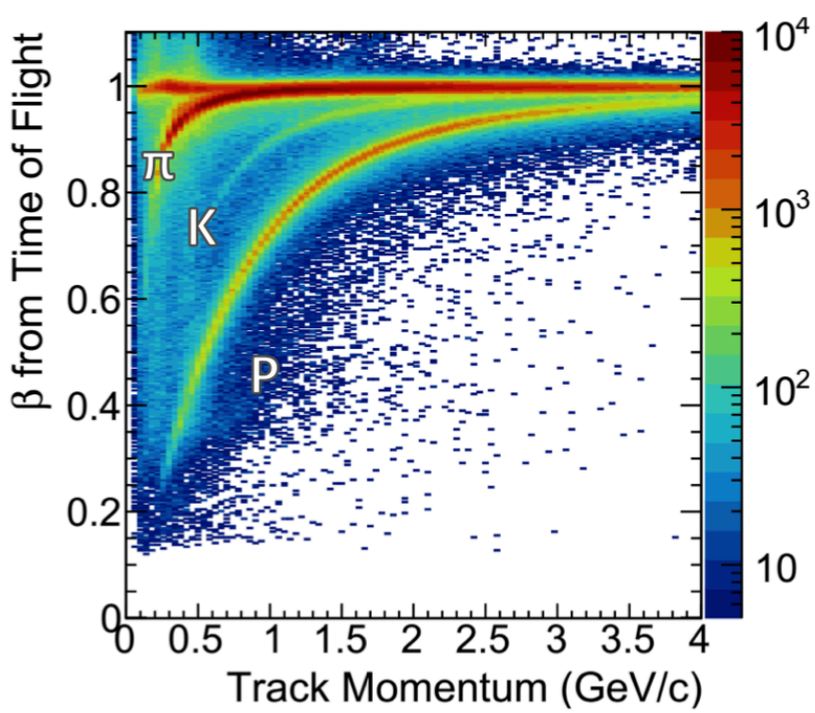
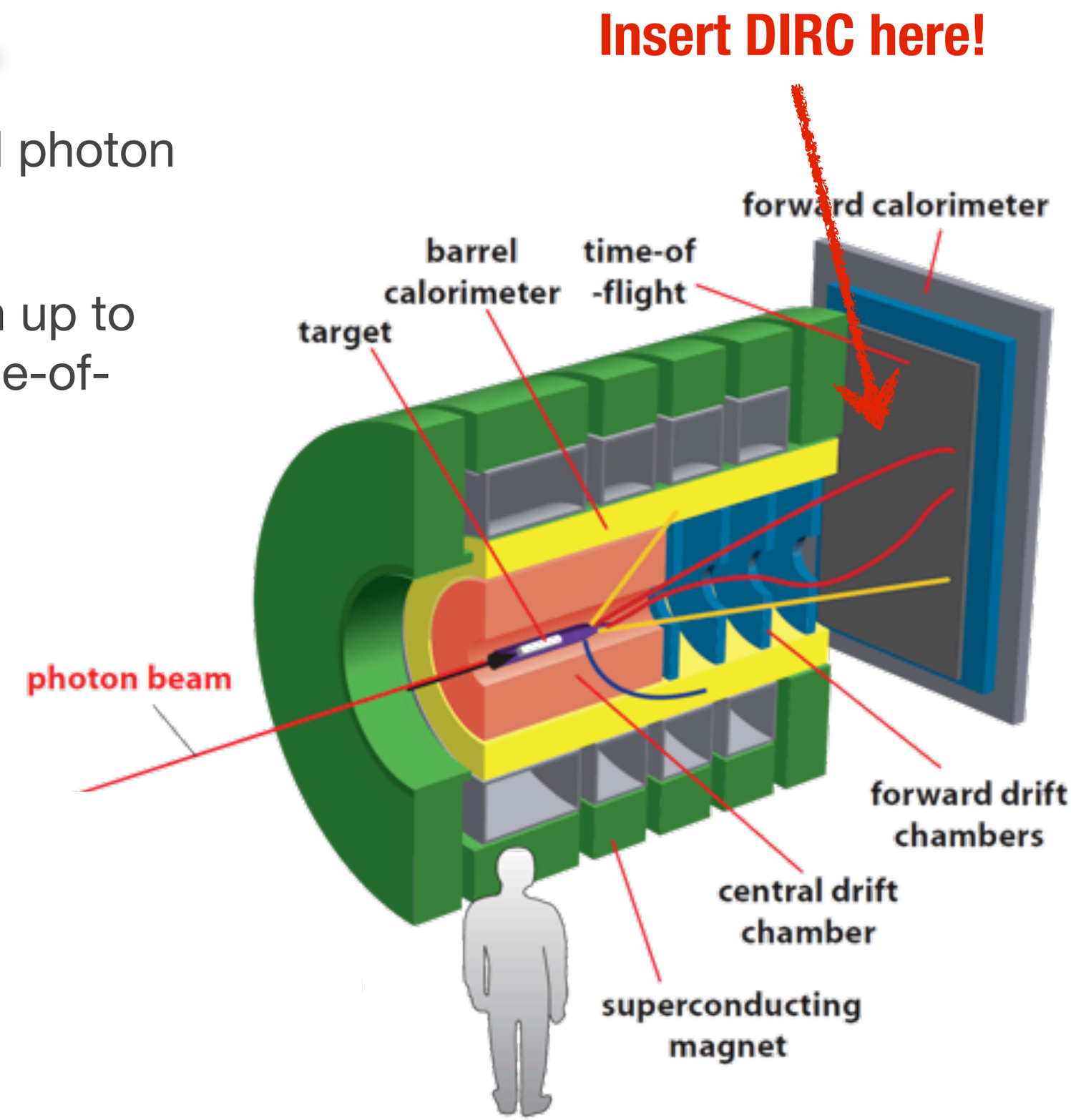
# DIRC for KLF

Justin Stevens

WILLIAM & MARY
CHARTERED 1693

- 9 GeV linearly-polarized photon beam on $LH_2$ target
- Baseline π/K separation up to ~2 GeV provided by time-of-flight for θ < 11 °



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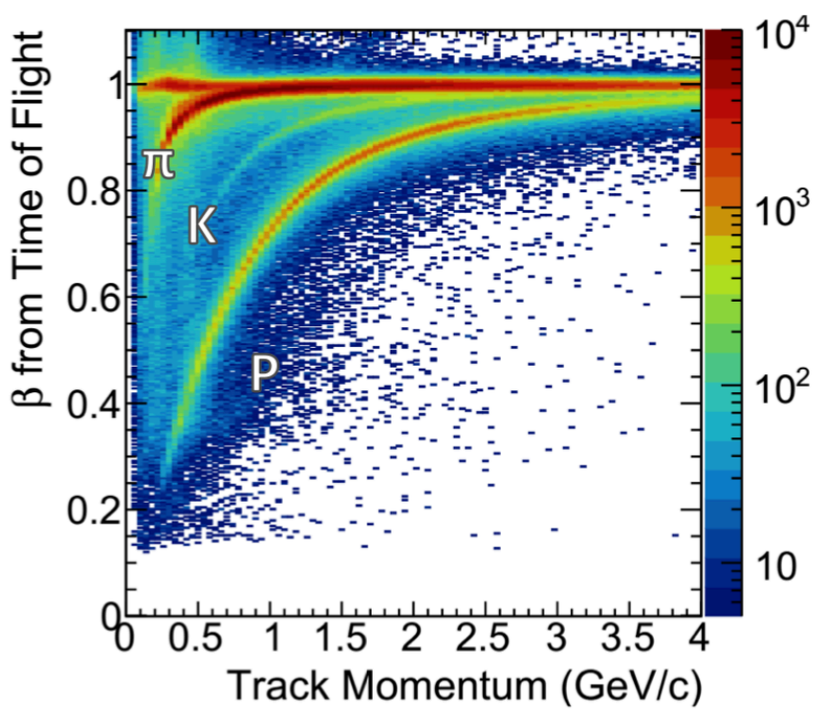
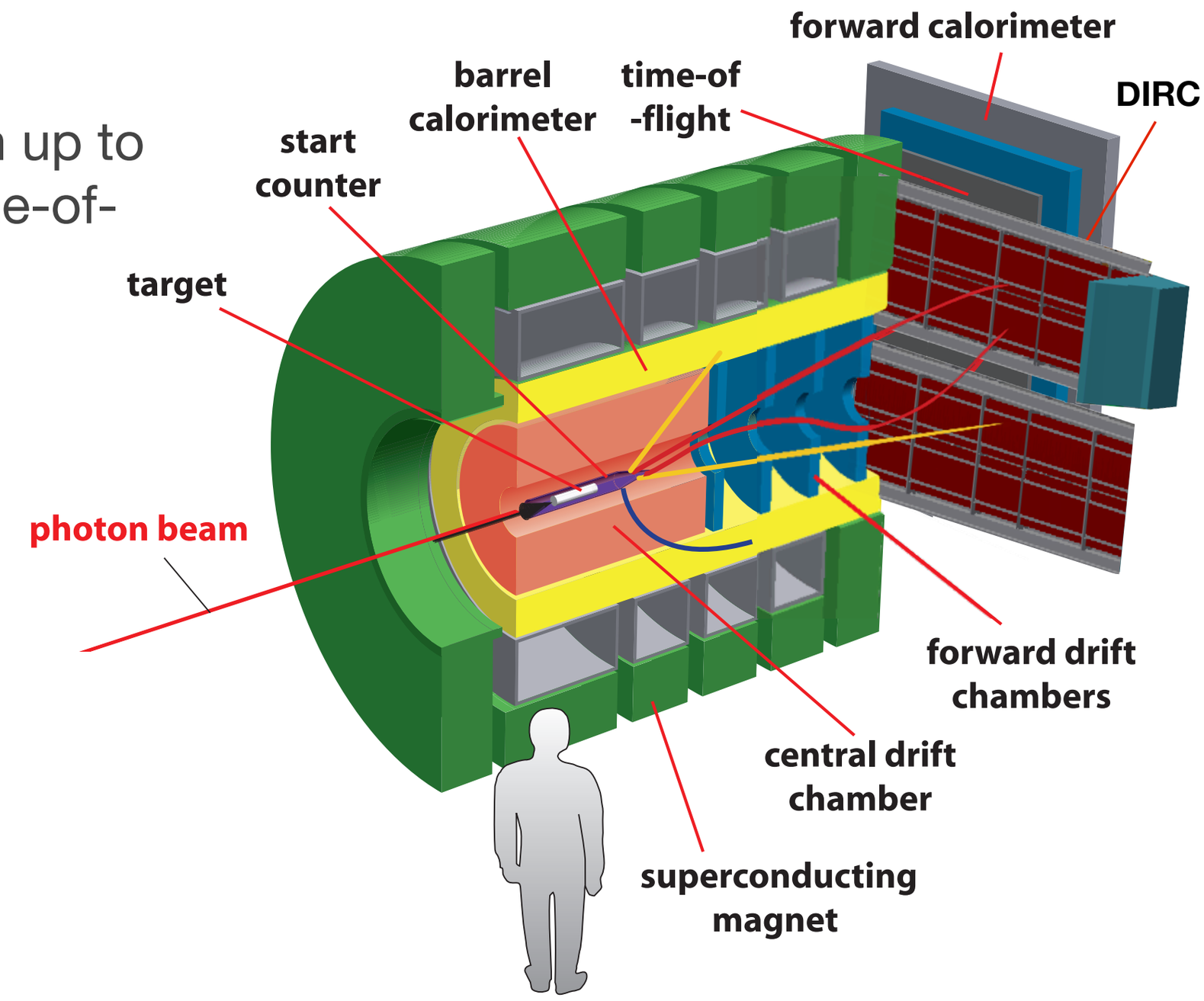
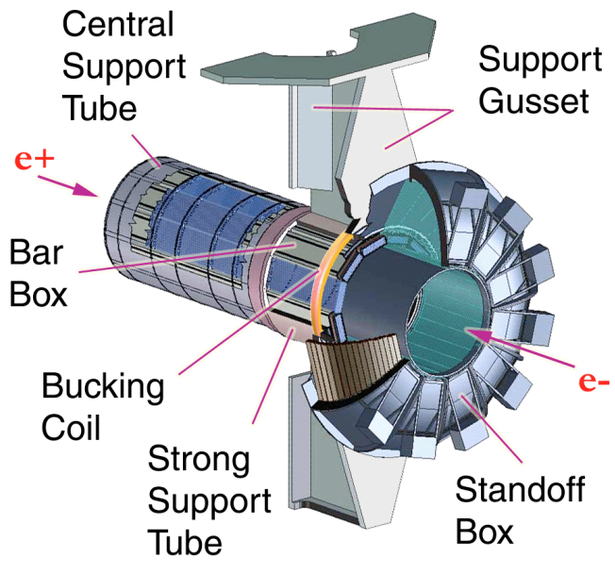


