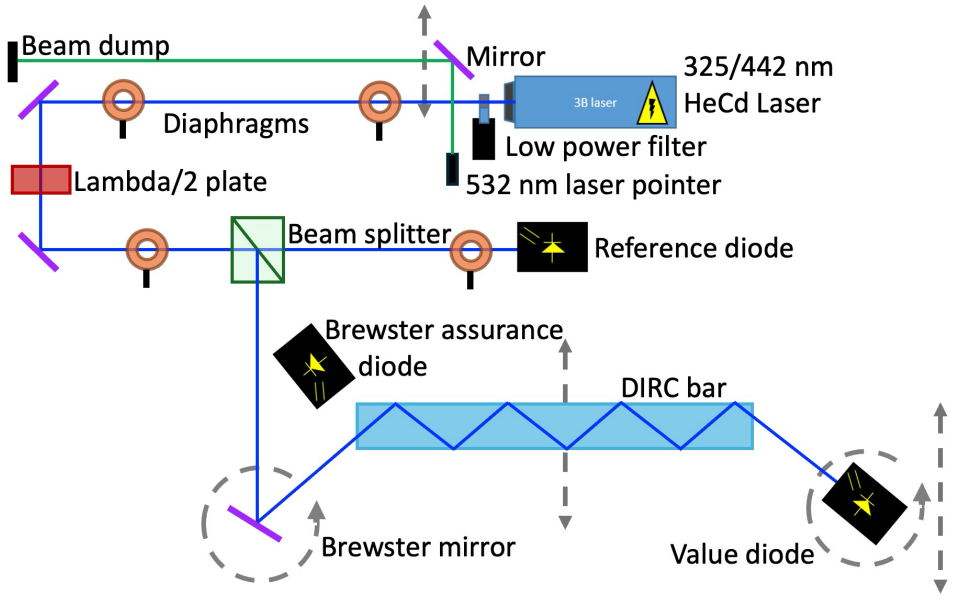
BARS

- Laser setup built at JLab based on similar setup at GSI for PANDA Barrel DIRC
- Reflection coefficient measurement allows to evaluate surface quality of the bars with sub nm precision
- HeCd laser with two wavelengths is used (325 nm, 442 nm)

