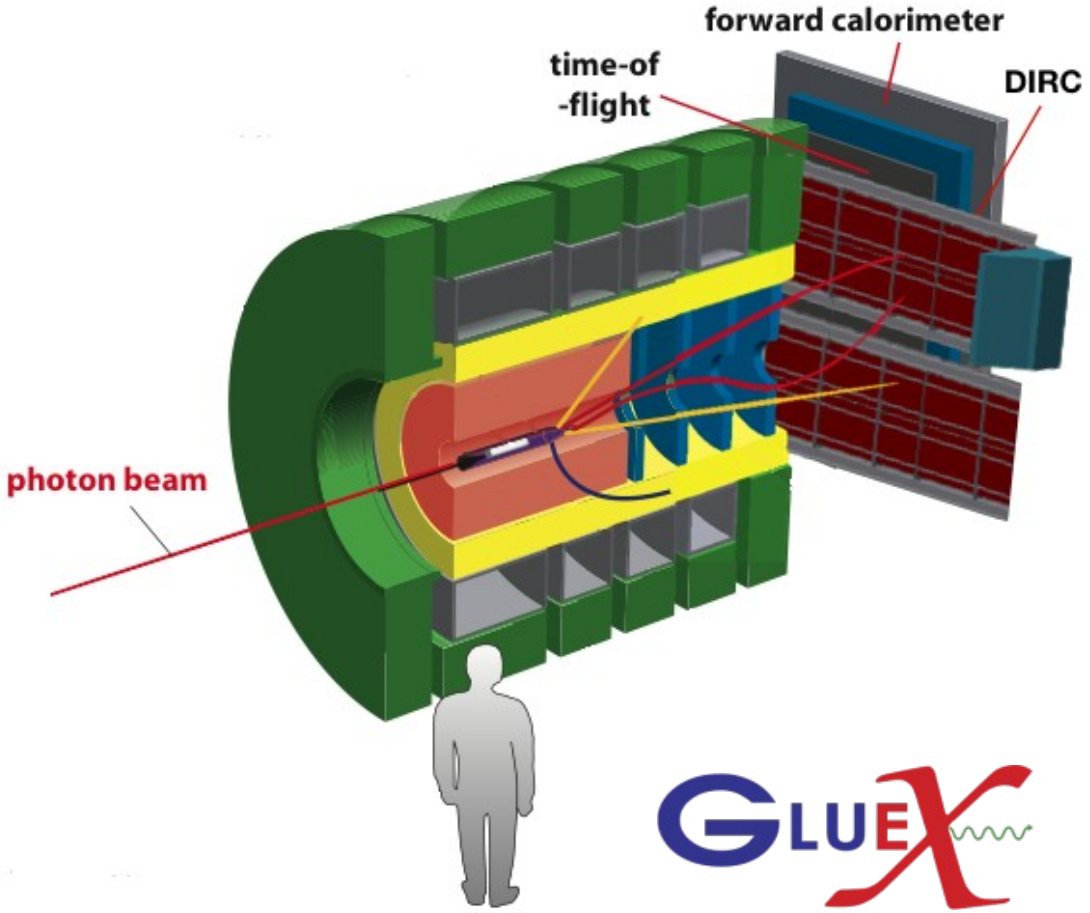
The DIRC Upgrade for the GlueX Experiment



DPG 2017 HK 44.2

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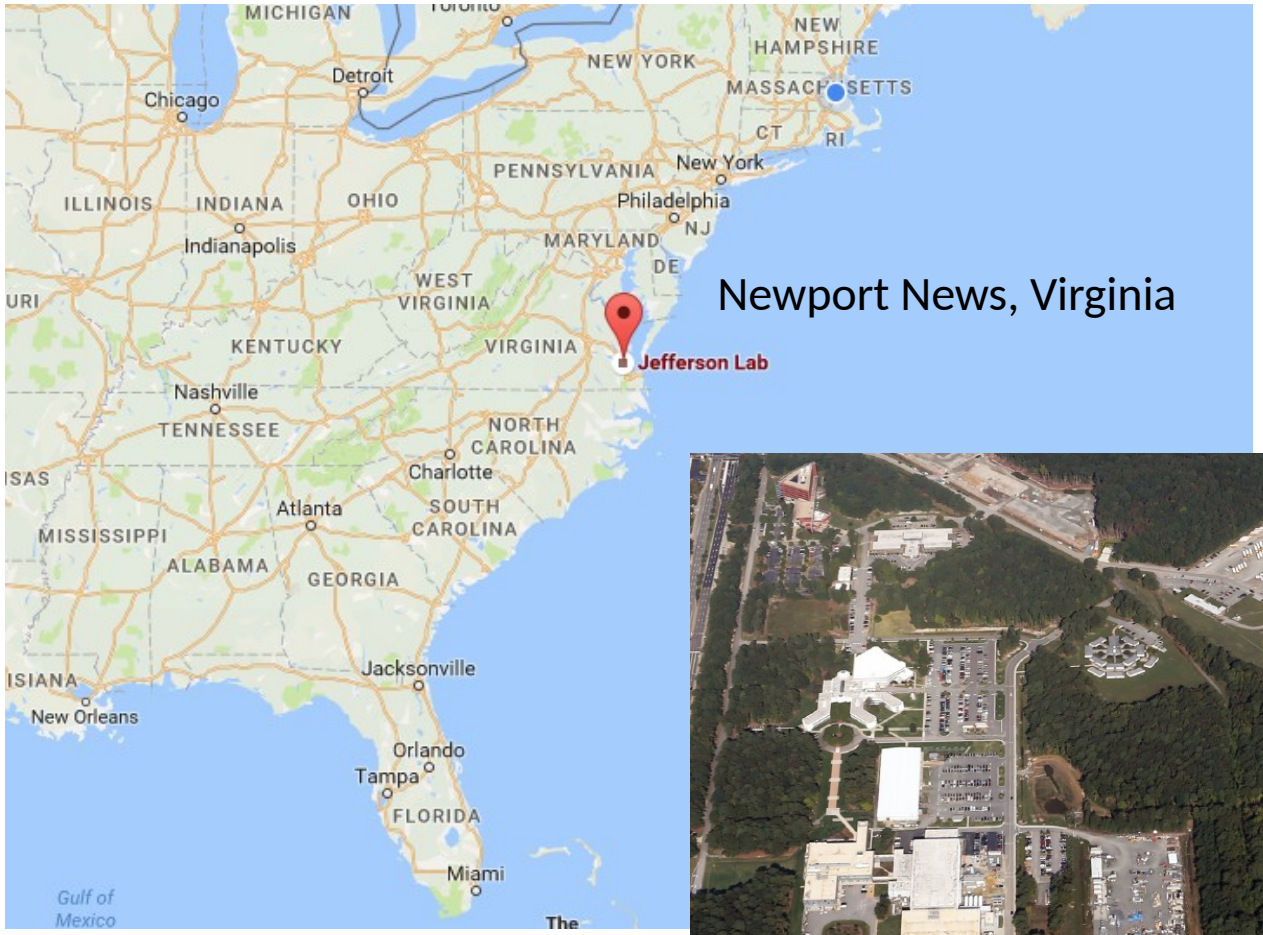
J. Schwiening
for the GlueX Collaboration