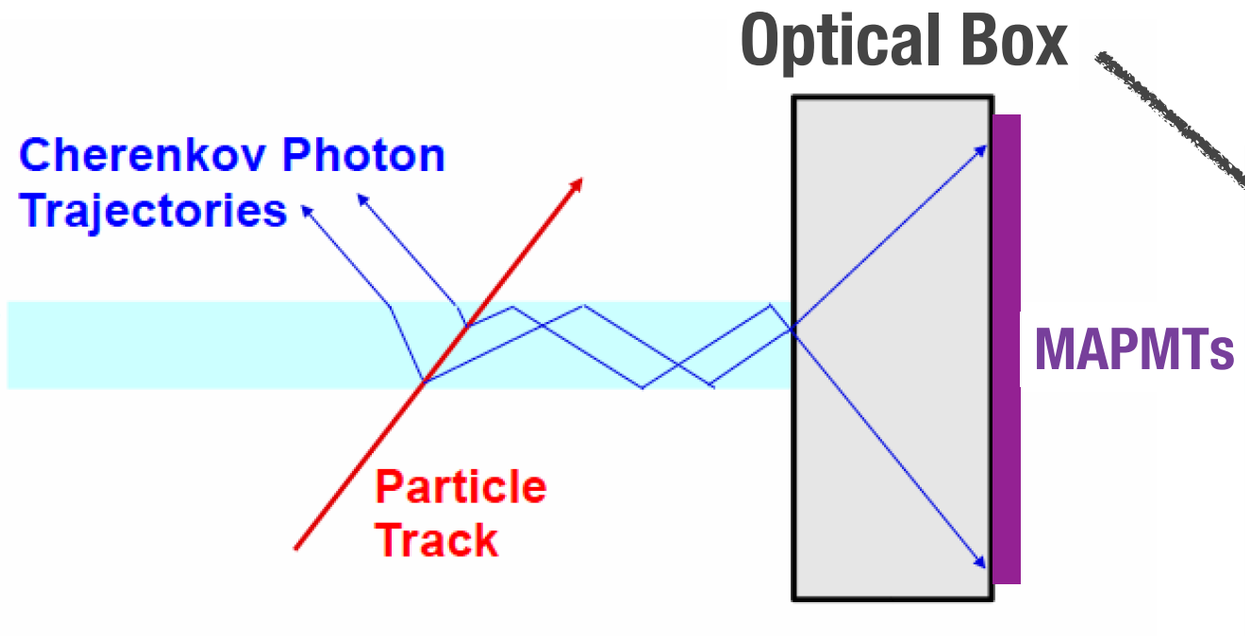
# DIRC bar box transportation

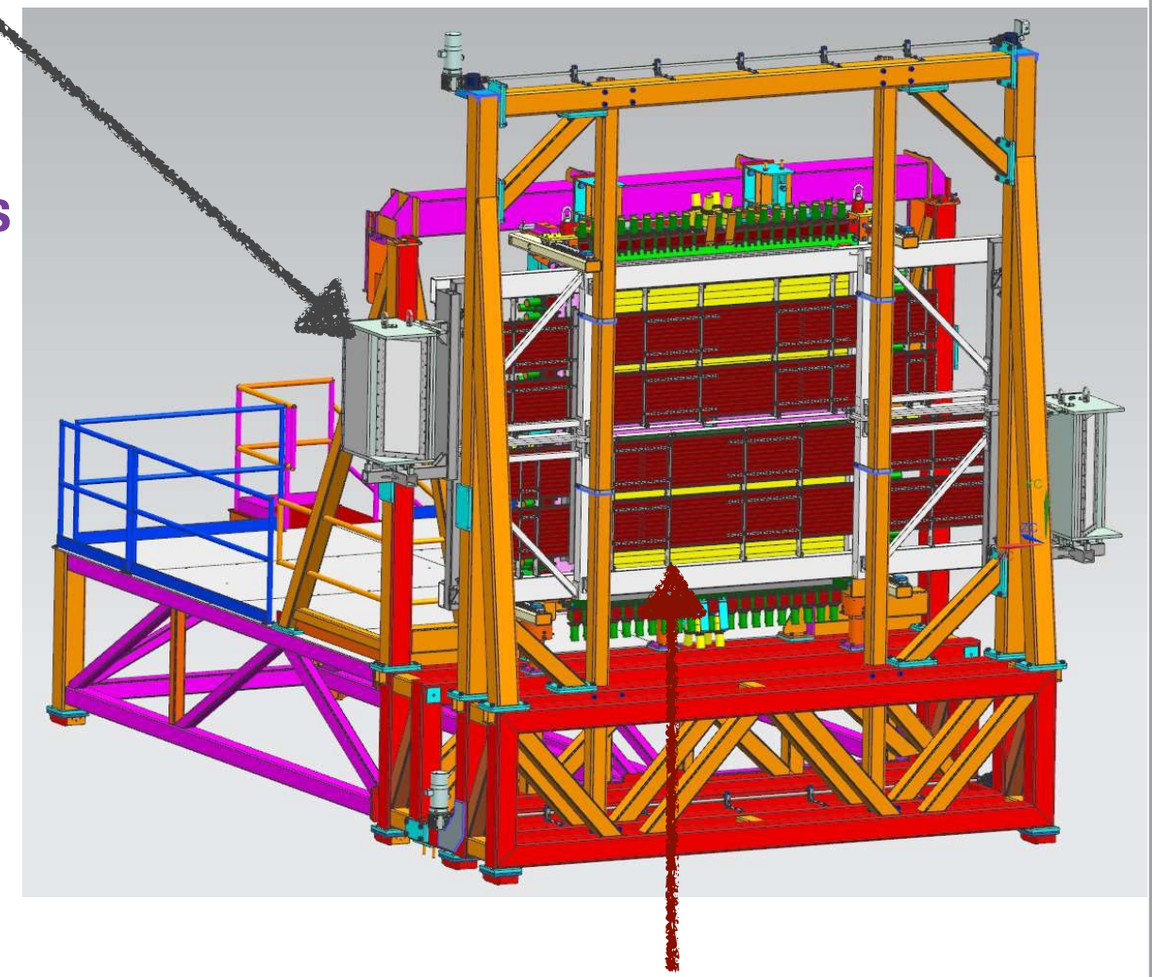
## Transported 1/3 of BaBar DIRC radiators to JLab



**Cameras, accelerometers, etc. provided real time feedback to trail car**

# DIRC upgrade



**48 fused silica radiator bars installed, covering θ < 11°**

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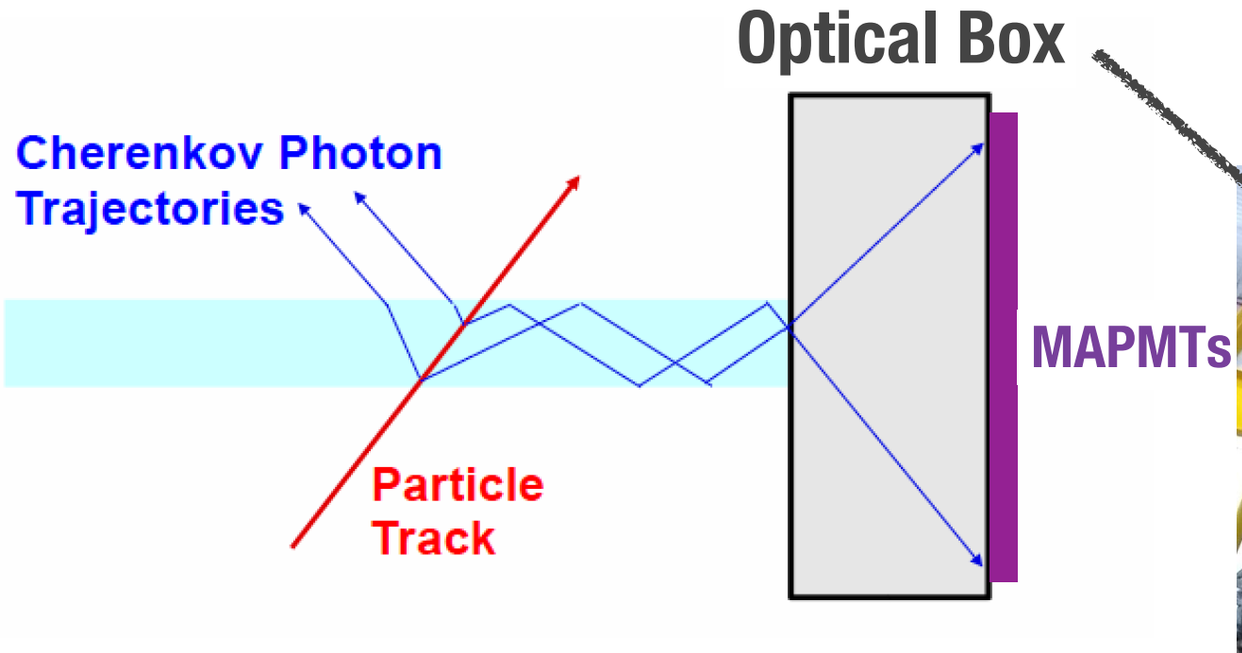


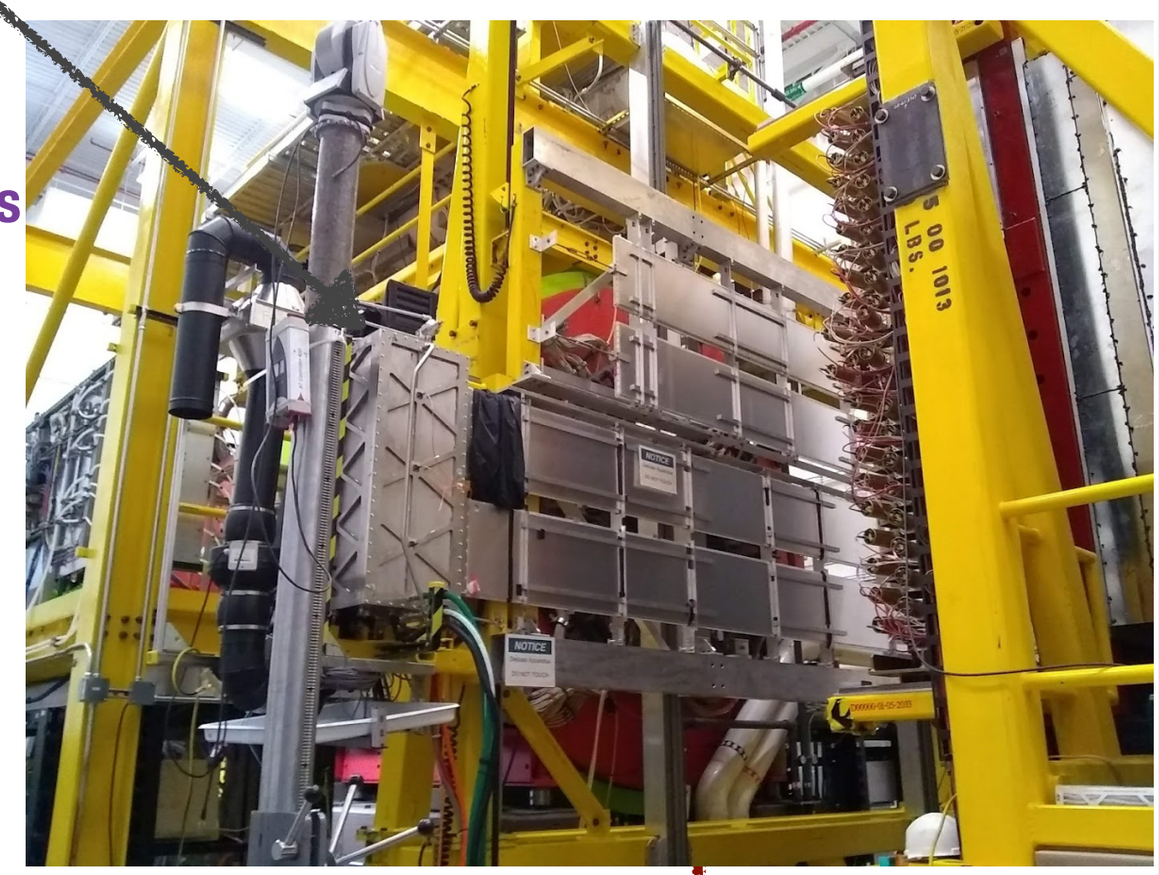

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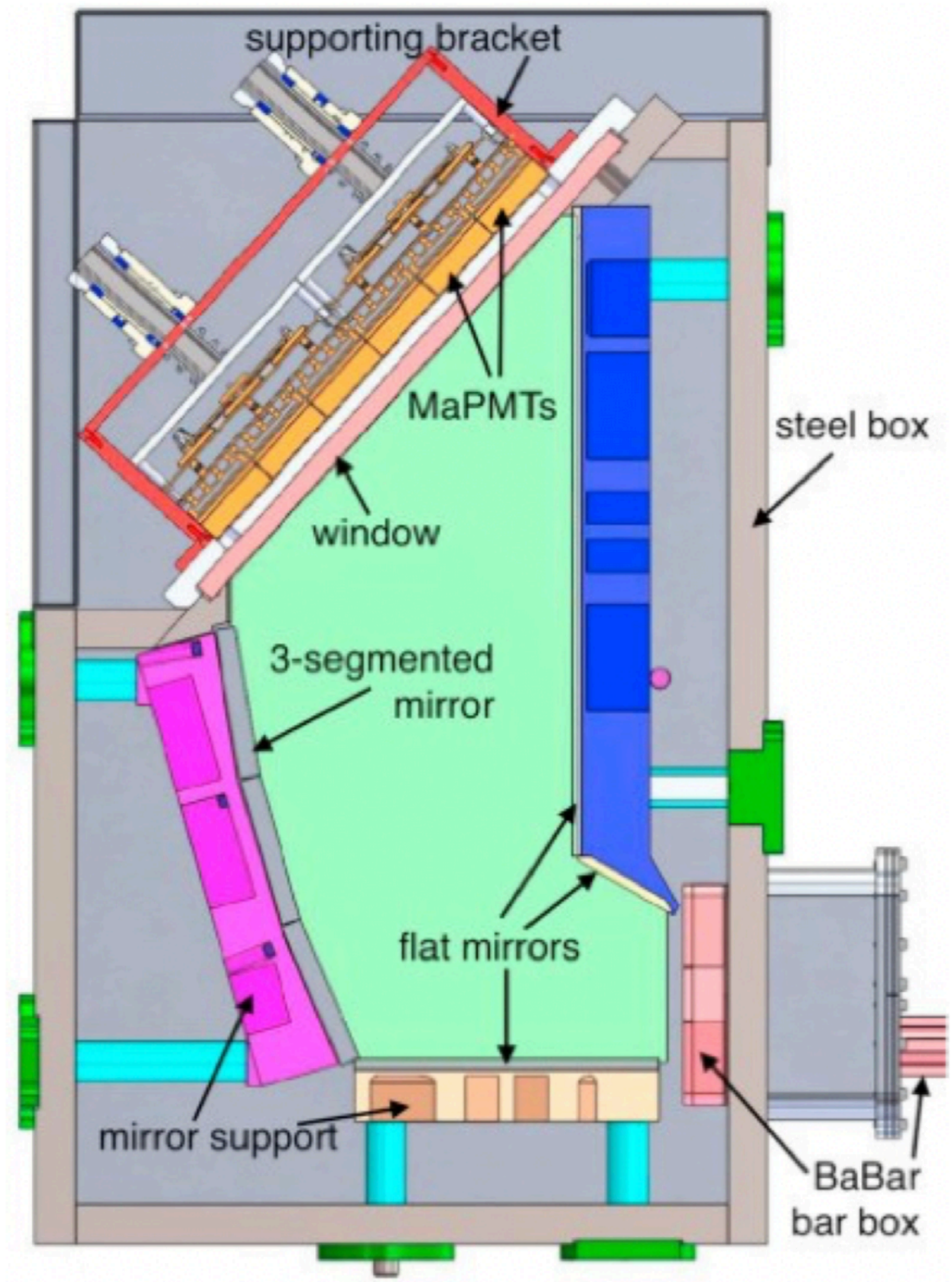
# GlueX optical box design

- Design based on SLAC FDIRC prototype
  - Replace fused silica block from FDIRC prototype with mirrors contained in water
  - Replace of cylindrical mirror with 3-segment flat mirror
- Similar coupling of bar boxes to water volume as used at BaBar