Measurement with 442 nm laser

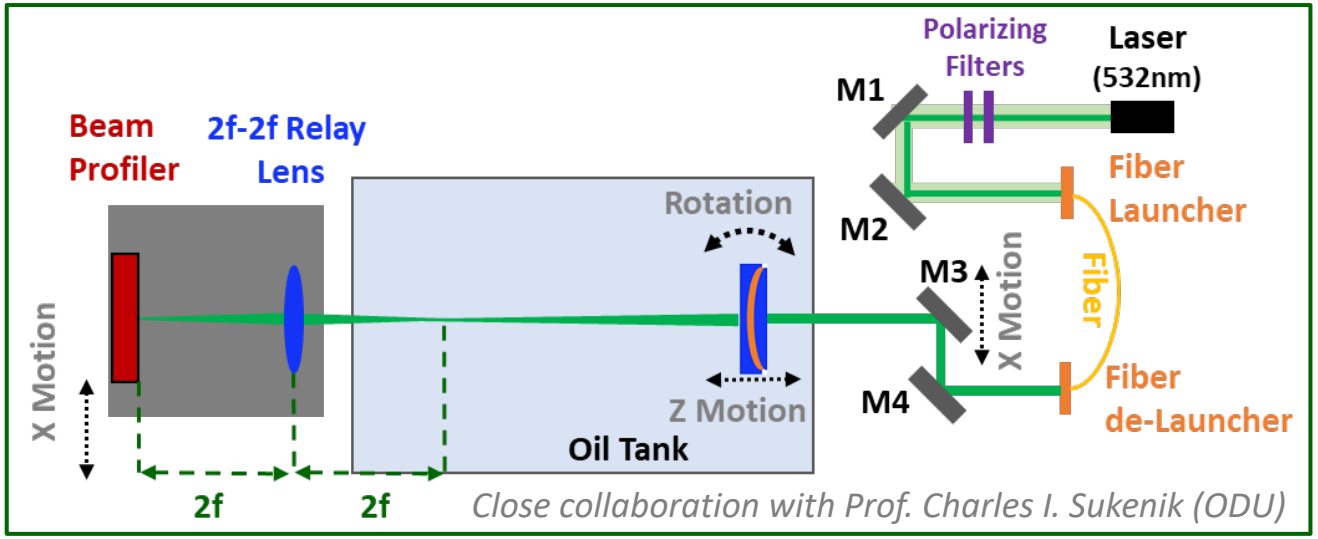




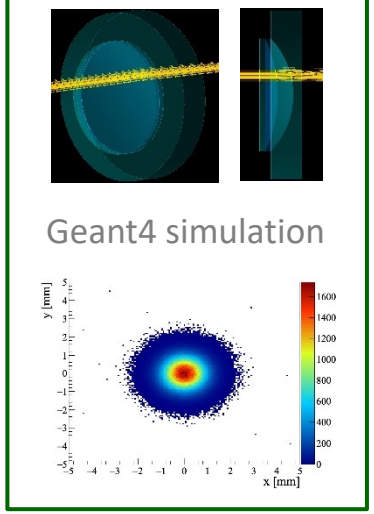


LENSES

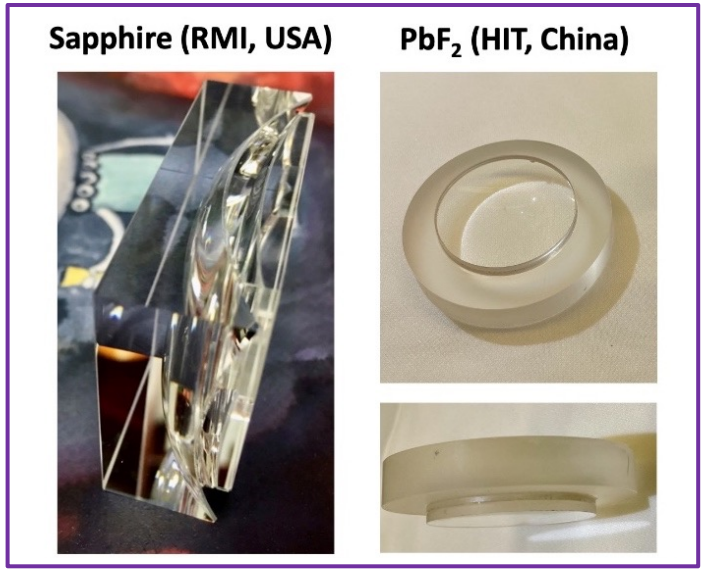
- Detailed scans of lens focusing properties with laser in optical lab at ODU



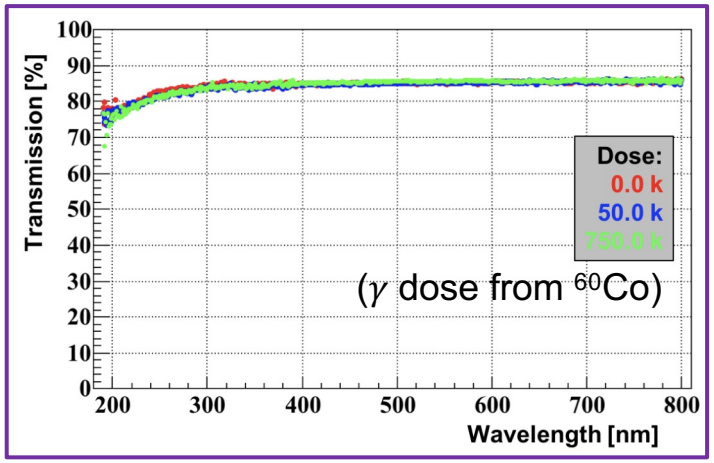
Close collaboration with Prof. Charles I. Sukenik (ODU)