- GlueX Experiment
- Upgrade with DIRC
- Design Evolution
- Reconstruction Methods
- Outlook

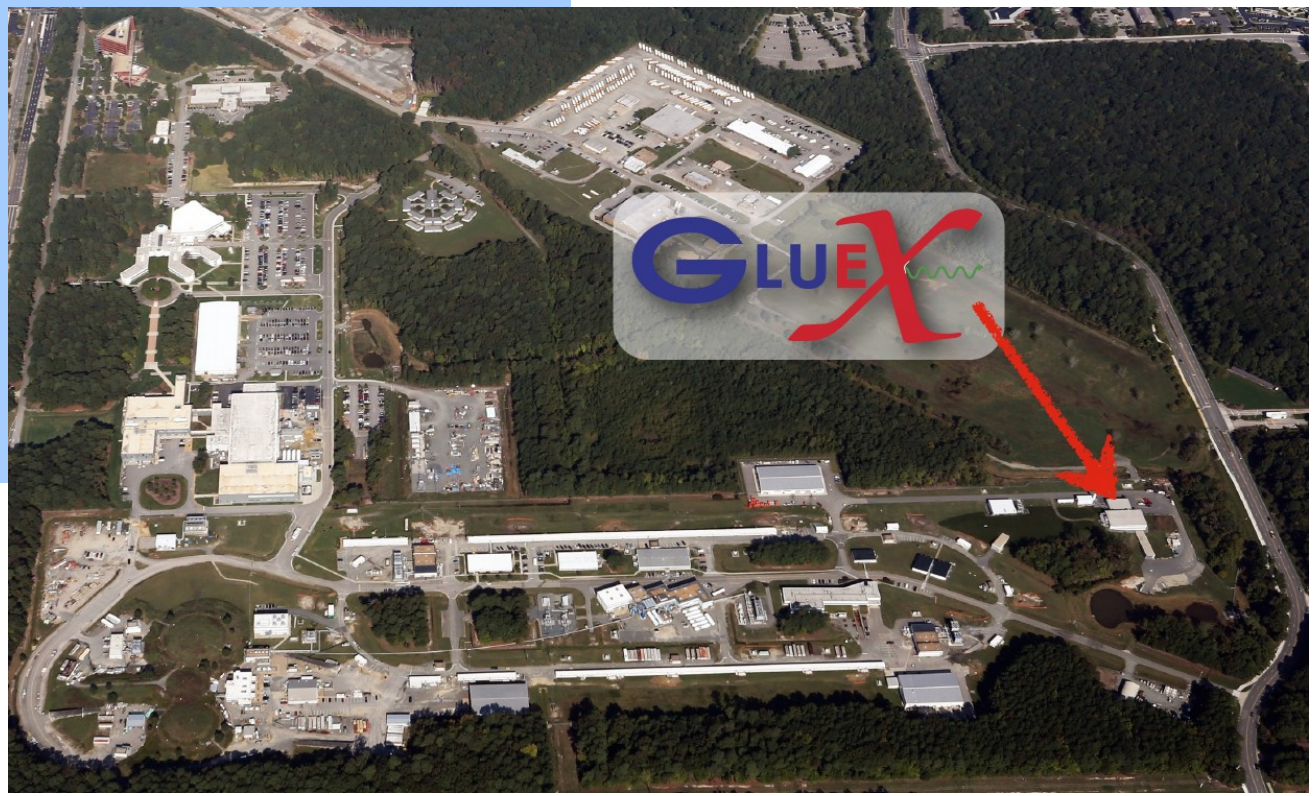
Jefferson Lab

GSI

Jefferson Laboratory



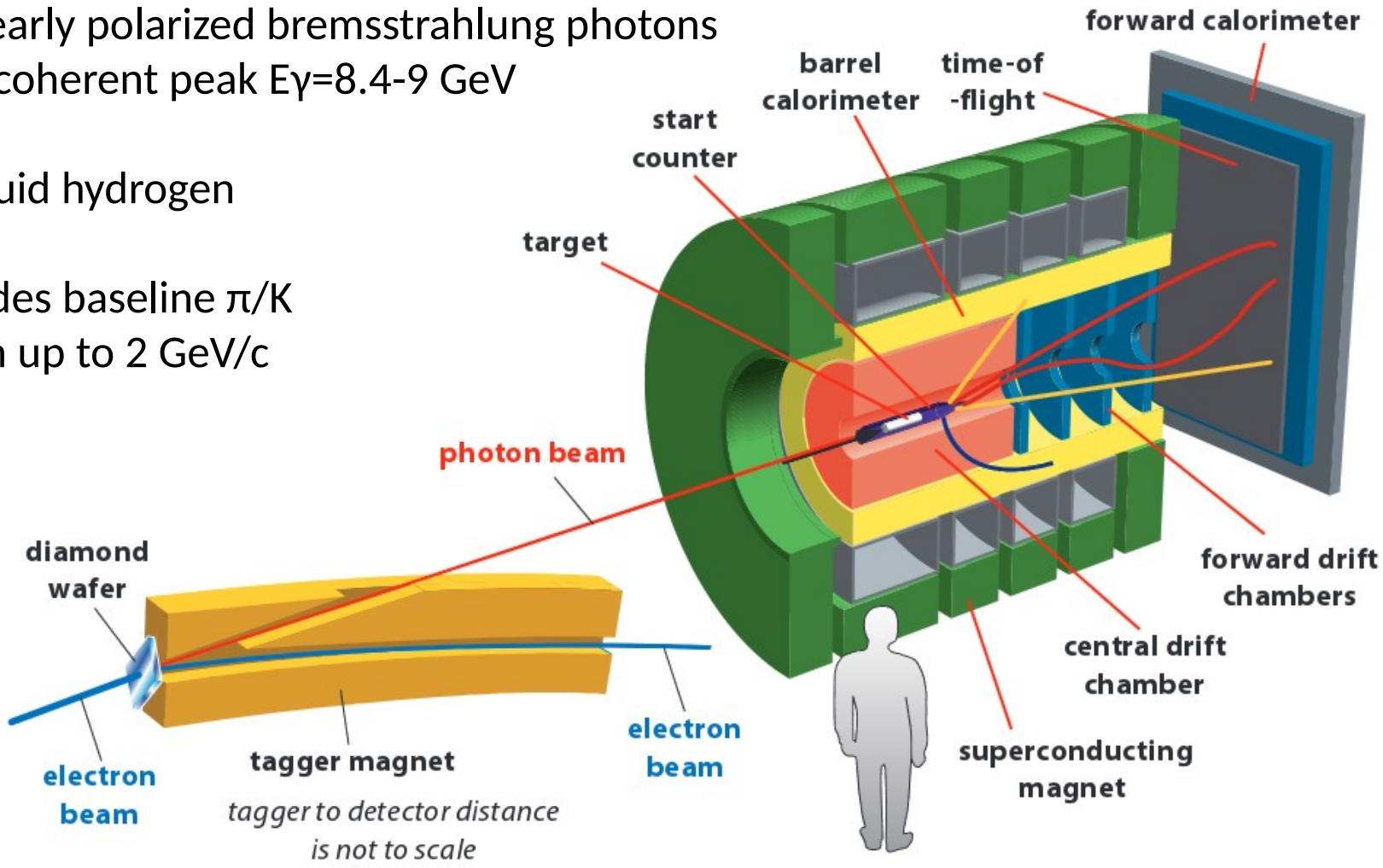
Newport News, Virginia



Continuous Electron Beam Accelerator Facility (CEBAF) 12 GeV