**Optical Box**



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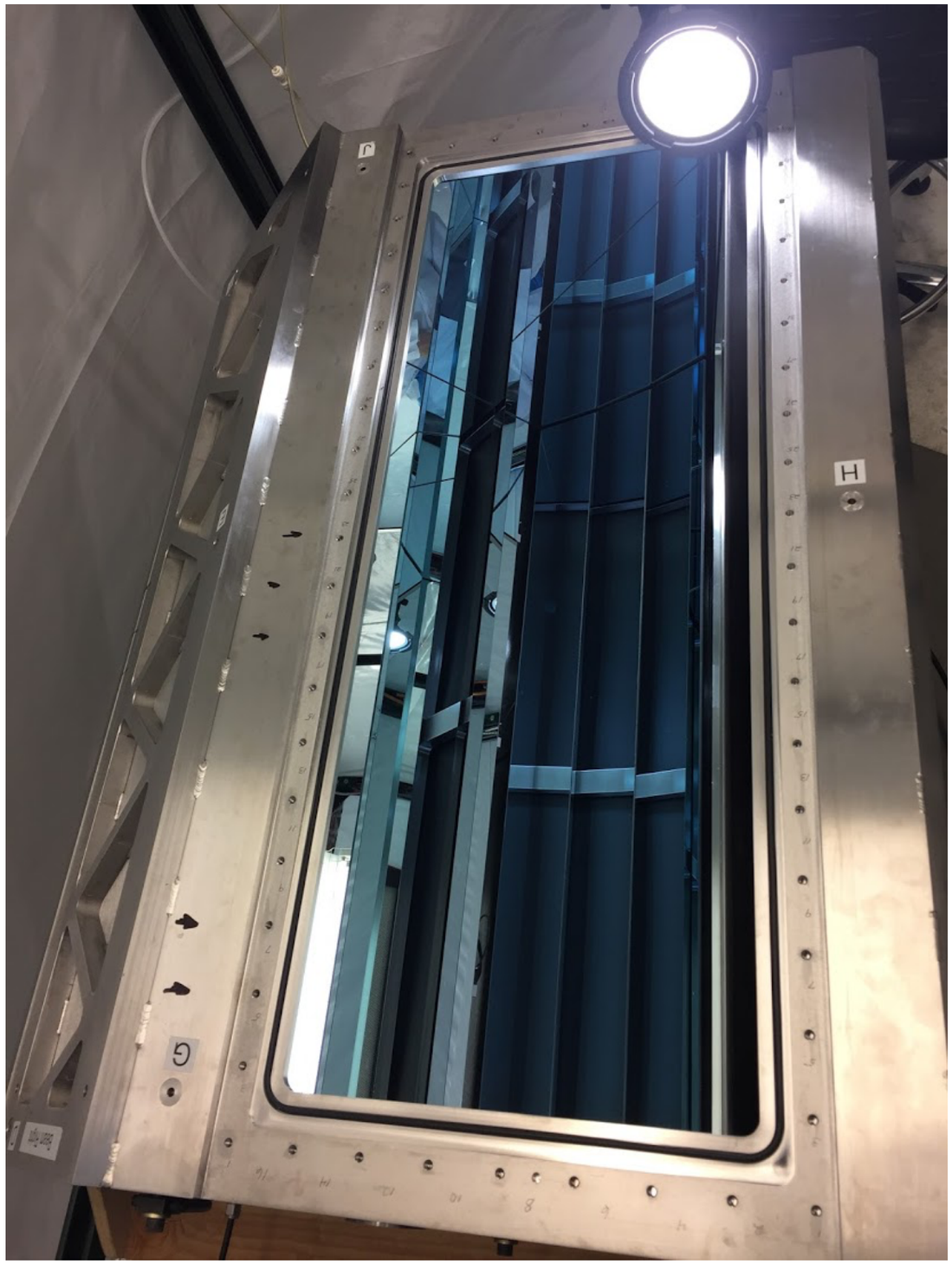
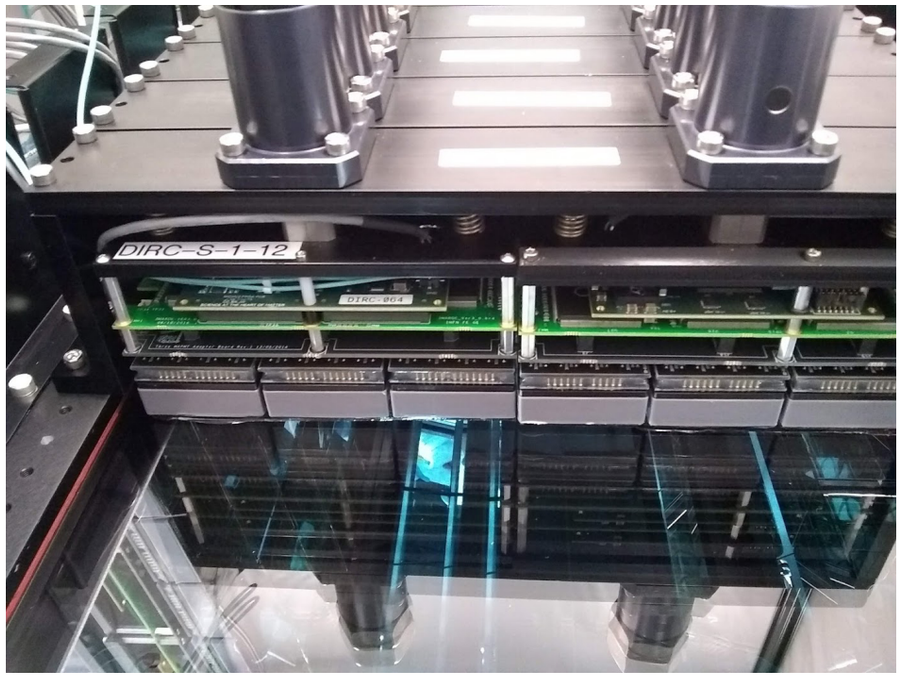
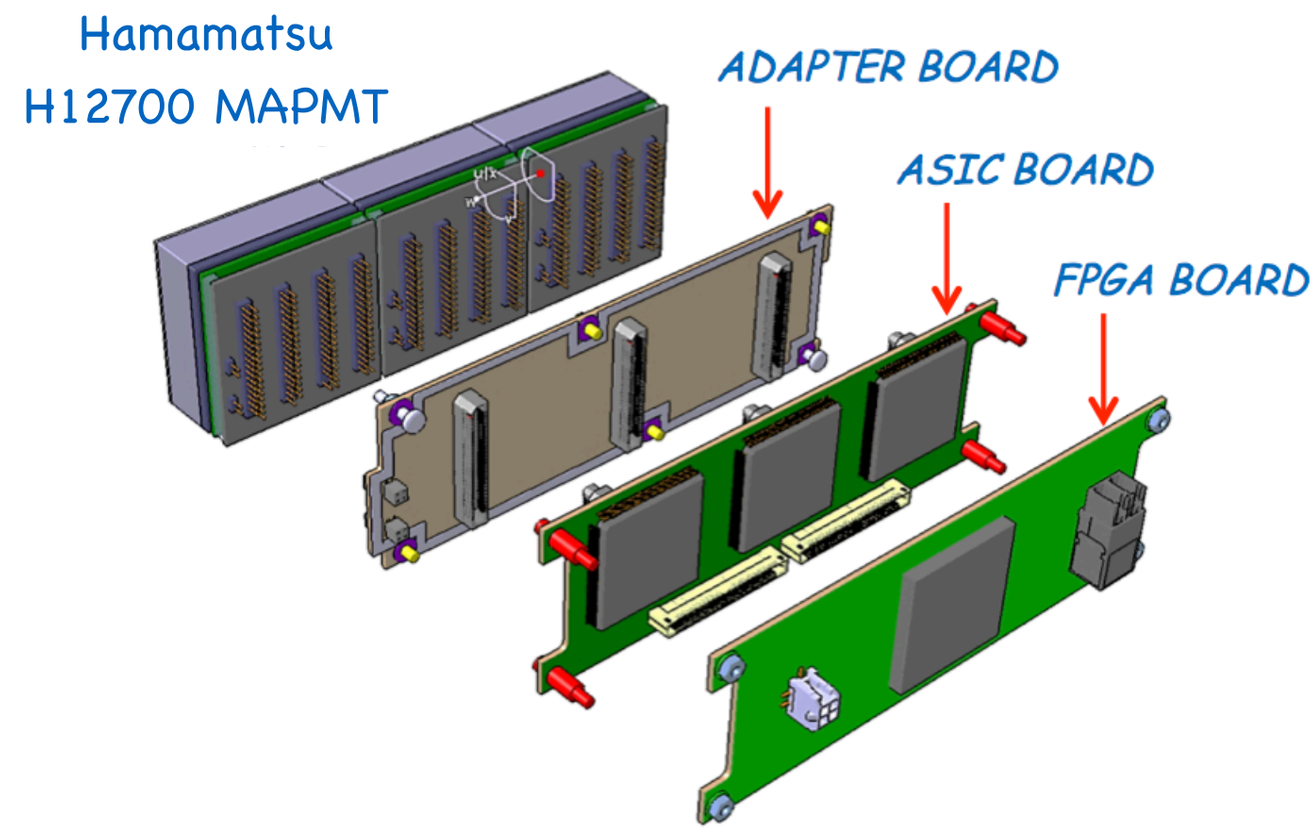
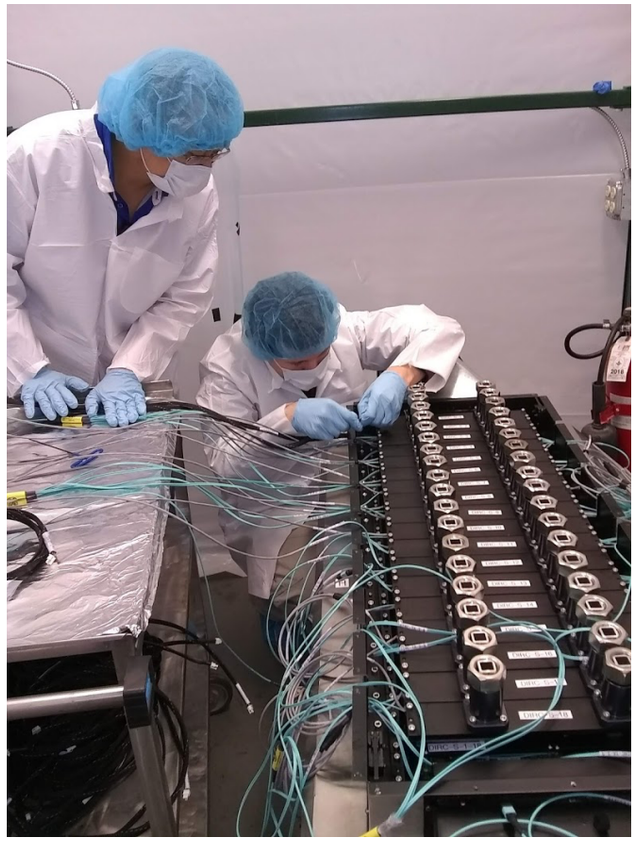


# DIRC PMT installation



- Small magnetic field and limited timing resolution requirements to other DIRCs
- MAPMTs coupled to quartz window by optical cookies (a la Belle II)
- Utilized CLAS12 RICH readout with very similar requirements (see Marco's talk)

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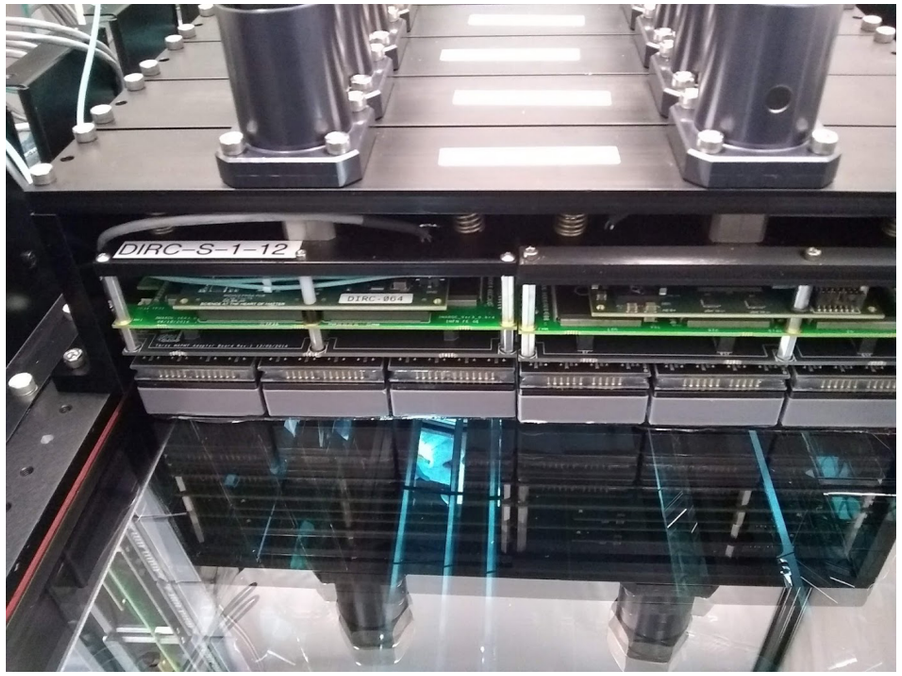
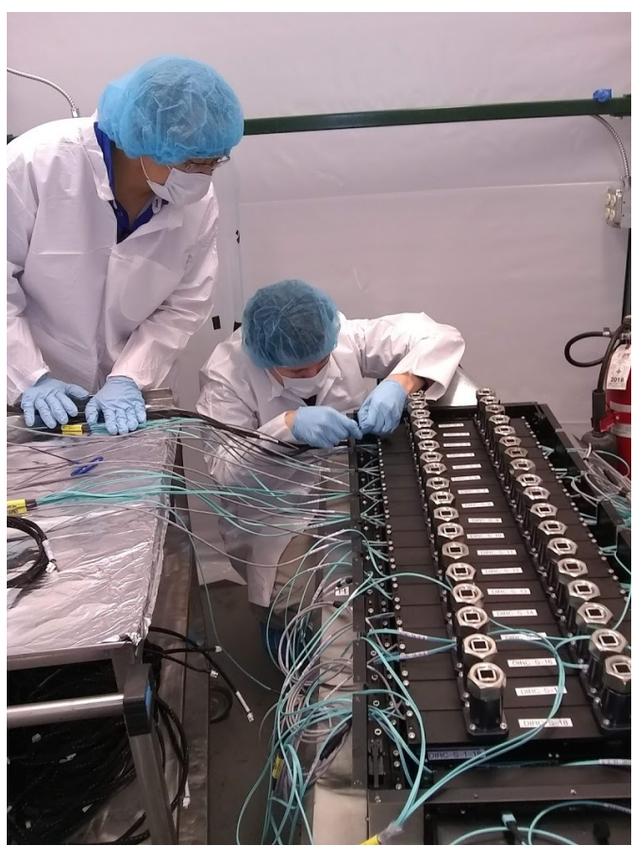
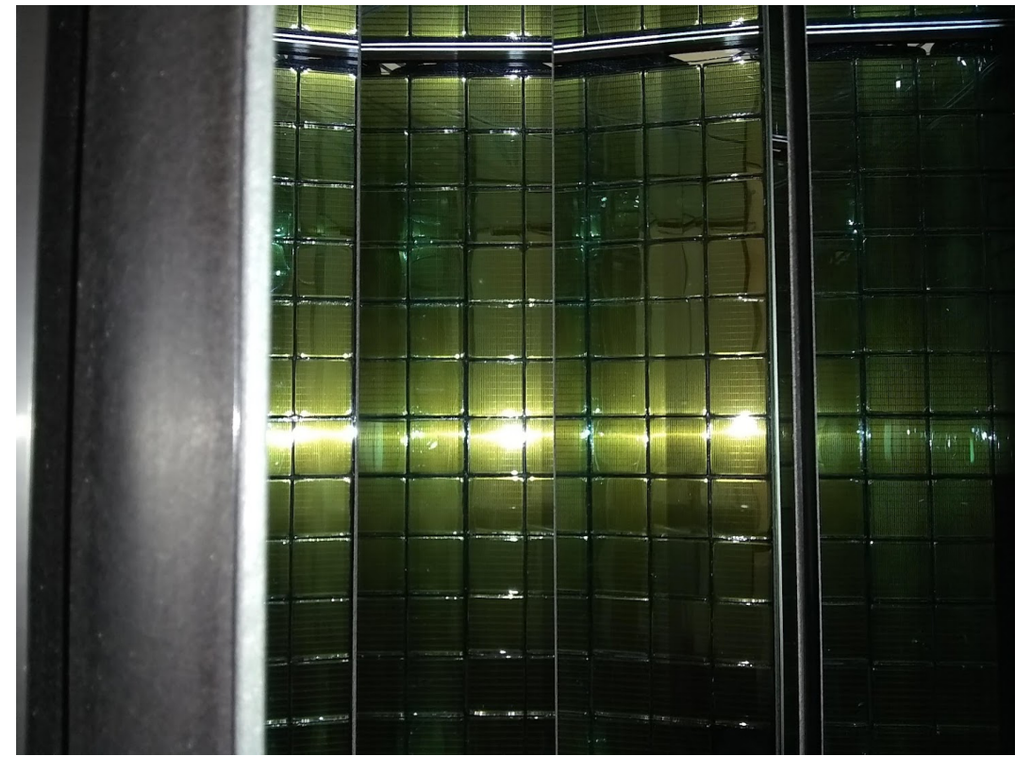