Radiation-hard 3-layer lens prototypes

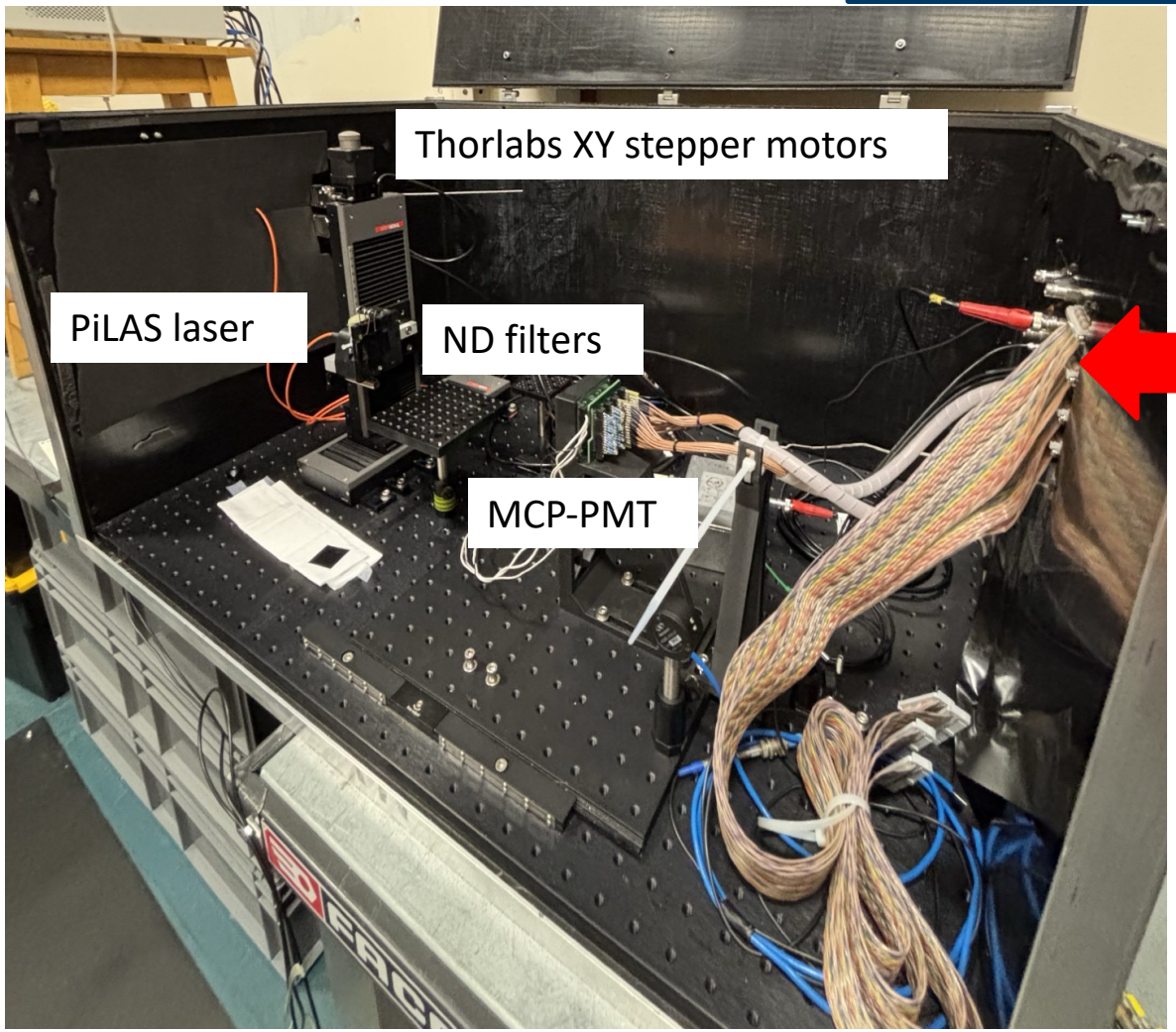


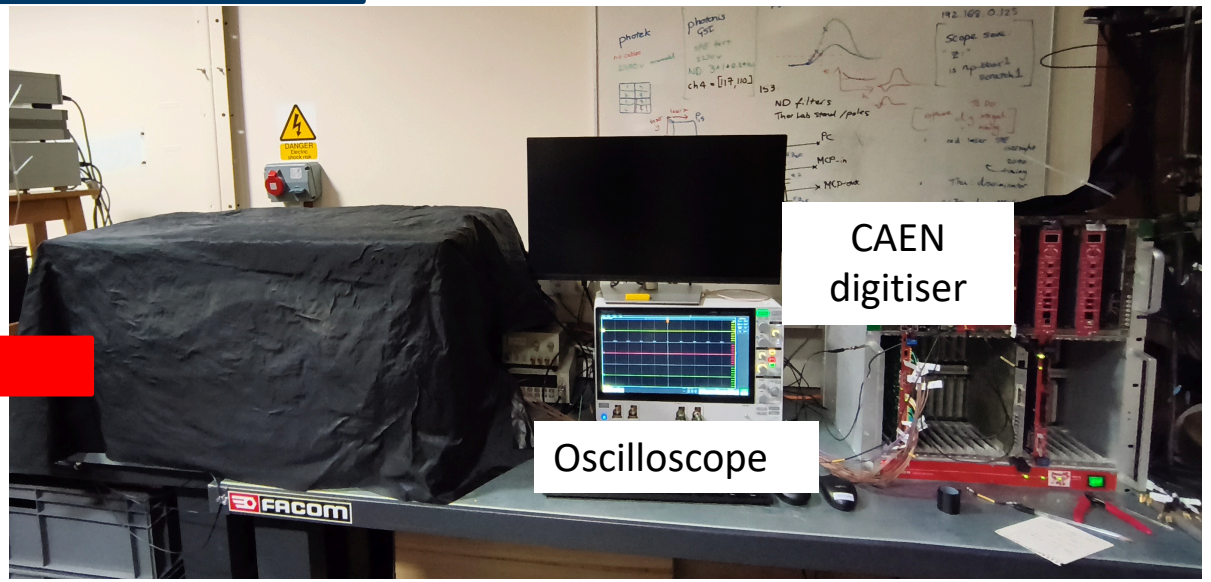
Radiation hardness of sapphire