GlueX Experiment

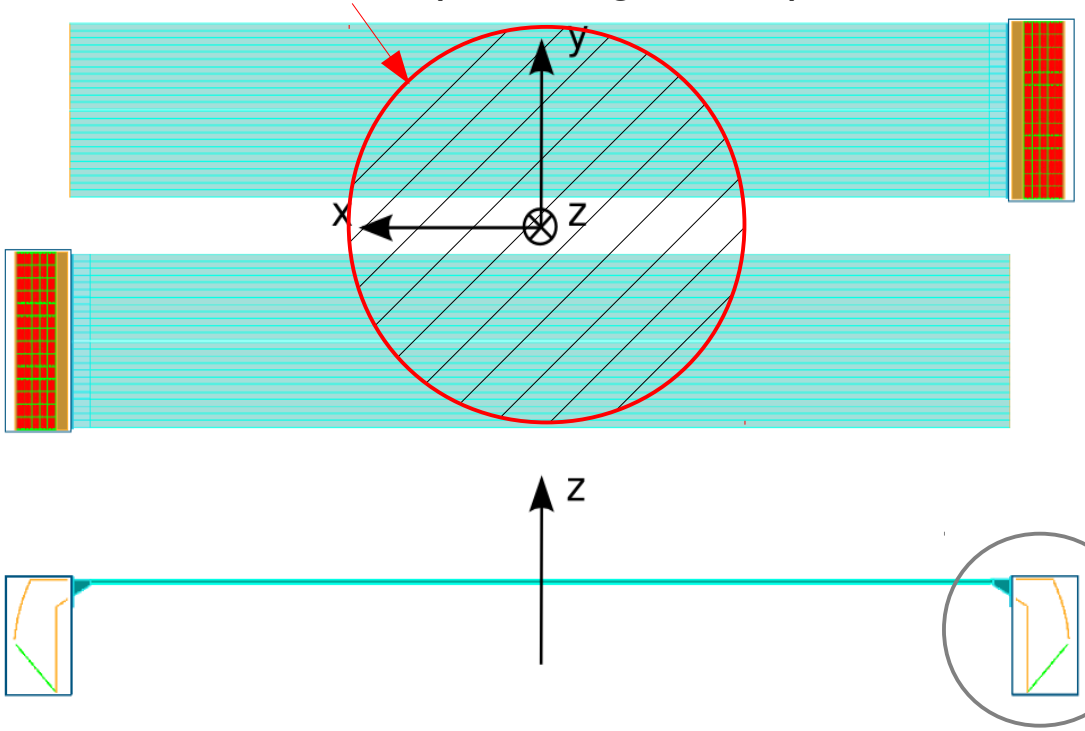
- Light quark hybrid meson spectroscopy
- Beam: linearly polarized bremsstrahlung photons 10^8 γ/s in coherent peak Eγ=8.4-9 GeV
- Target: liquid hydrogen
- TOF provides baseline π/K separation up to 2 GeV/c