## Cherenkov Photon's Perspective



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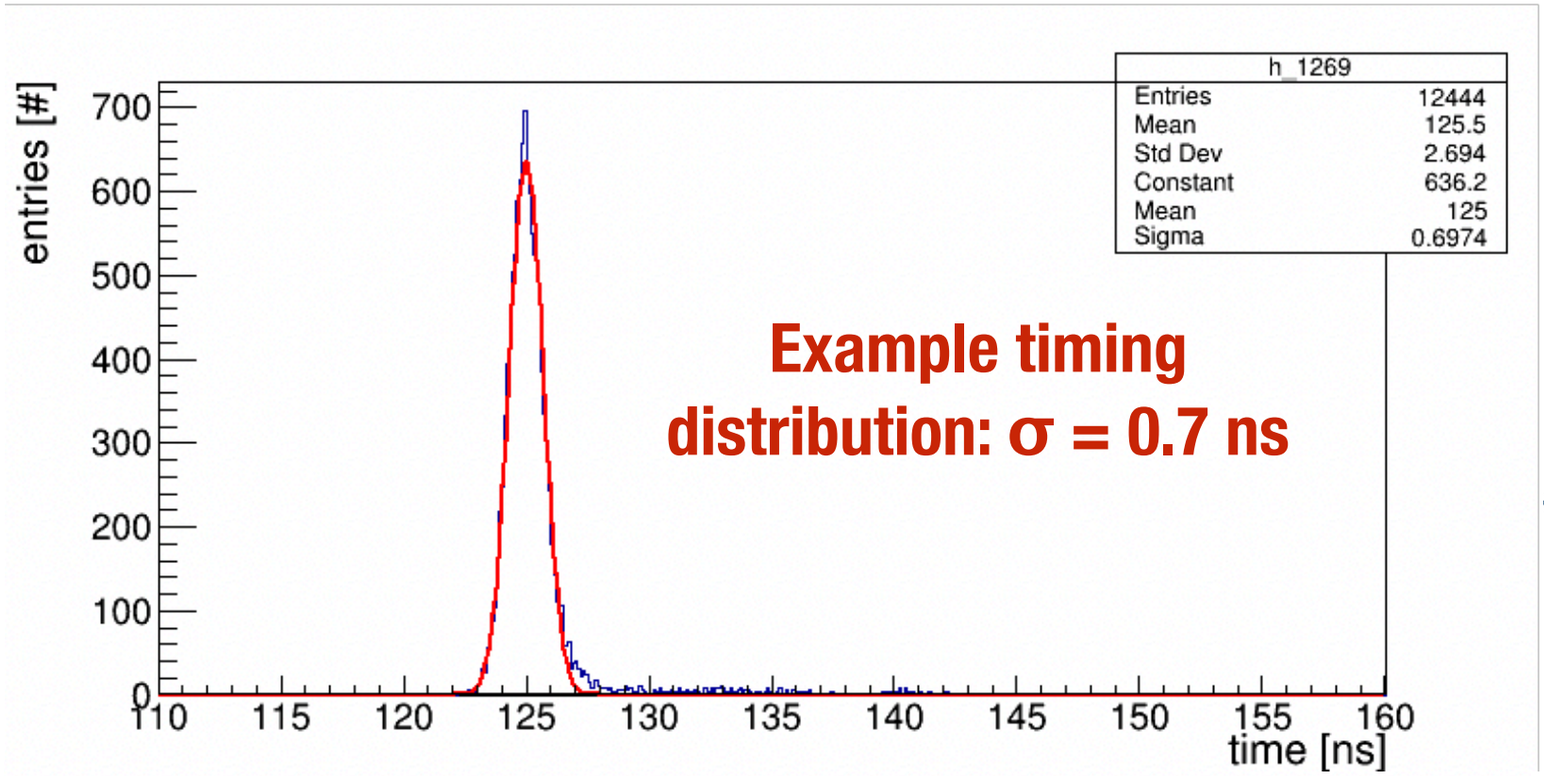
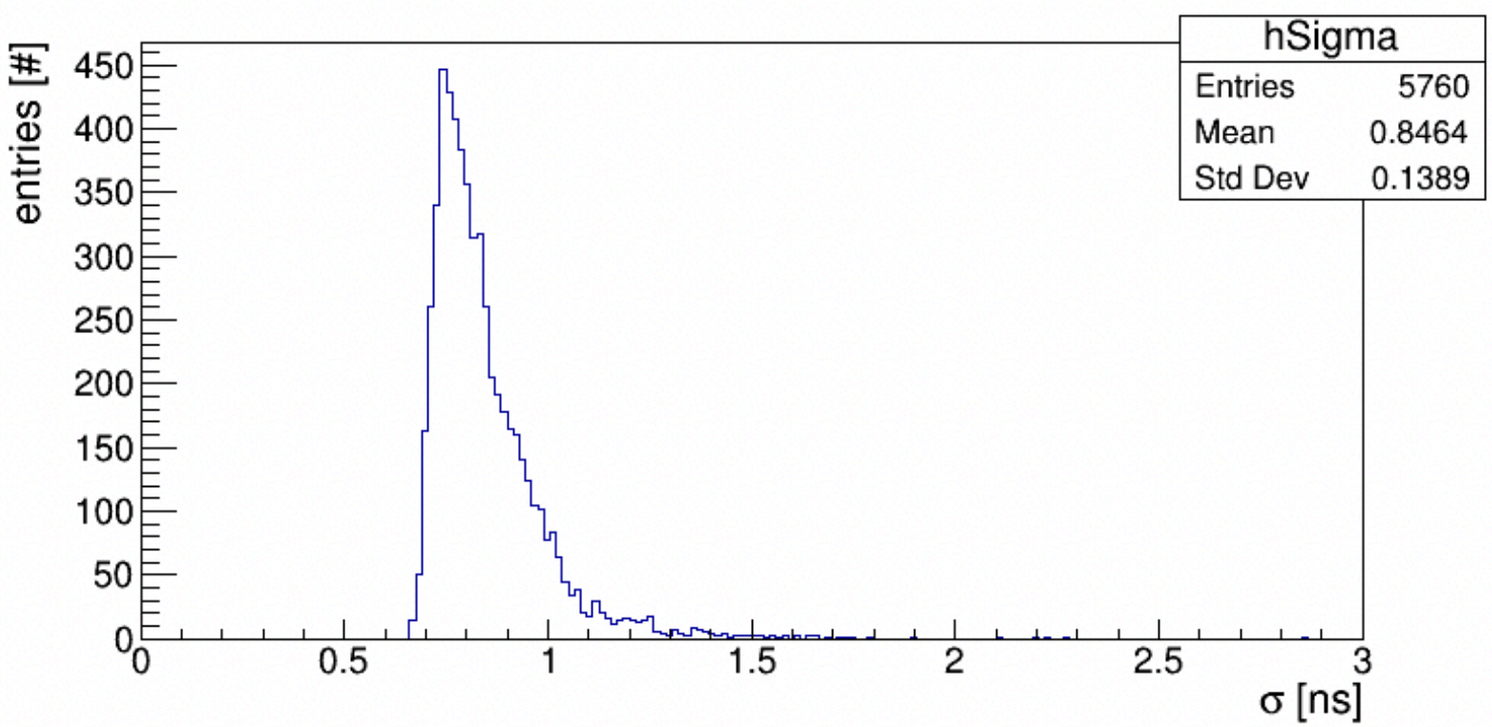
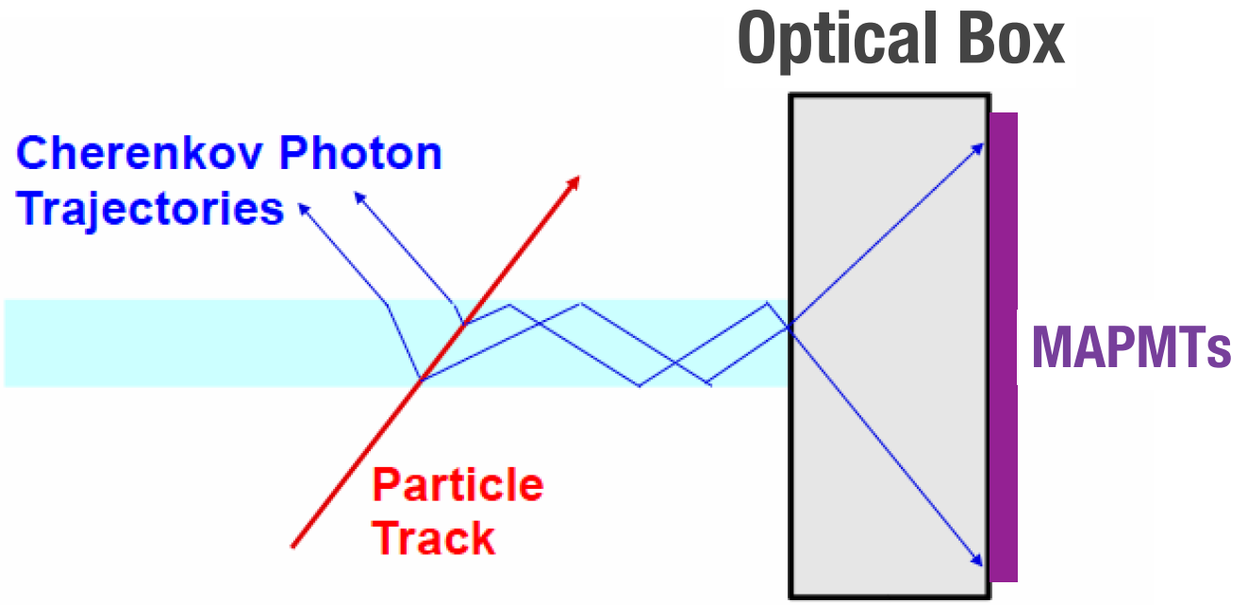
# DIRC calibration system

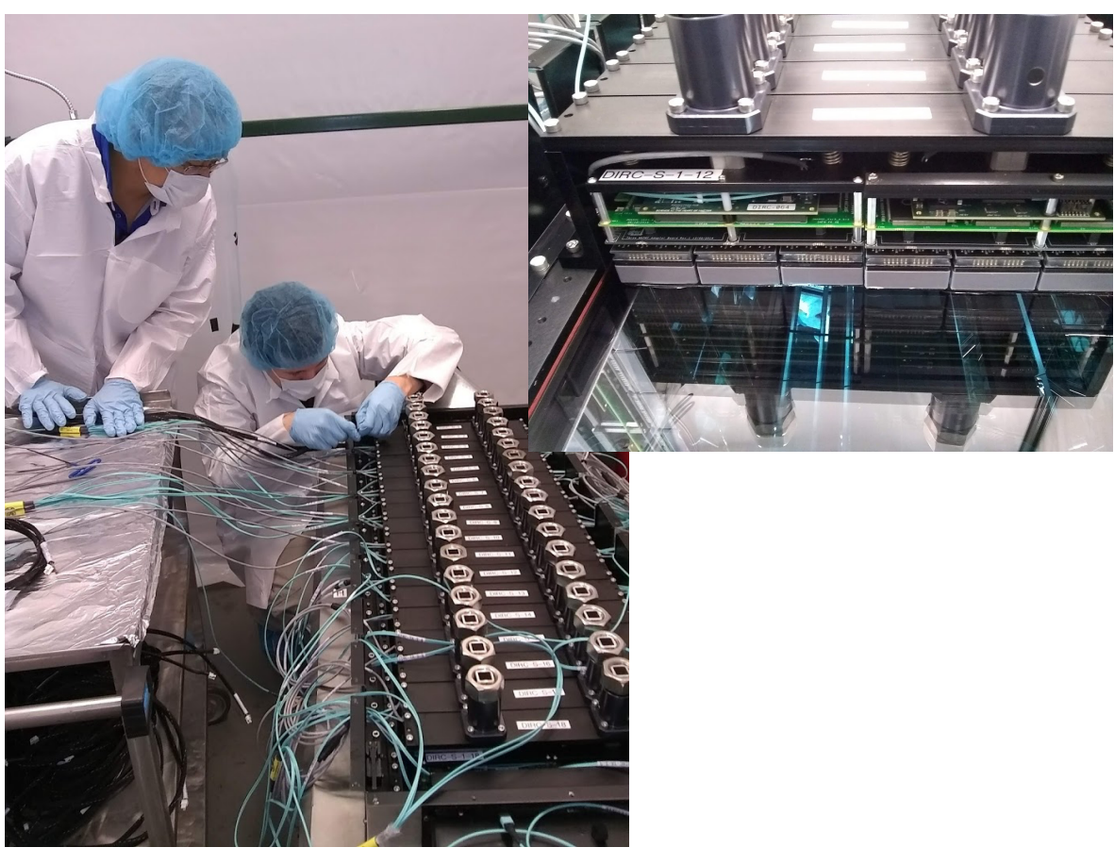


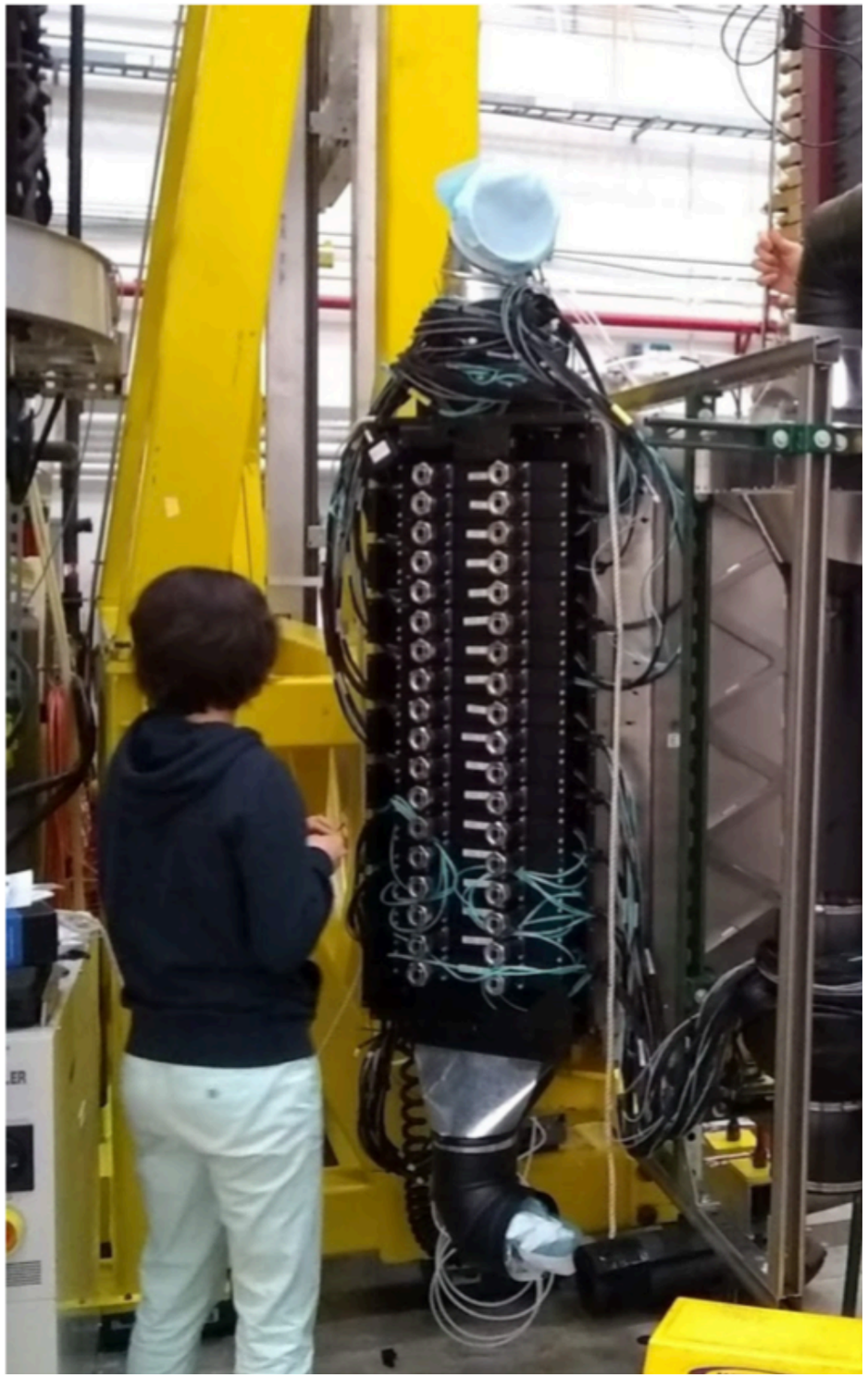




- Per-pixel timing offsets calibrated with LED system
- Resolution < 1 ns is sufficient for geometric LUT reconstruction