SENSORS

Andrew Cheyne
Rachel Montgomery
Kathleen Ramage
University of Glasgow





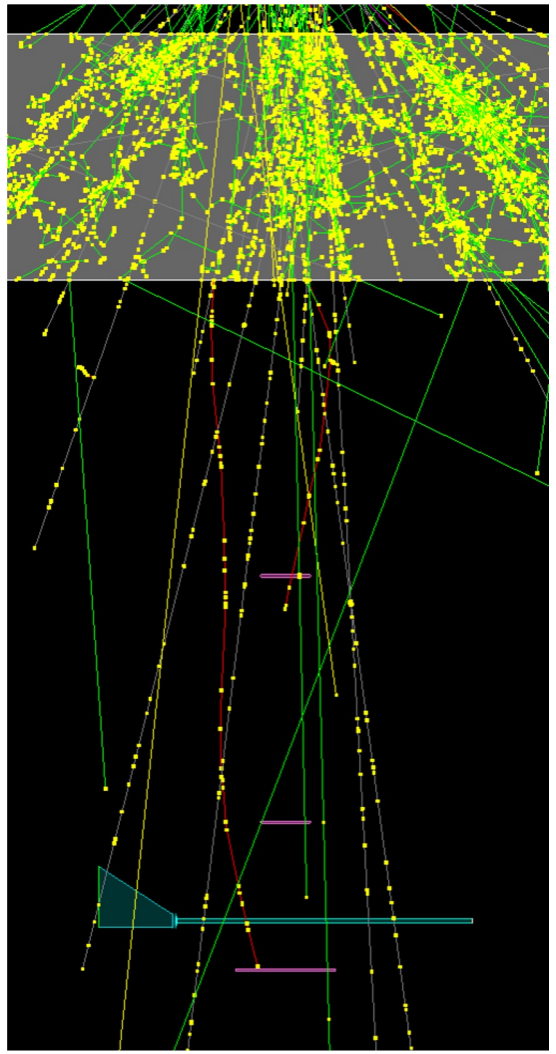
Validation of Components