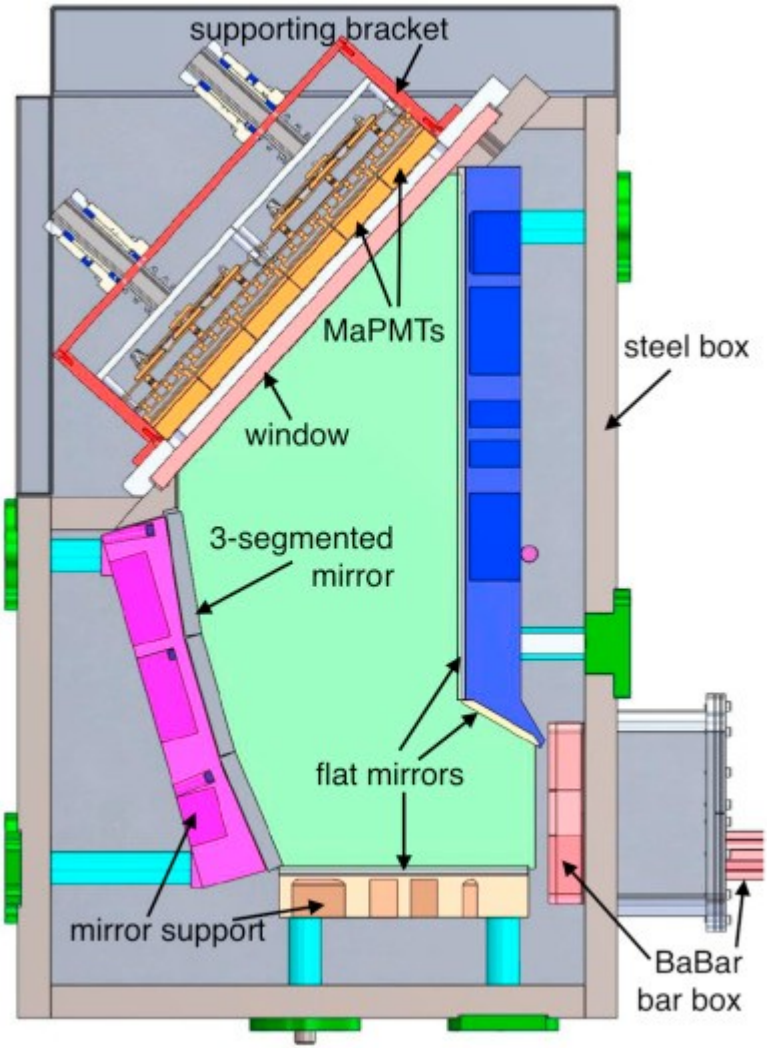


GlueX DIRC Upgrade

- **Radiator:** 48 fused silica bars, each 4.9 m long
  Reused from BaBar Experiment
- **Expansion volume:** Optical box filled with distilled water
- **Focusing:** segmented mirror

2-11° polar angle acceptance





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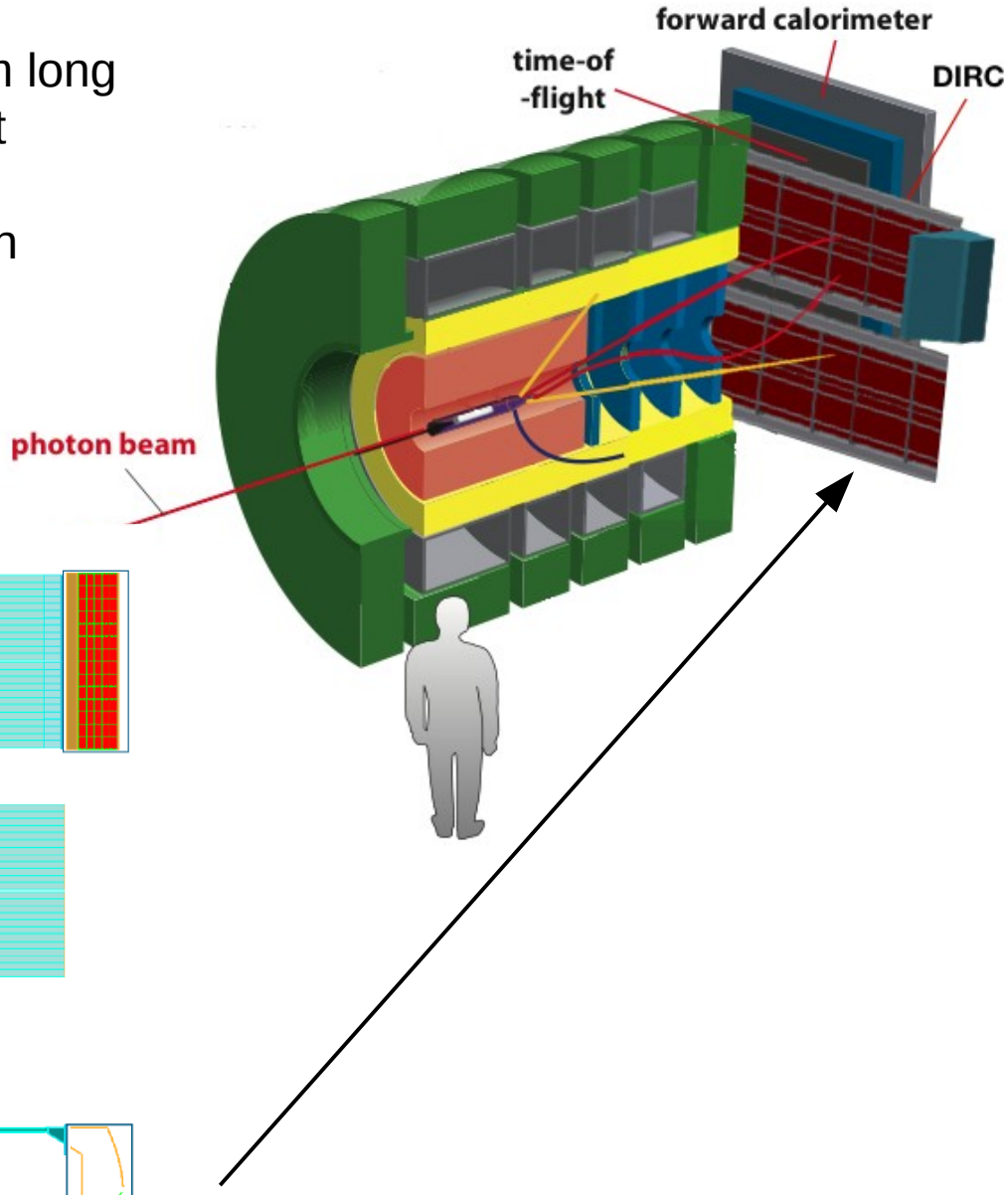