# DIRC upgrade





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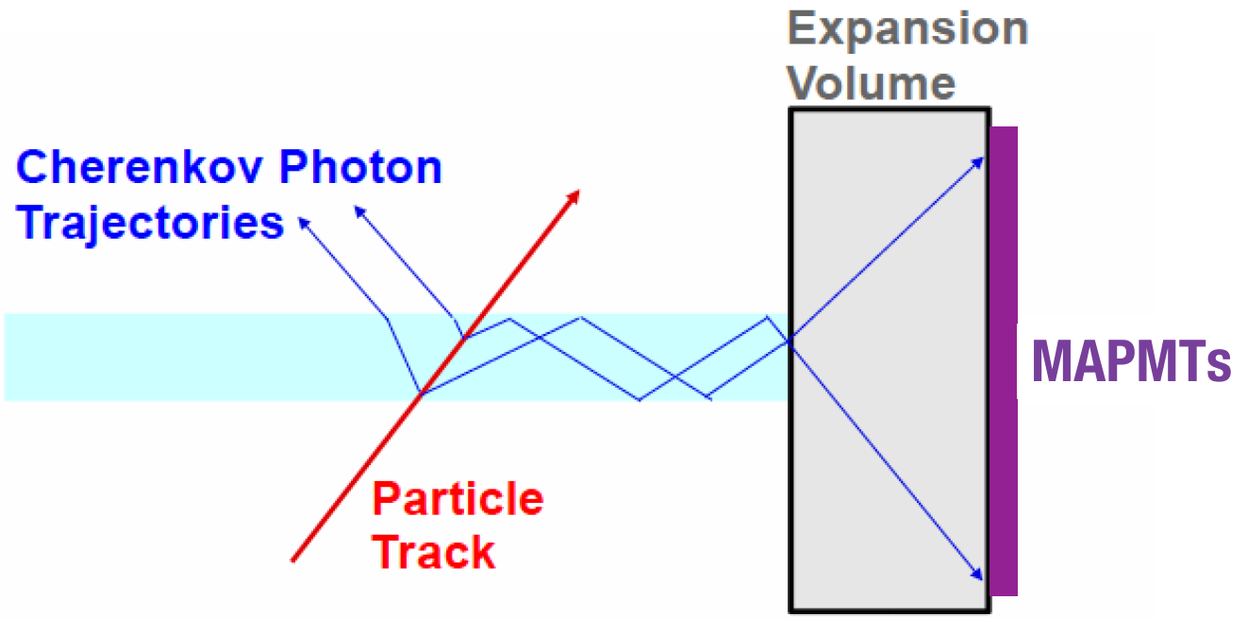
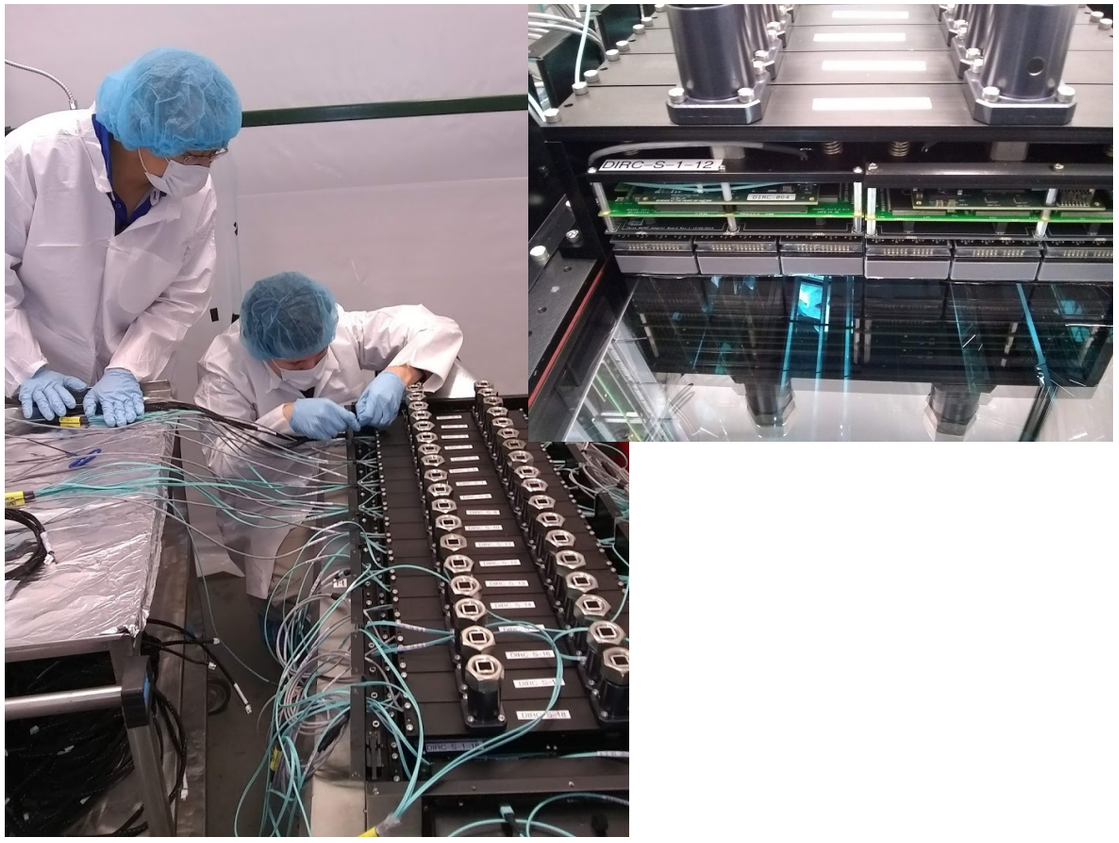
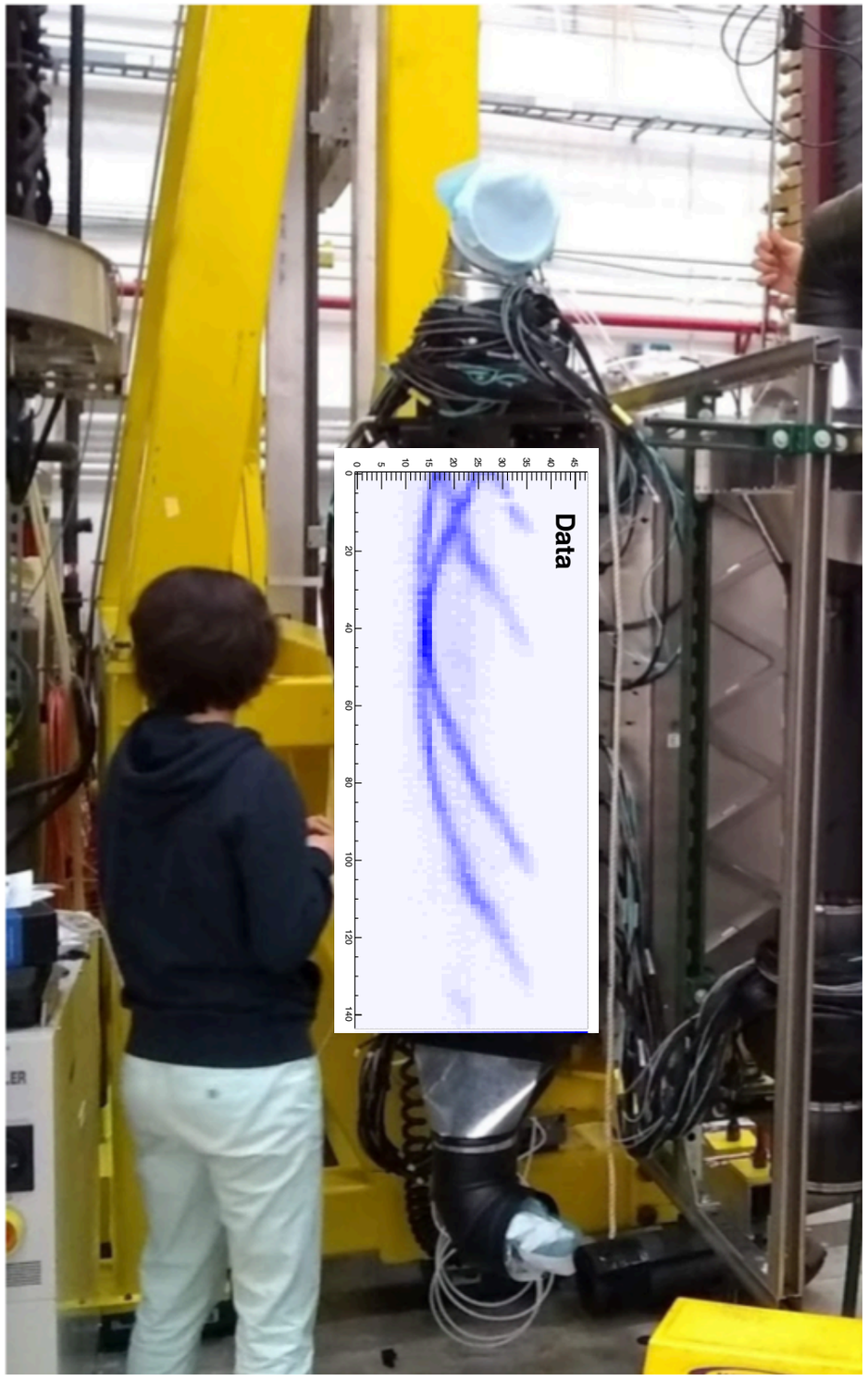
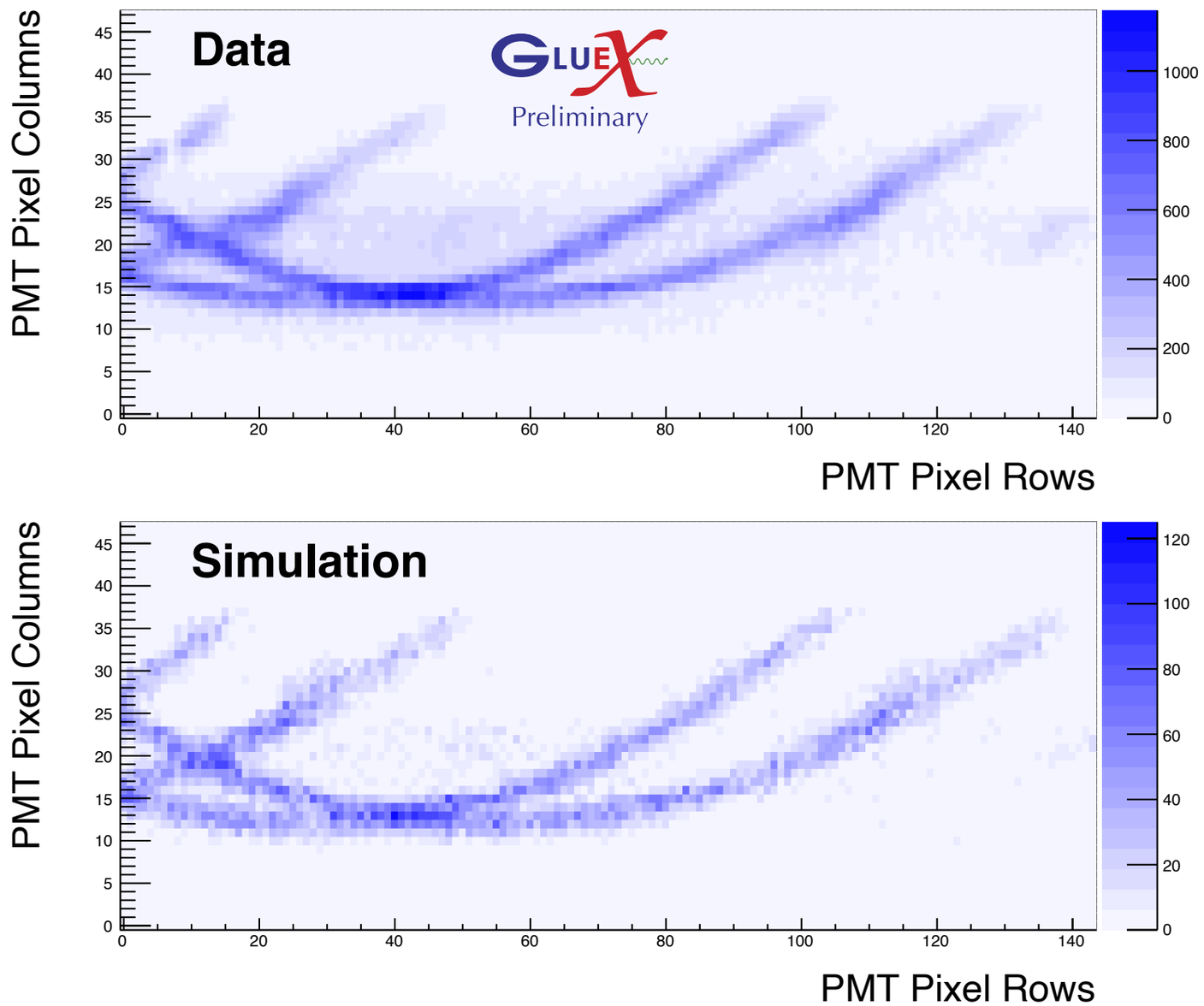


# DIRC commissioning

- February 2019: 10 days of GlueX beamtime with 1/2 of DIRC installed for commissioning