Cosmic Ray Telescope (CRT) at SBU

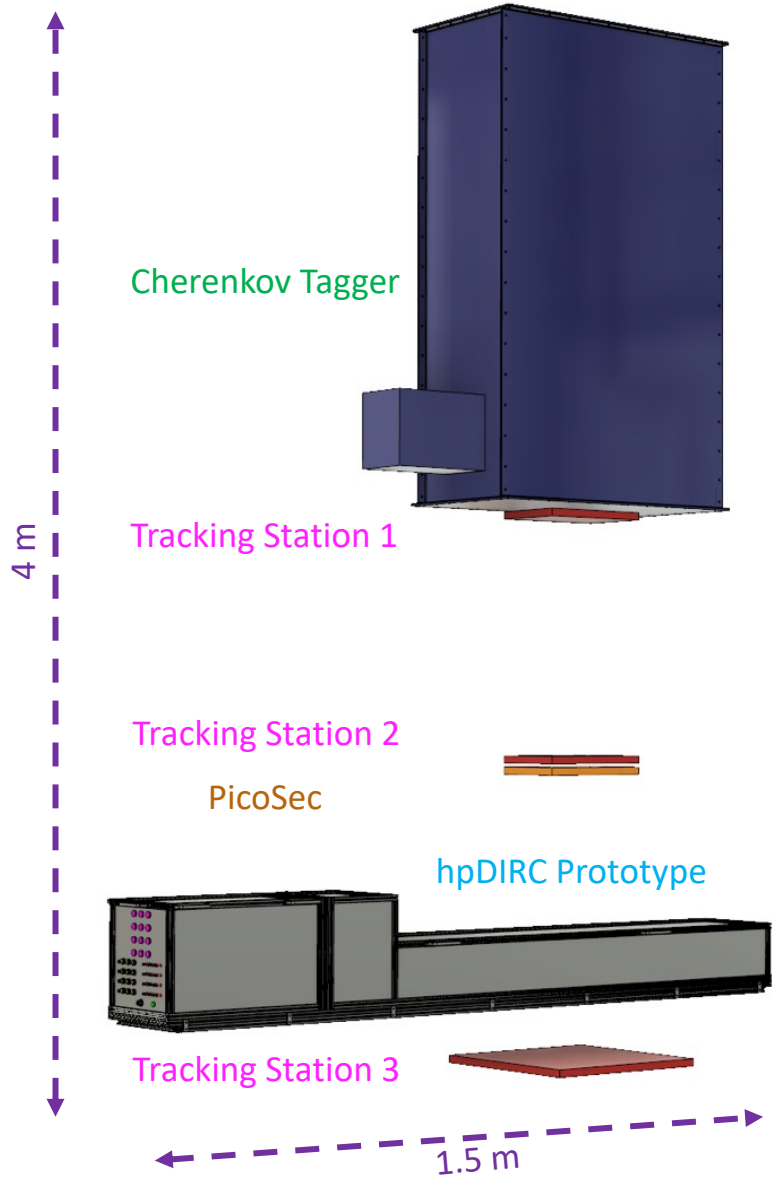
Facility to test incremental upgrades of prototype components, performance evaluation