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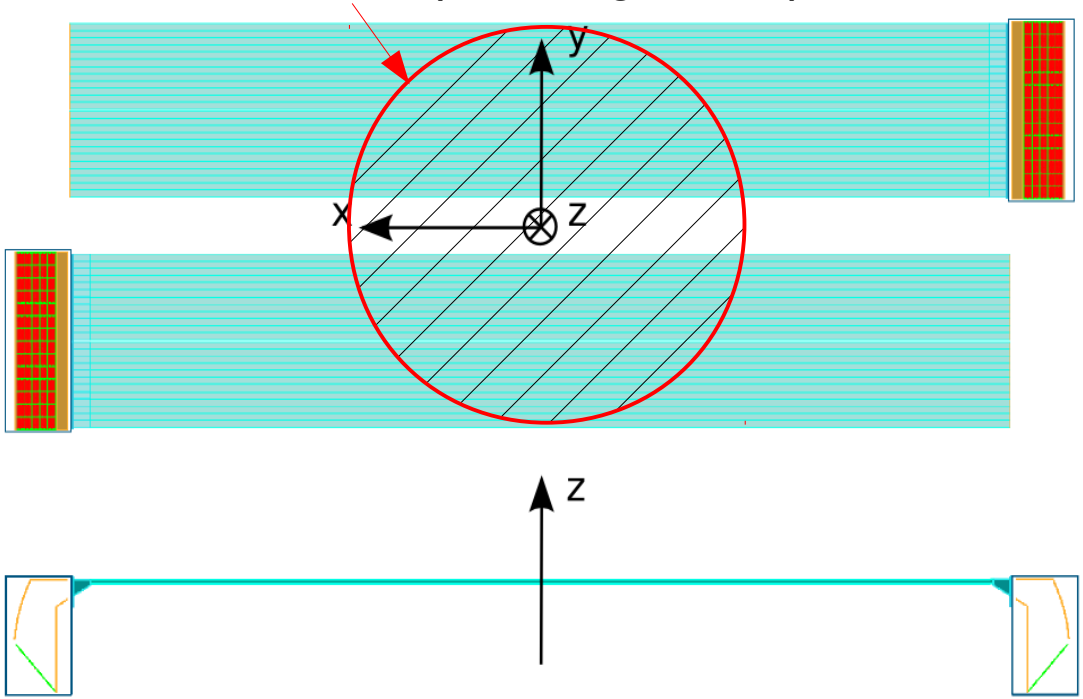
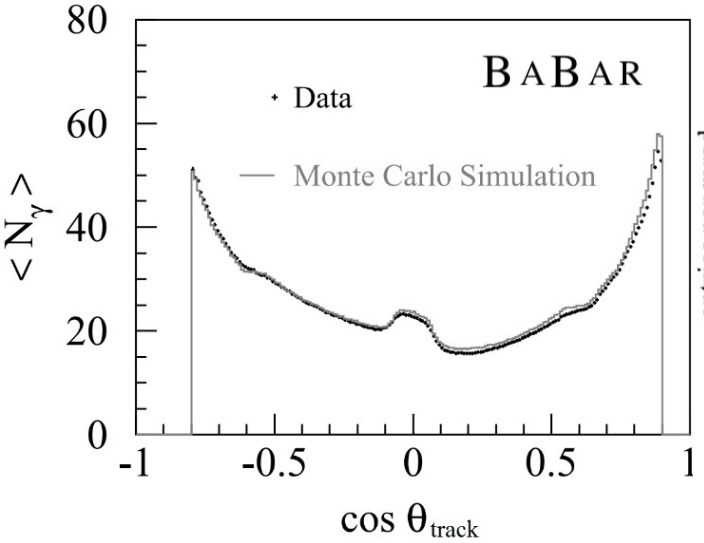
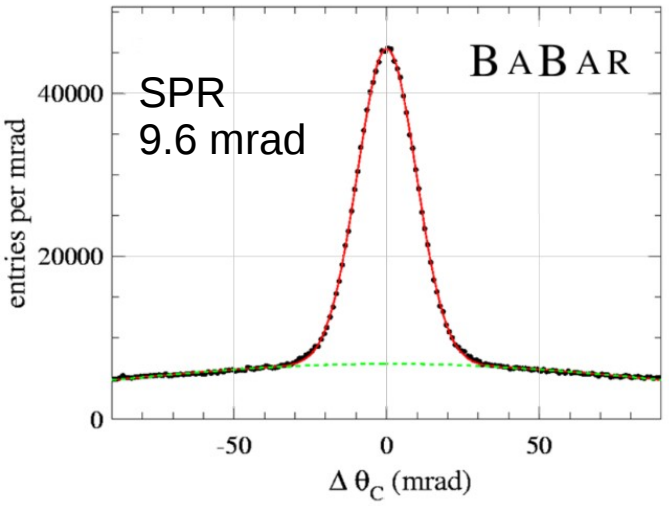
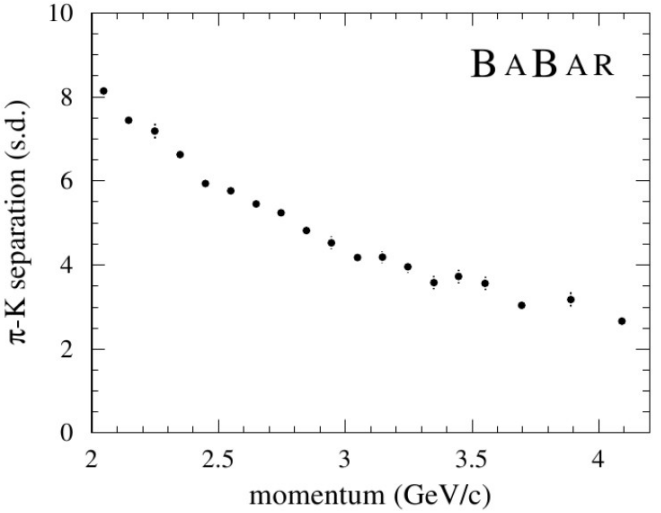