**Example π+ Cherenkov photon hit pattern**

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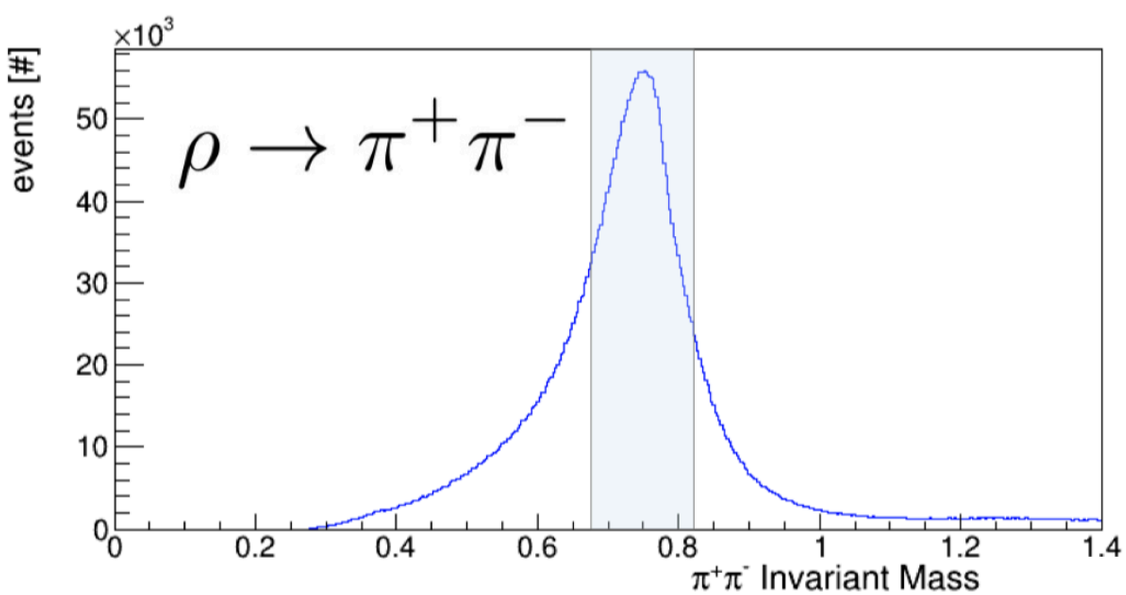
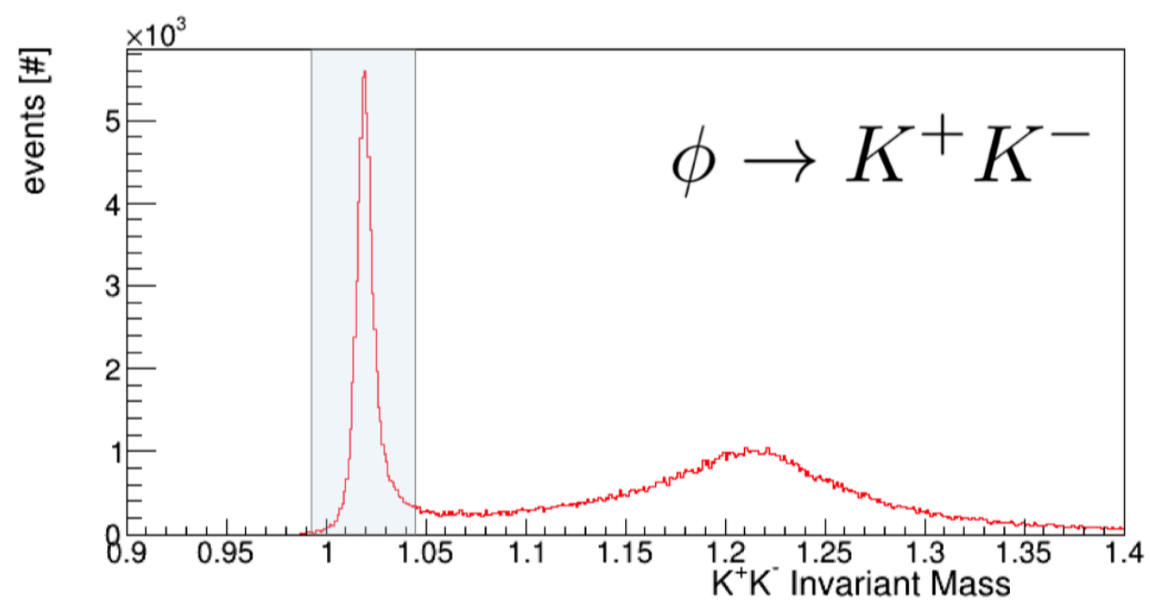
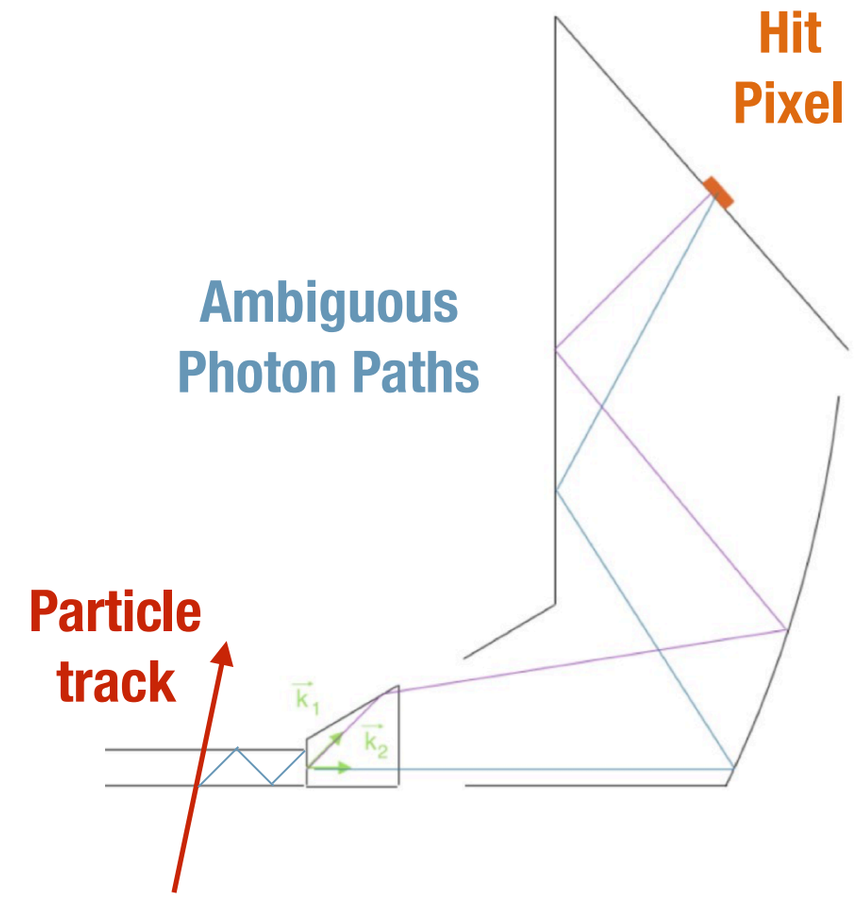
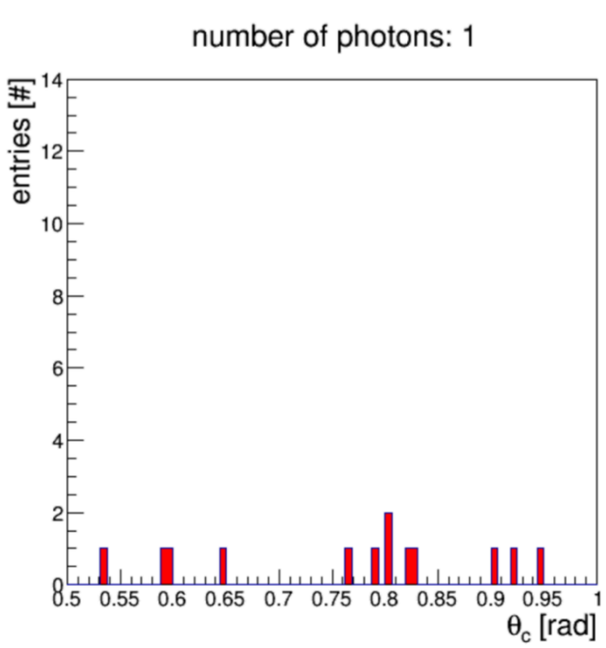


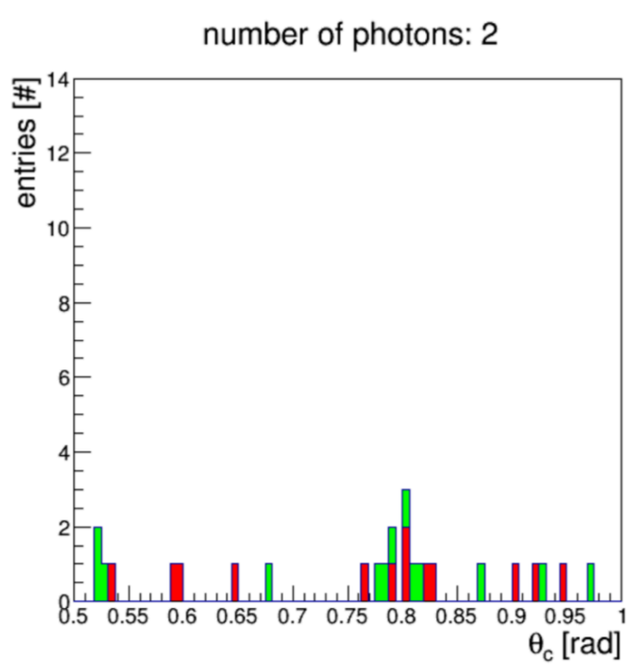



# Geometric reconstruction

- Each photon detected has multiple ambiguous paths with different Cherenkov angles $\theta_C$
- Cumulative $\theta_C$ over many photons
- Compute likelihood for π and K mass hypothesis over all detected photons

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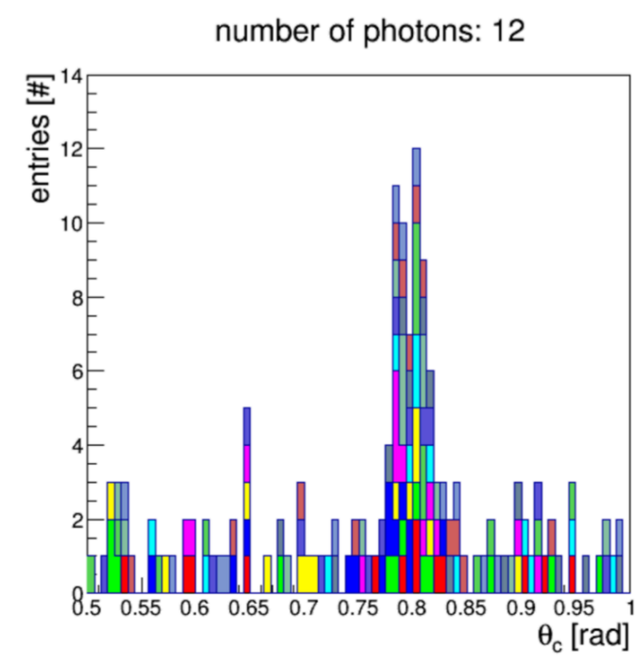
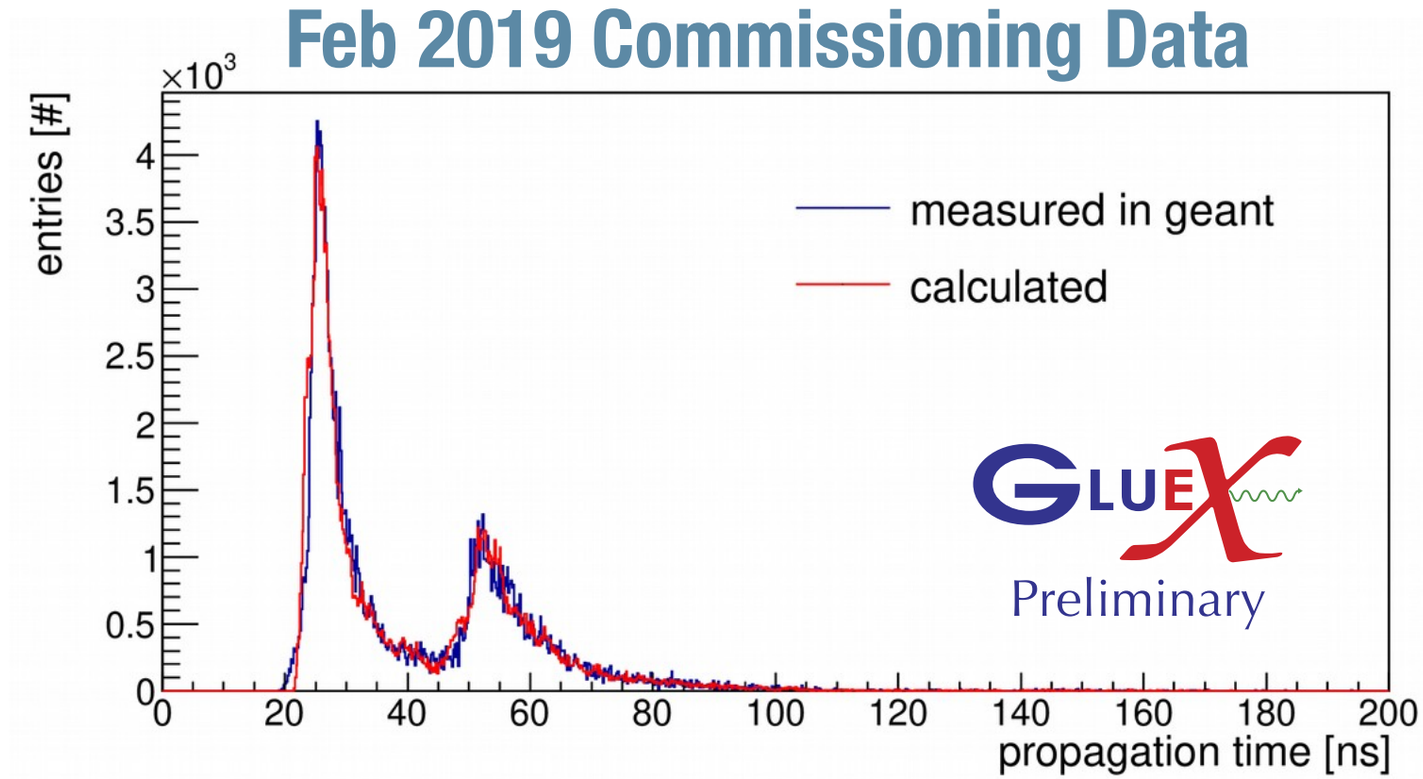
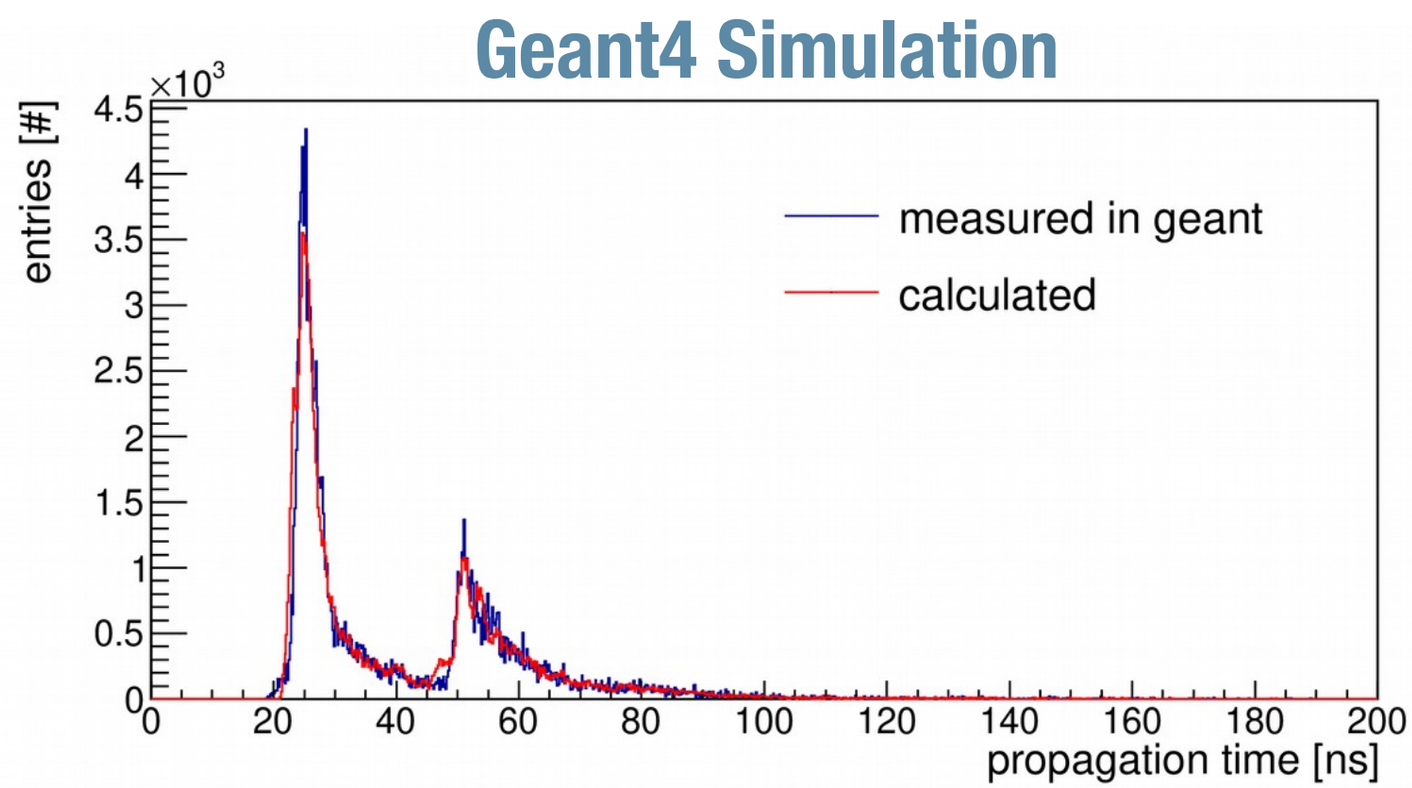