- Initial PANDA Barrel DIRC-based prototype to commission setup
- Modular design will allow to add new ePIC hpDIRC components once they become available
- Cherenkov Tagger to select muons above 3.5 GeV/c
- Three tracking stations for high-precision 3D-track reconstruction (location optimized with simulations)
- PicoSec detector for event timing (Jlab group committed prototype and personnel to project)
- Geant4 simulation used to optimise setup arrangement

Geant4 simulation of CRT setup

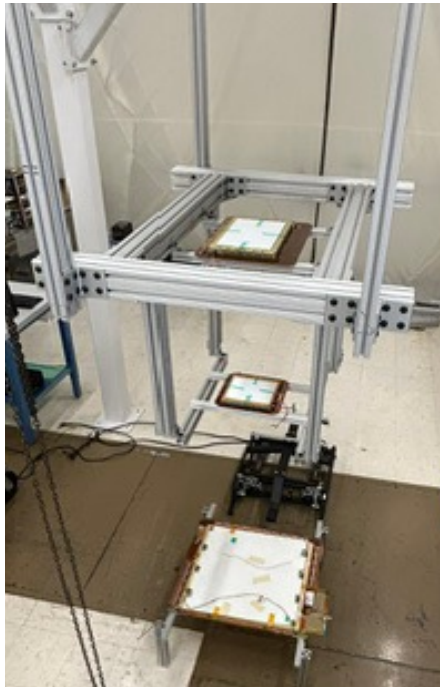


CRT setup CAD schematic

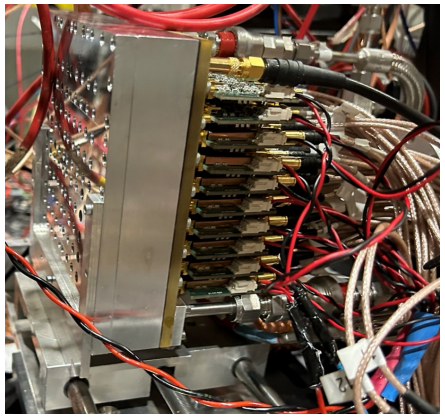