Expected Performance

- Based on BaBar results:





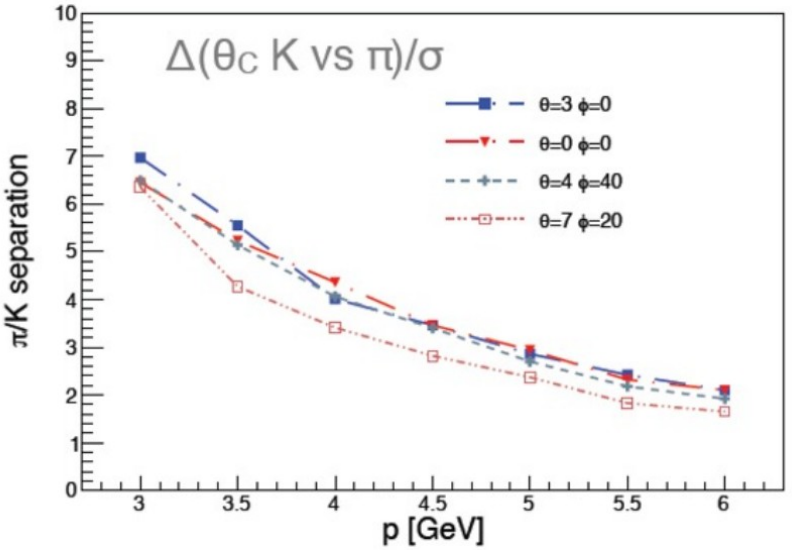


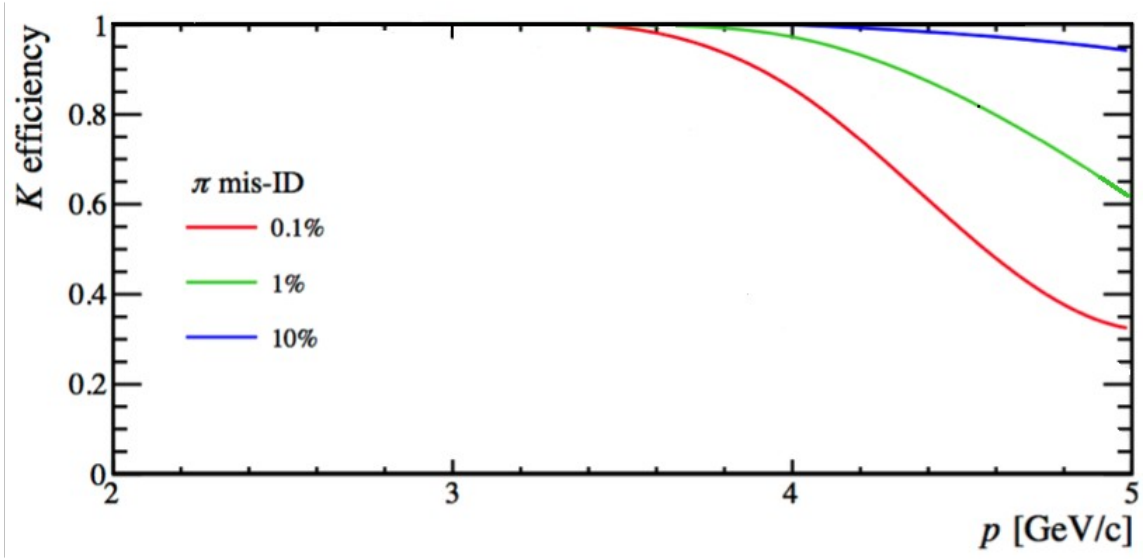
=> 3 s.d. π/K separation up to 4 GeV/c

- GlueX improvements:
  - Smaller expansion volume (due to focusing)
  - PMTs with better quantum efficiency => higher photon yield