# DIRC performance

**Propagation time:** direct and reflected photons separable, reasonable data/MC agreement

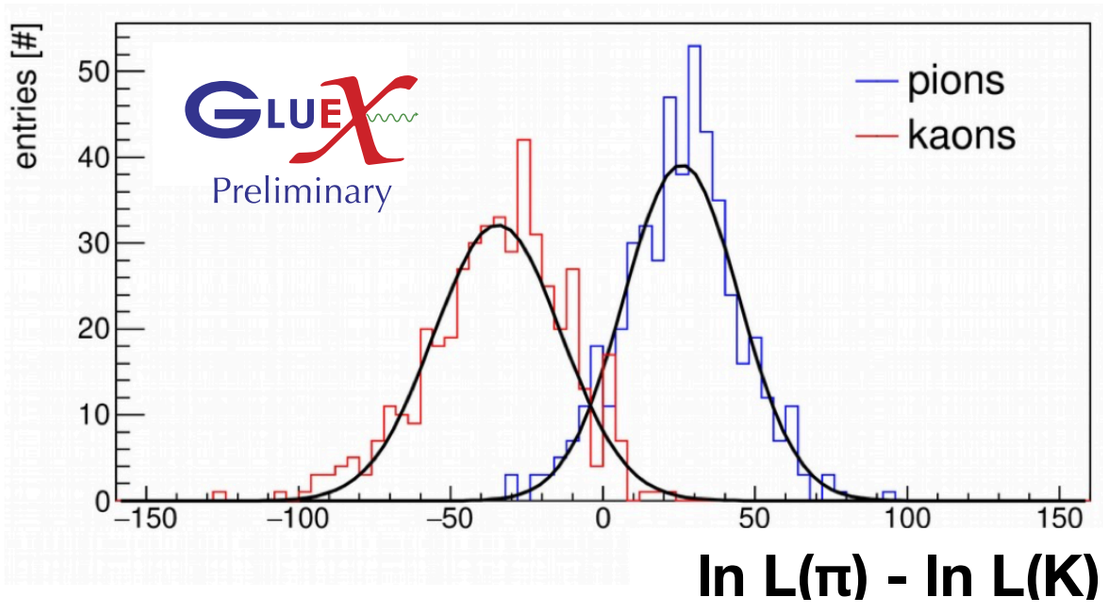


# DIRC performance

- **February 2019:** 10 days of GlueX beamtime with 1/2 of DIRC installed for commissioning
- Samples of exclusive ρ and ϕ production provide pure samples of π and K tracks for PID studies
- Initial studies show significant π/K separation, further studies underway to reach final performance

**π/K separation power @ 3 GeV**



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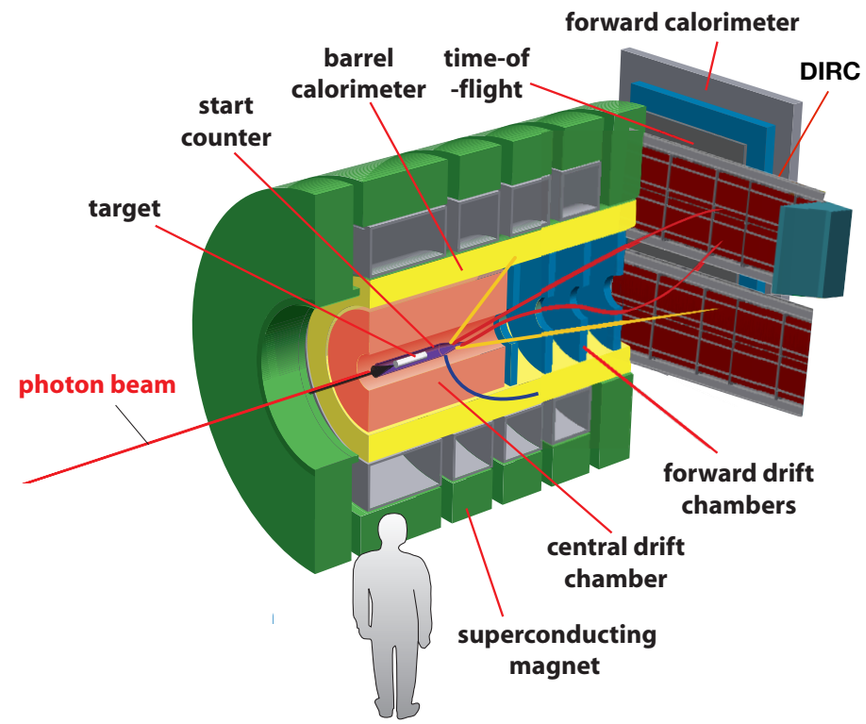
- **December 2019:** Full DIRC installation completed, 14 days of commissioning
- **Spring 2020:** GlueX-II high intensity running w/ DIRC

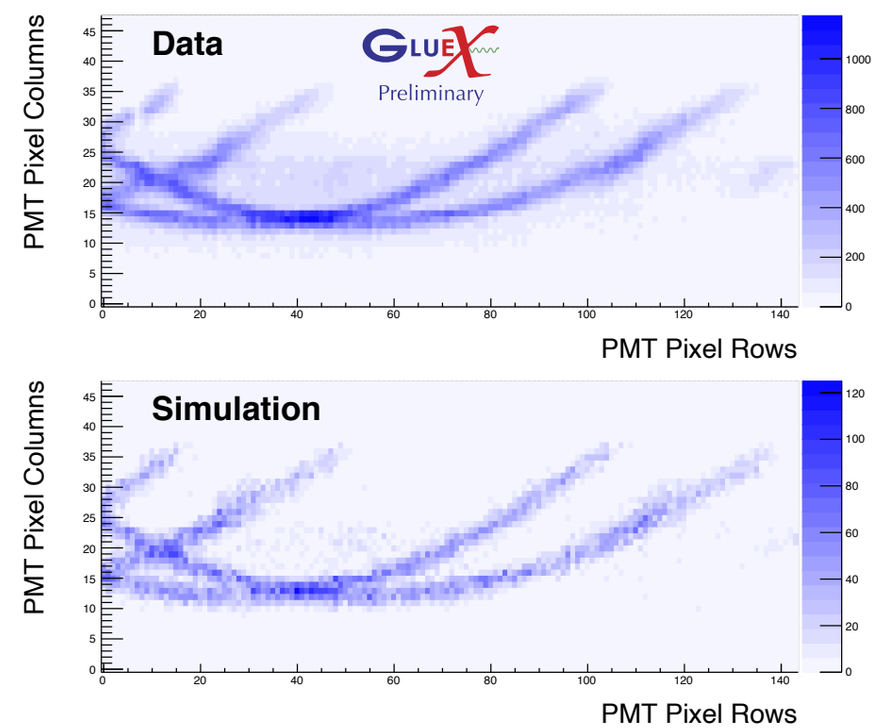
# Impact on KLF program

- For the large $W$ region (e.g. Kπ scattering), the forward angle (θ < 11°) coverage of the DIRC π/K separation could be quite useful
- What are relevant background processes for
  - $K_L p \to K^{\pm}\pi^{\mp}p$
  - $K_L n \to K^{-}\pi^{0}p$
- Are the kinematics of any of the hyperon program accessible for the DIRC angular coverage?

# Summary

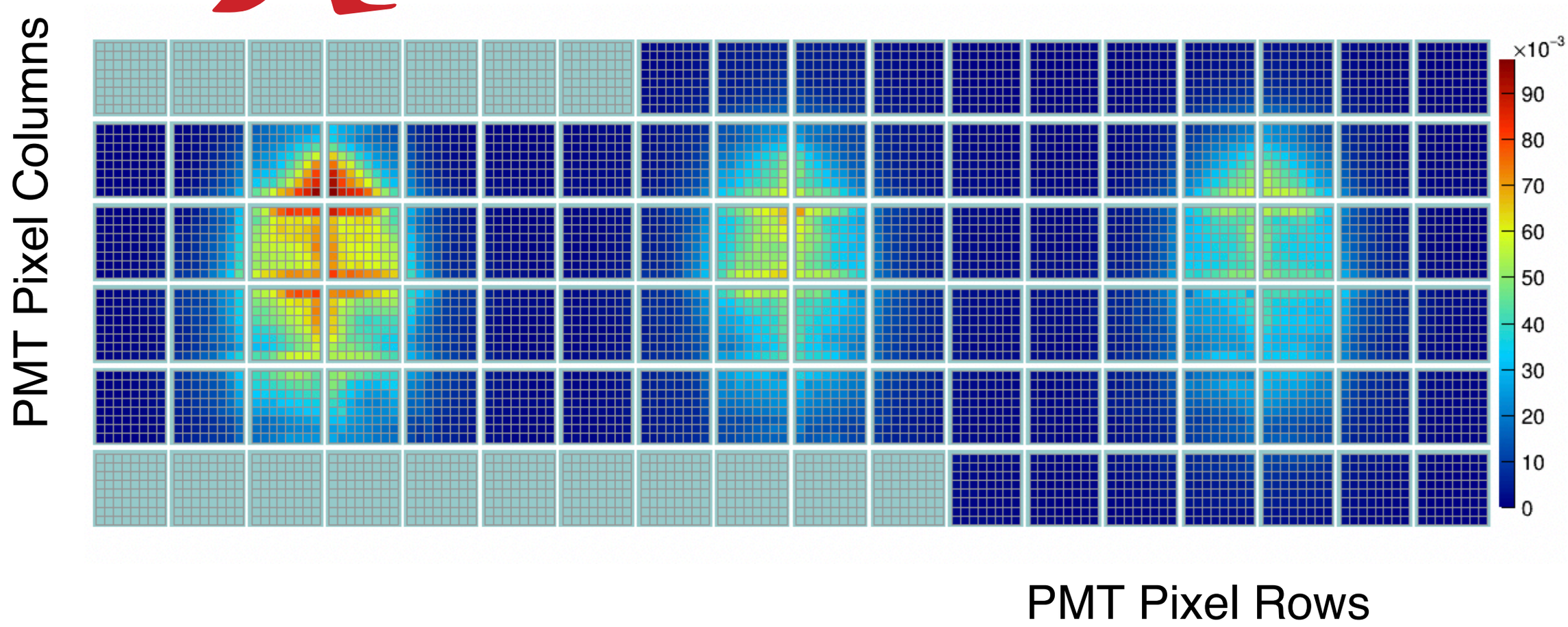
- Successful DIRC commissioning run with many lessons learned and analysis well underway
- The “High Intensity” phase of GlueX is underway to collect 5x higher statistics with the complete DIRC, enabling a robust strange meson program
- Background suppression for π/K/p mis-identification at KLF, needs further investigation



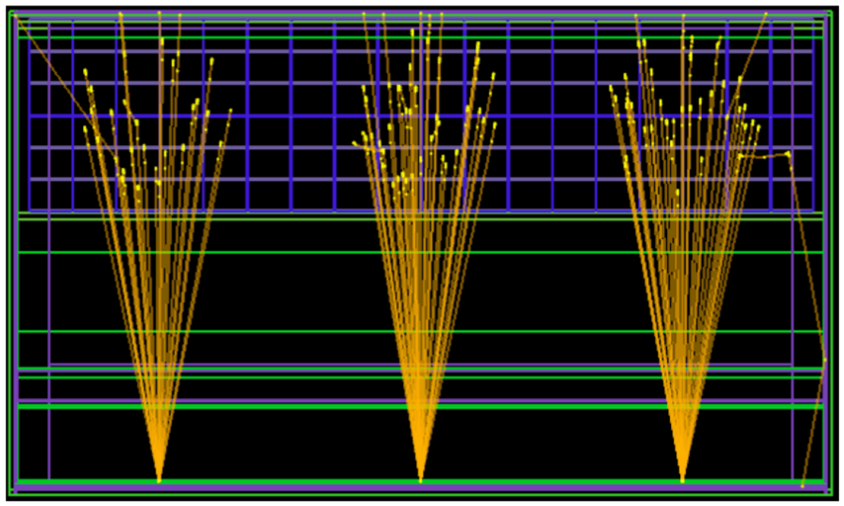



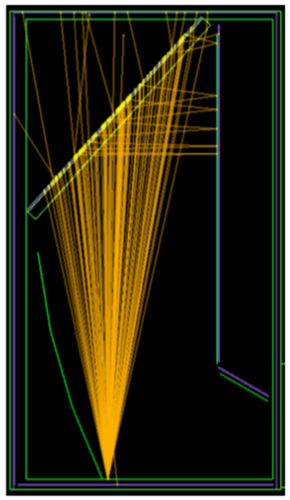

Supported by DE-SC0018224

# DIRC calibration system




- 405 nm LED pulser with 840 ps rise time, split over 3 fibers with 25° opening angle to cover the full MAPMT array
- Run in parallel with physics trigger for continuous monitoring





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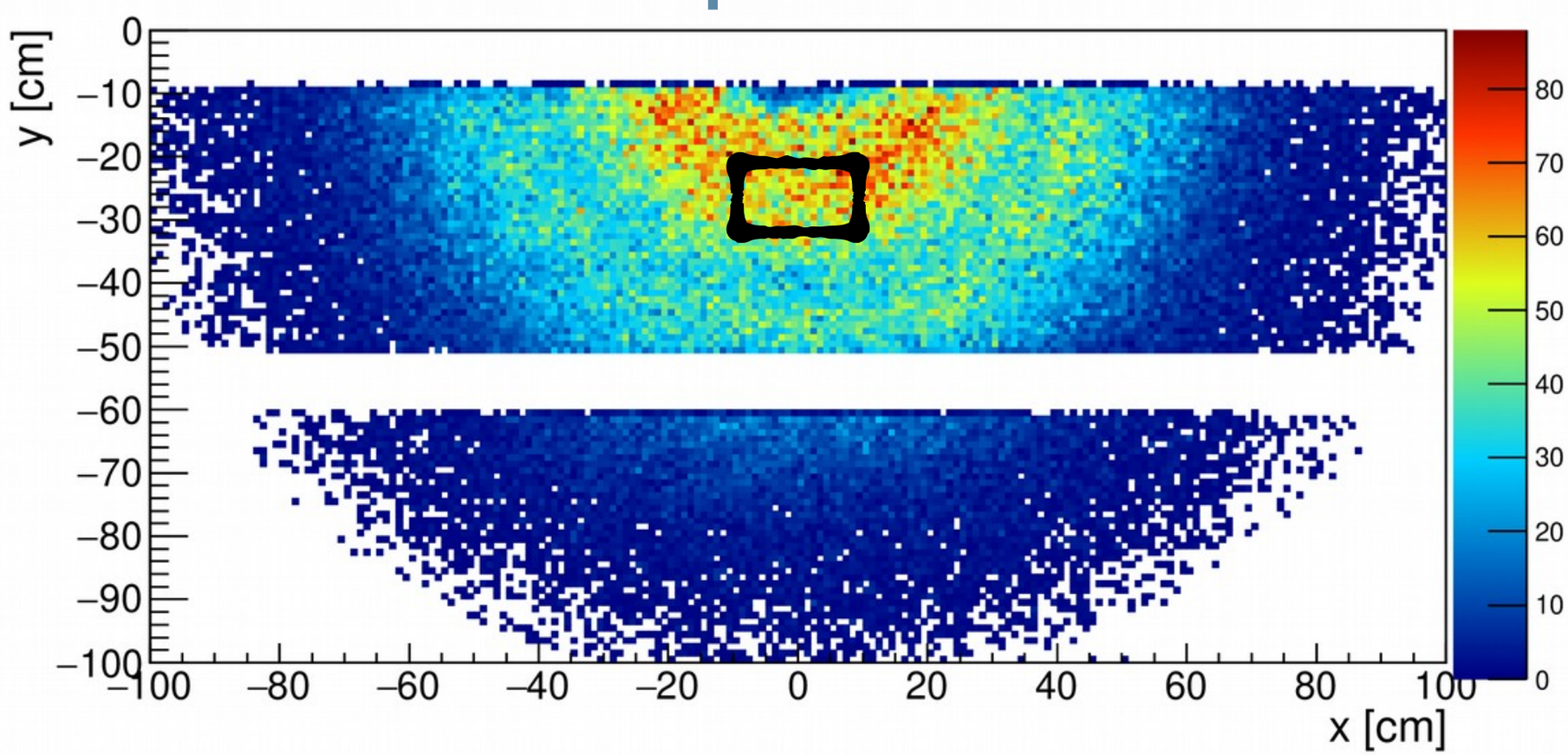
**π+ track extrapolation on DIRC wall**