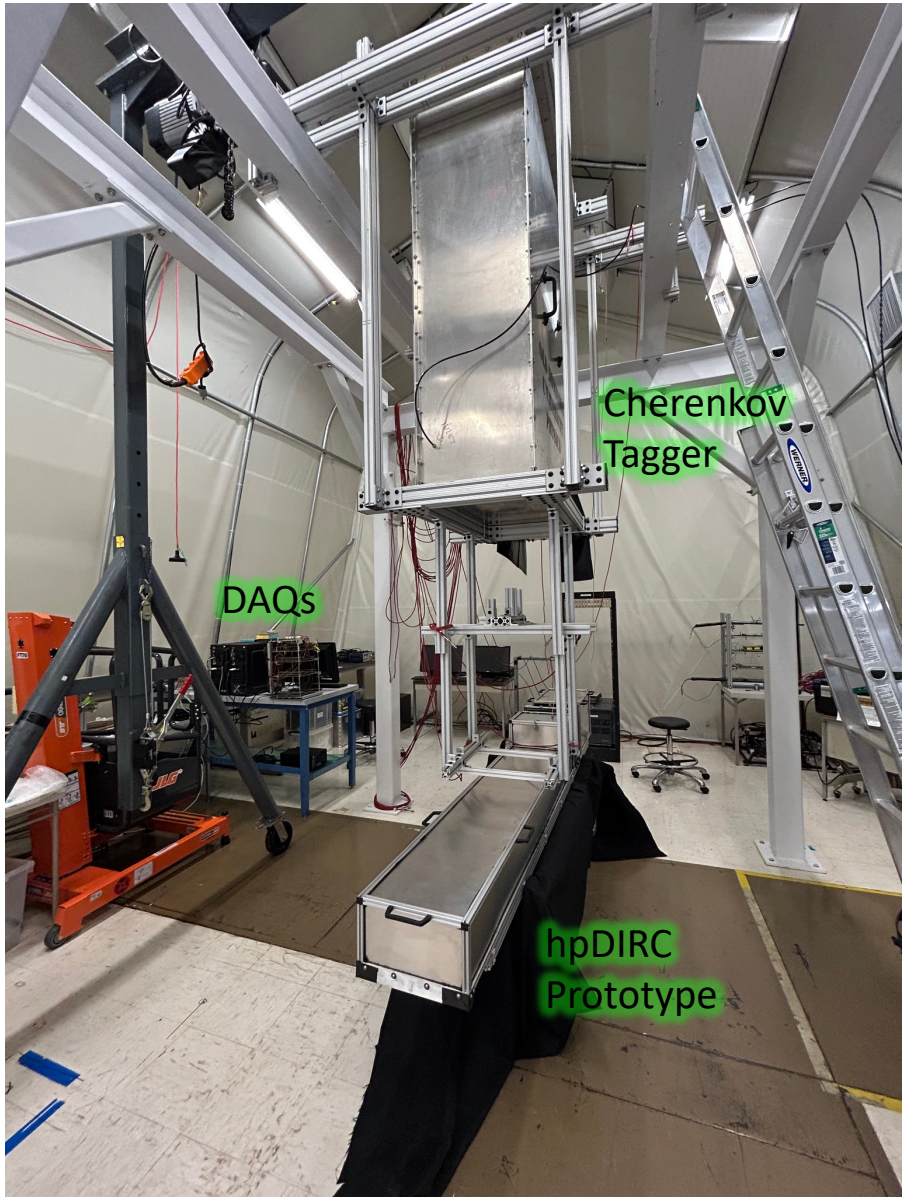
VALIDATION OF COMPONENTS

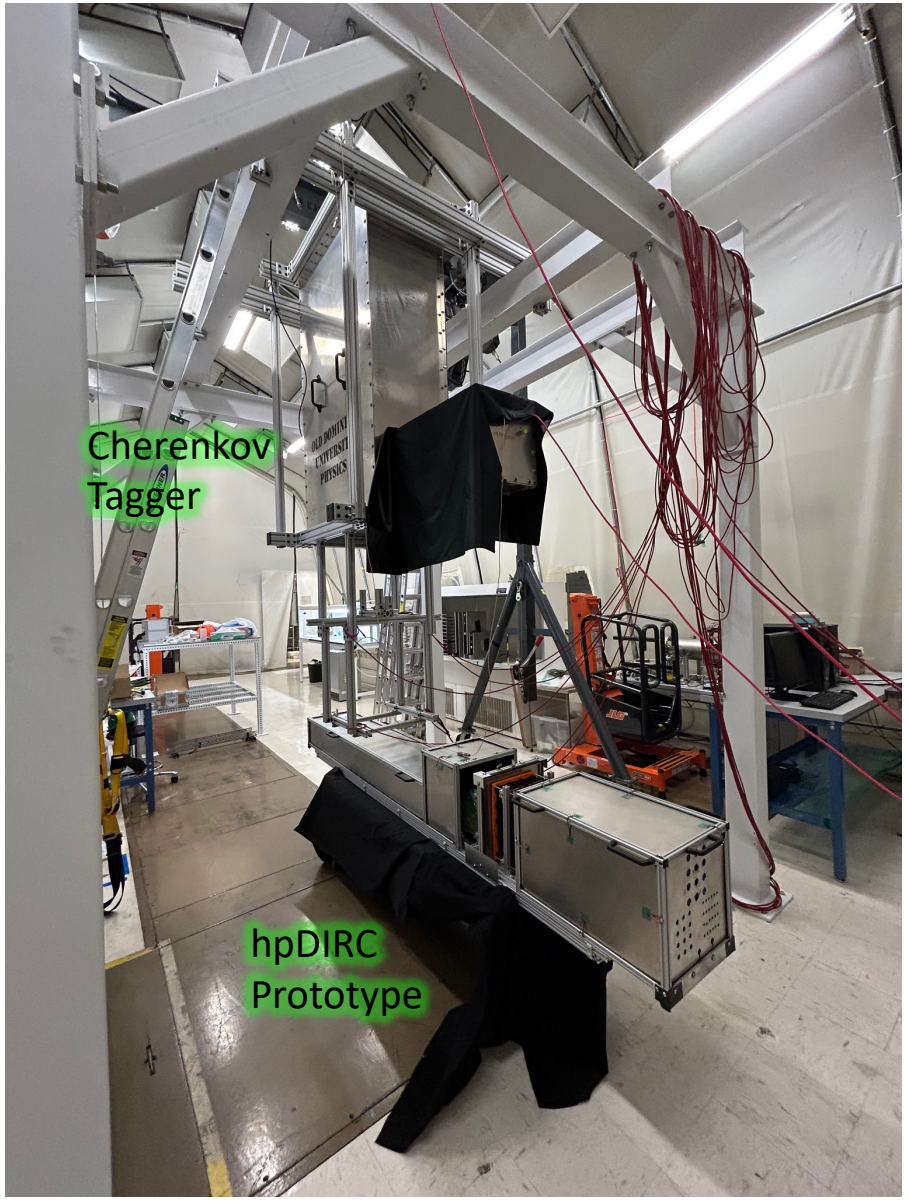
Trackers in the CRT



Large area PICOSEC





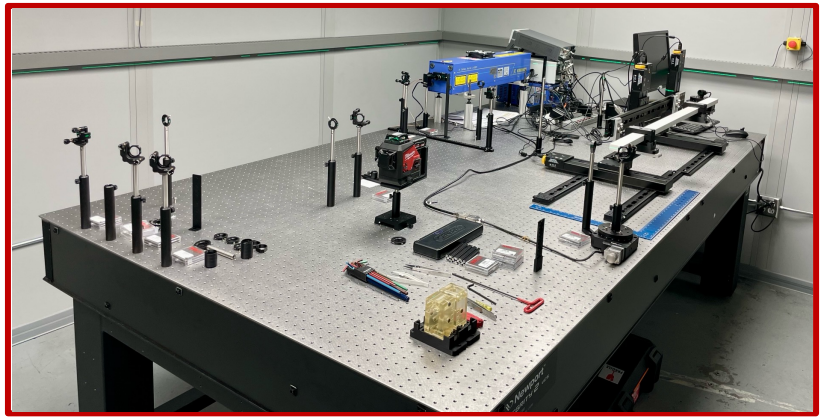


QA Plan

Quality assurance plans (100% components will be verified/tested)

Combination of process control/QA at vendor site and lab measurements

- Radiator bars and light guides: vendor QA for mechanical properties, laser scanning system at JLab to monitor internal photon transport efficiency of disassembled BaBar DIRC bars and/or new DIRC bars
- Sensors and electronics: laser pulser systems at Glasgow/JLab/USC (TBD) to measure gain, quantum and collection efficiency, dark count rate, etc
- Lenses: laser lab at ODU to evaluate shape of focal plane
- Prisms: vendor QA, checks at WSU
- Bar boxes, prism boxes: vendor QA, checks at CRT (SBU or JLab)
- Assembled DIRC module (bar box coupled to readout box, vertical slice): Cosmic Ray Telescope at SBU or JLab
- Installed DIRC module in ePIC: picosecond laser pulser calibration system, cameras to monitor optical coupling between sensors, prisms, lenses



DIRC laser lab at JLab

Lens evaluation setup at ODU

DIRC lab and Cosmic Ray setup at SBU (photos, Geant4)