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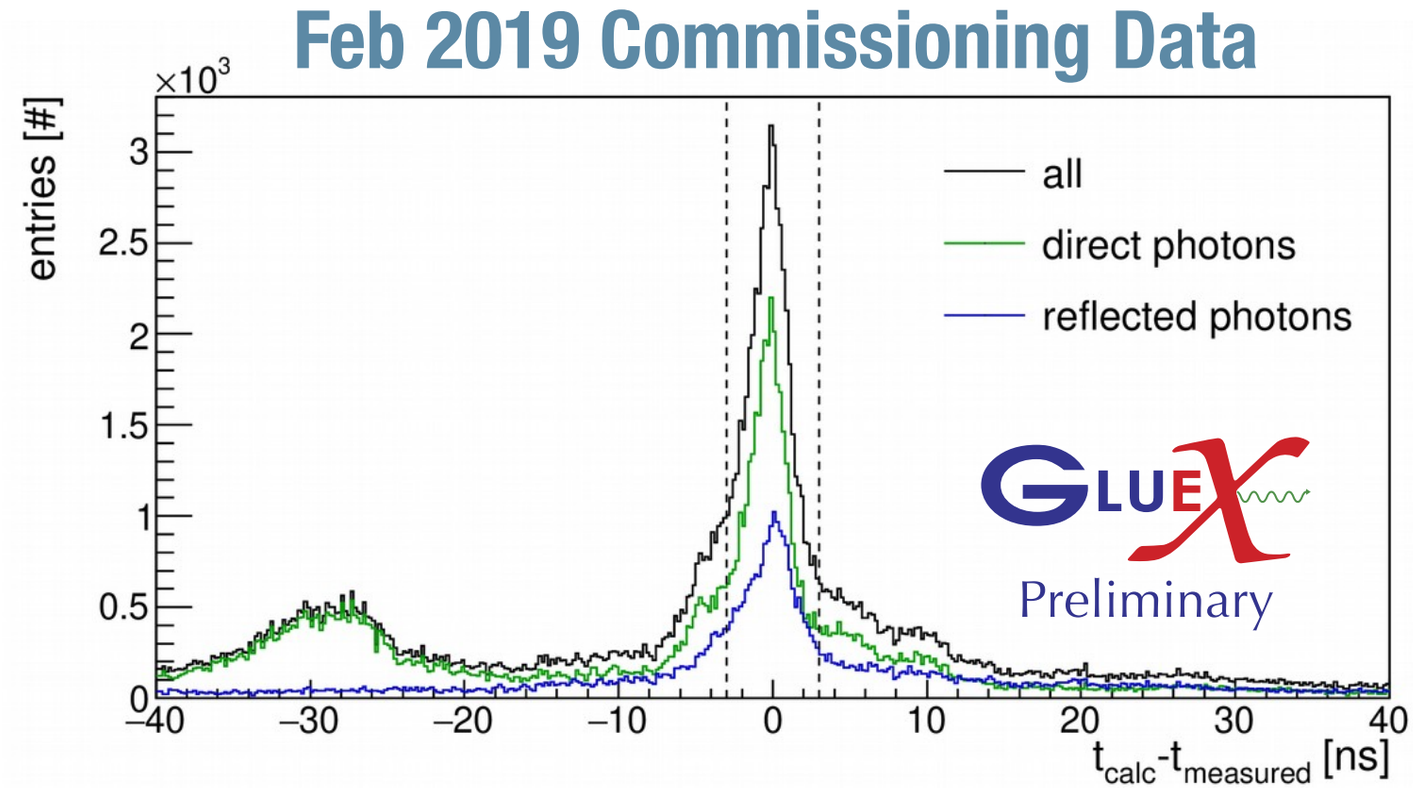
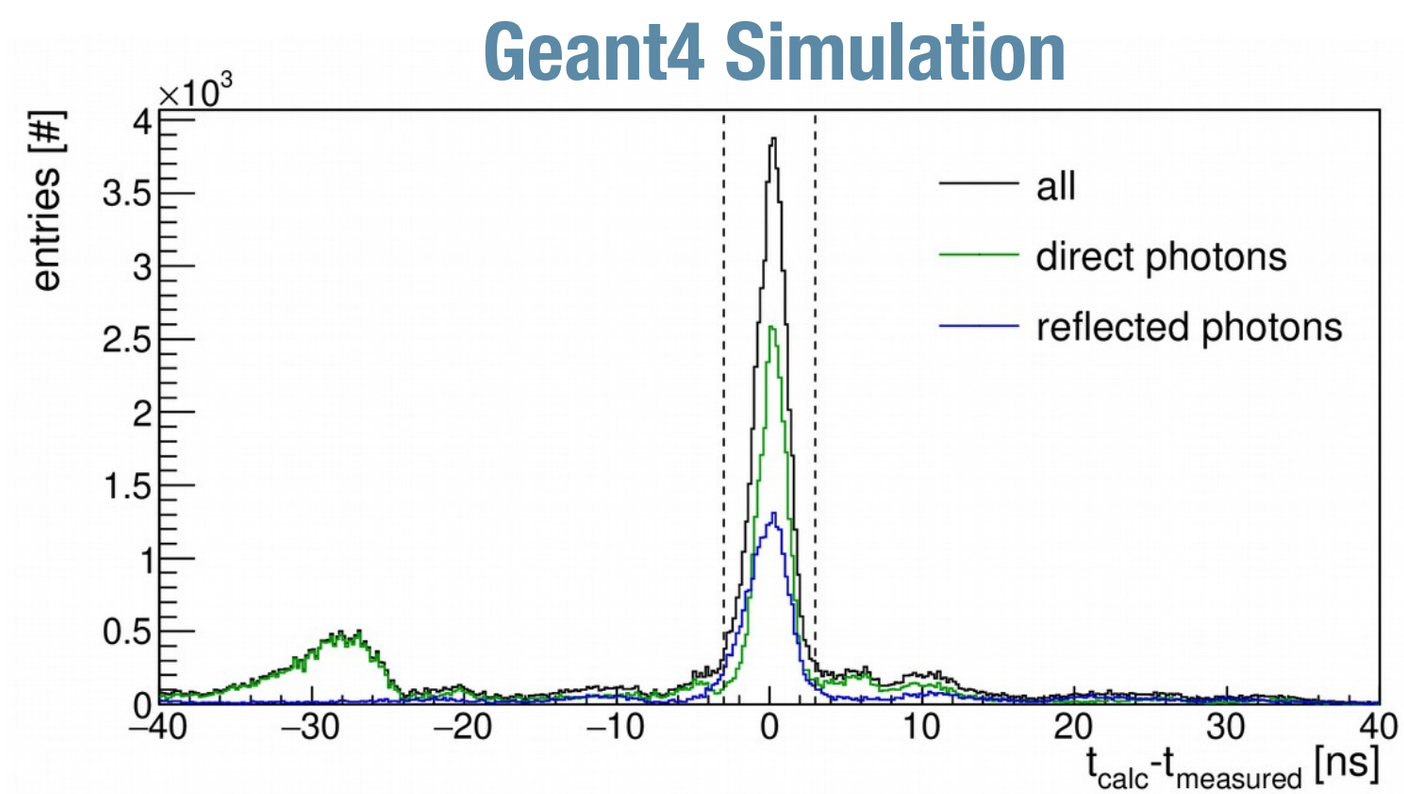
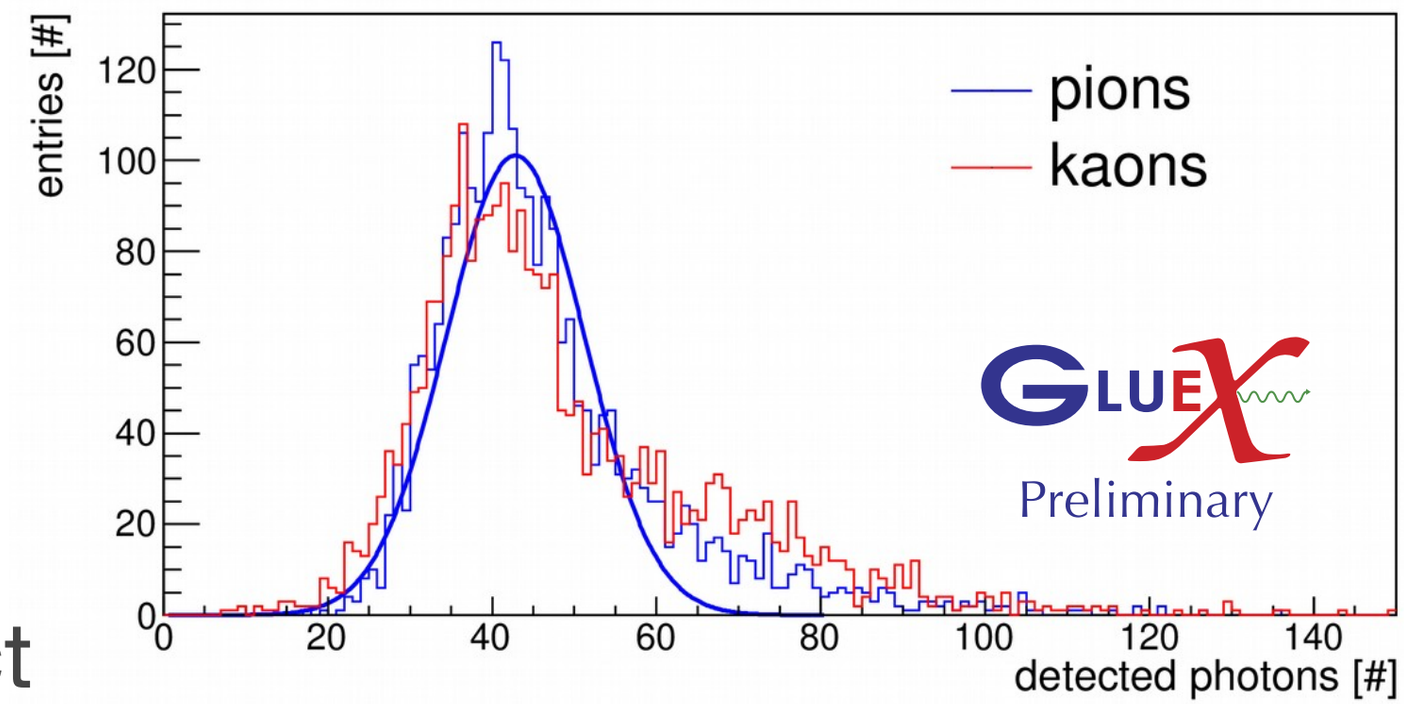


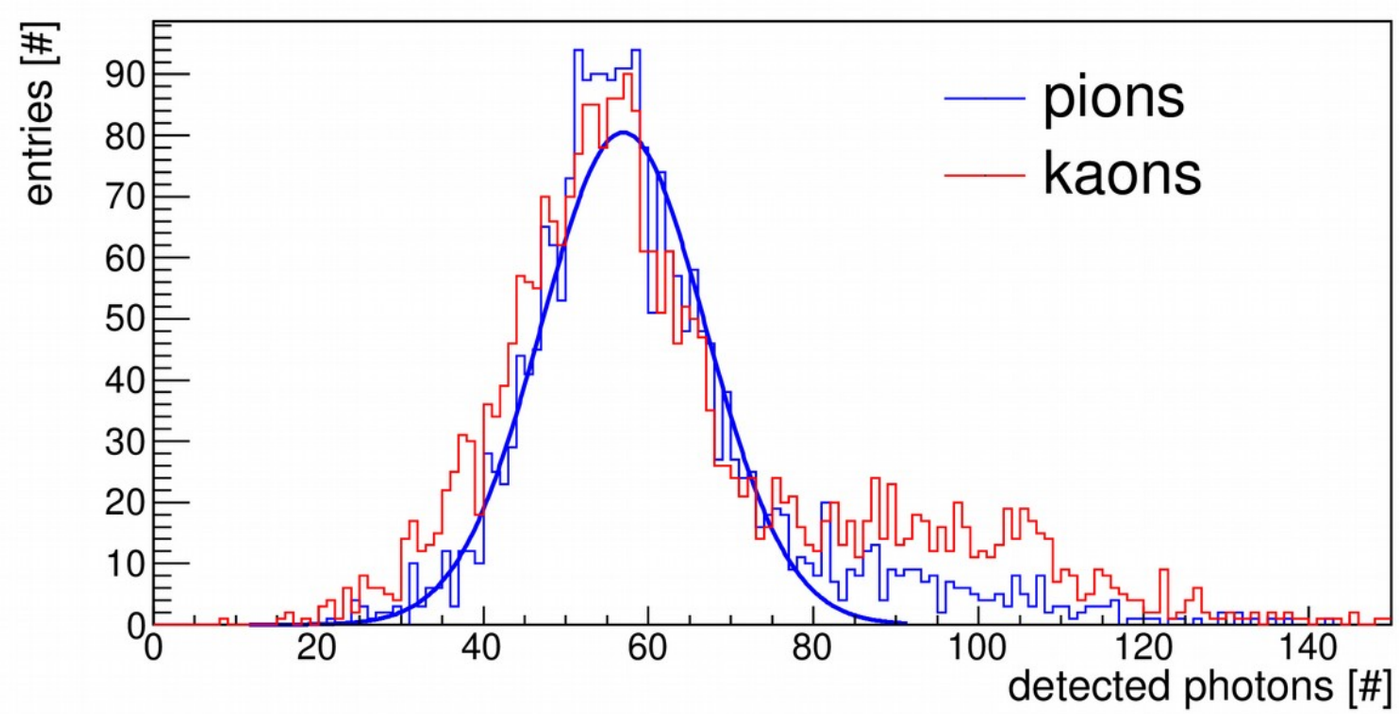



# DIRC performance

**Photon yields:**
simulation yields overestimated, suspect mirror simulation

**Feb 2019 Commissioning Data**




**Geant4 Simulation**