Expected Performance

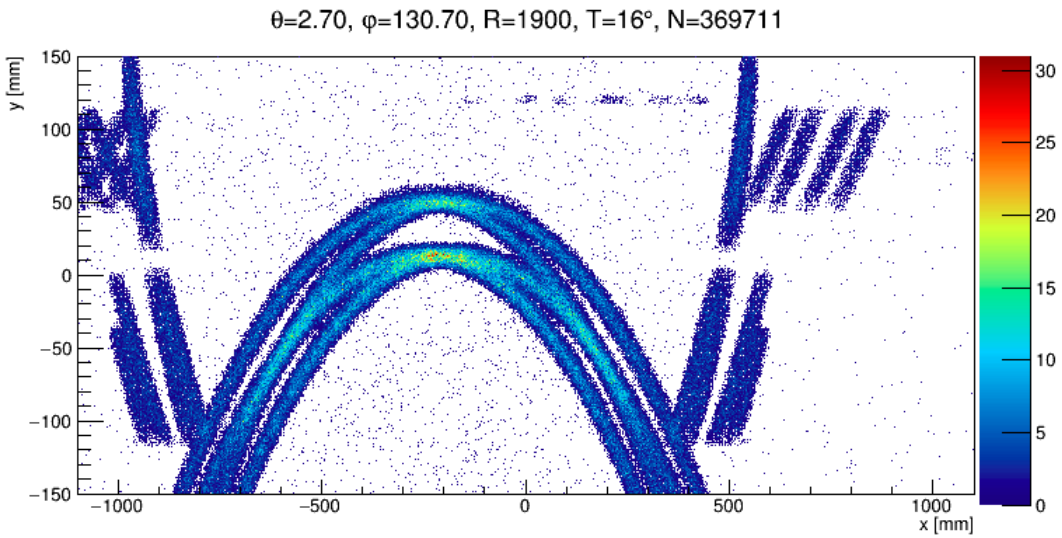
Conservative estimate of performance:

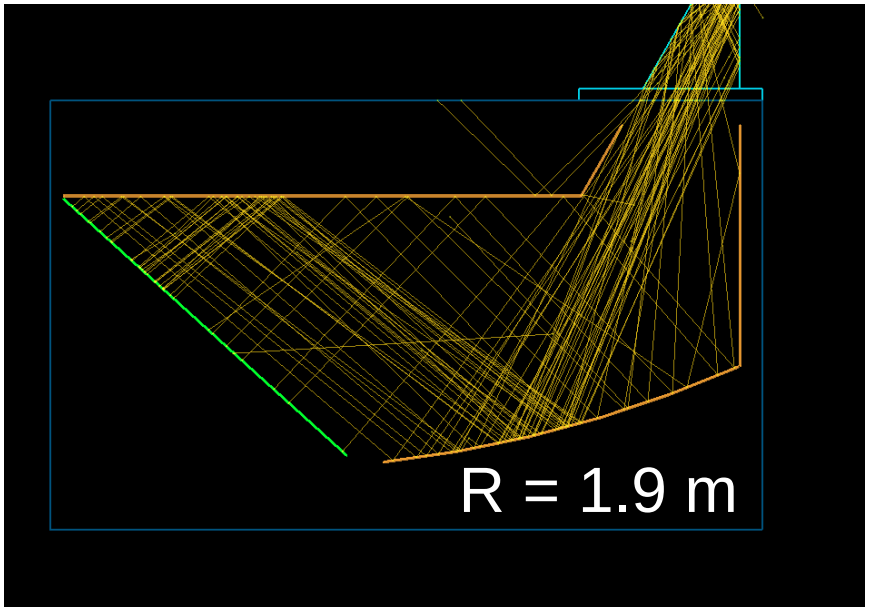


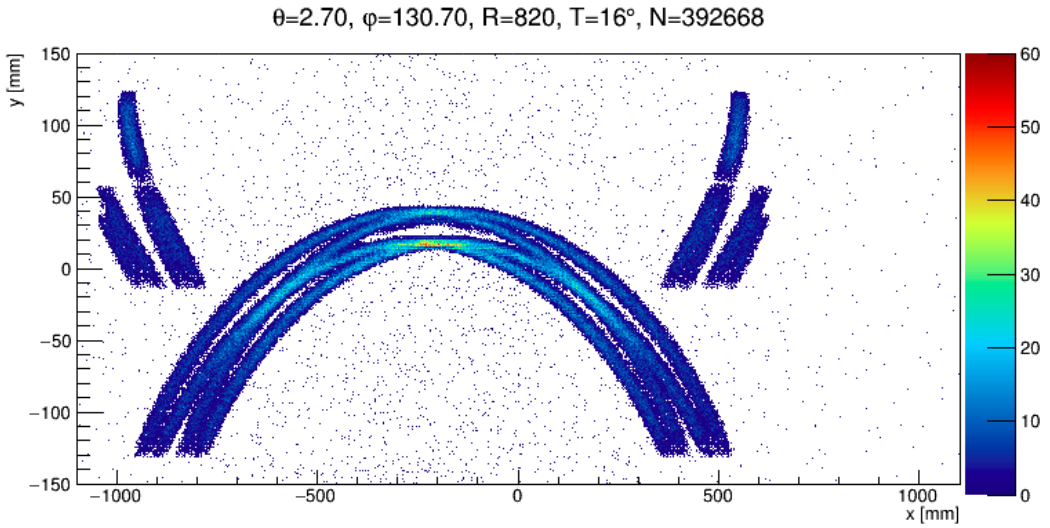


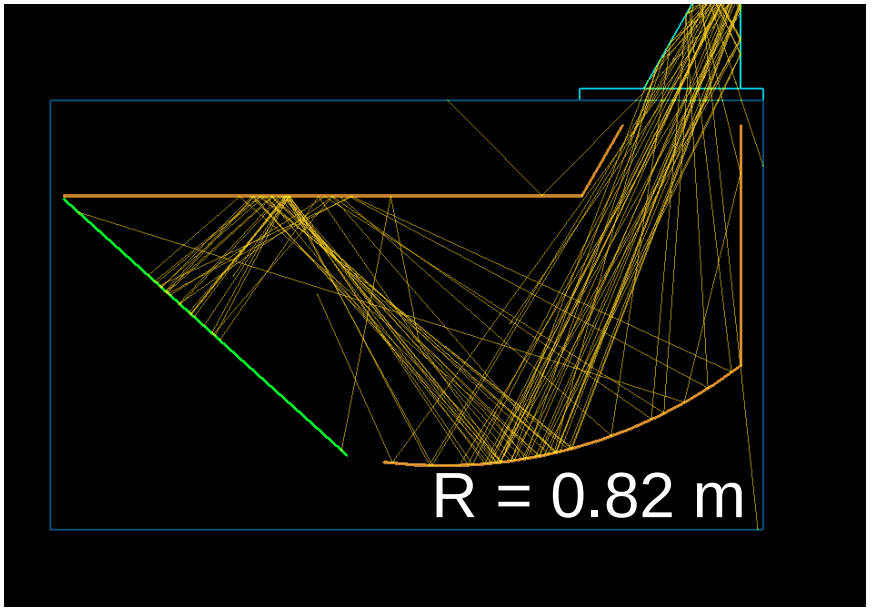
➡ Access to very high purity event selections (99%)

Design Evolution: Focusing Mirror









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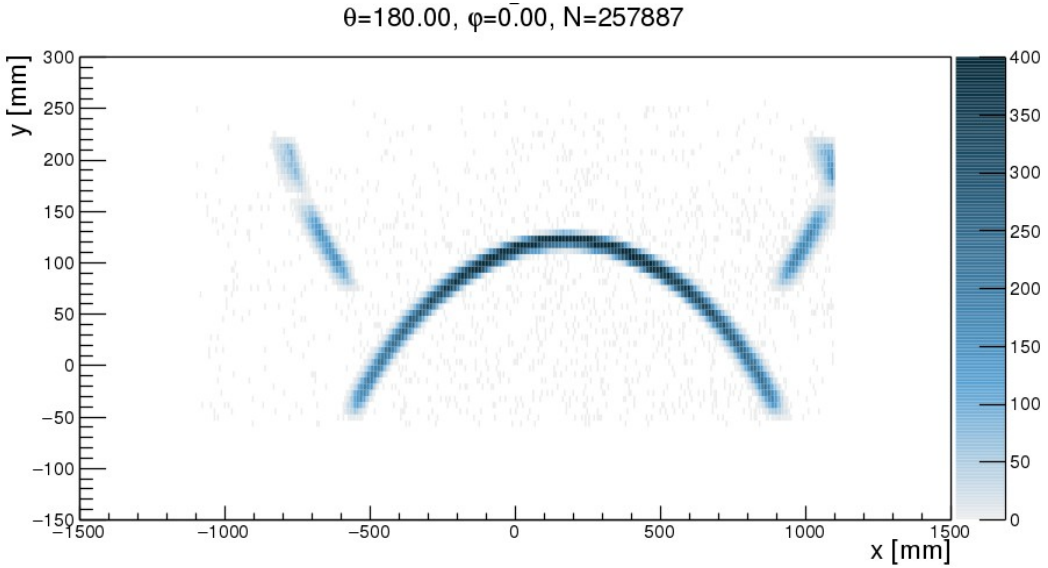
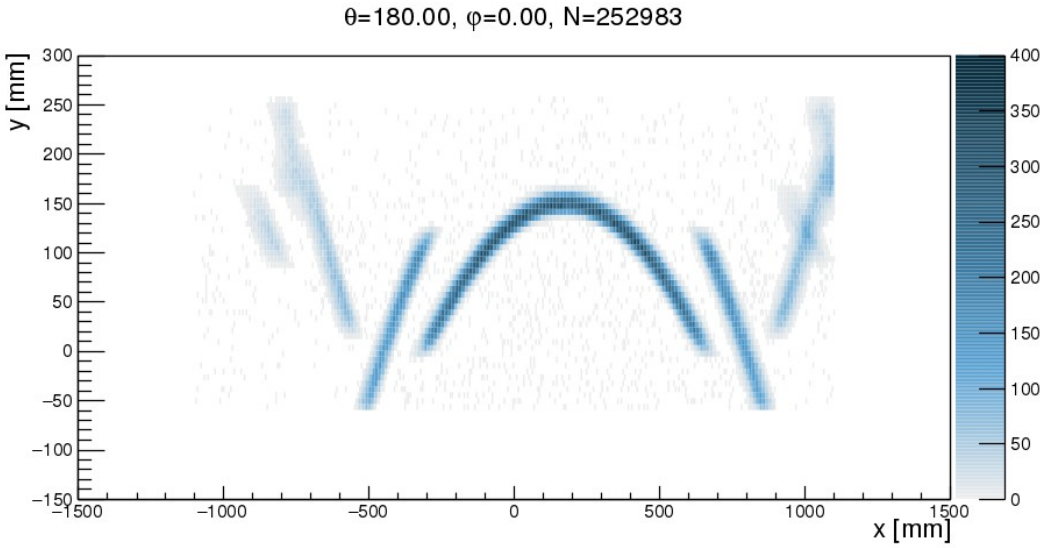
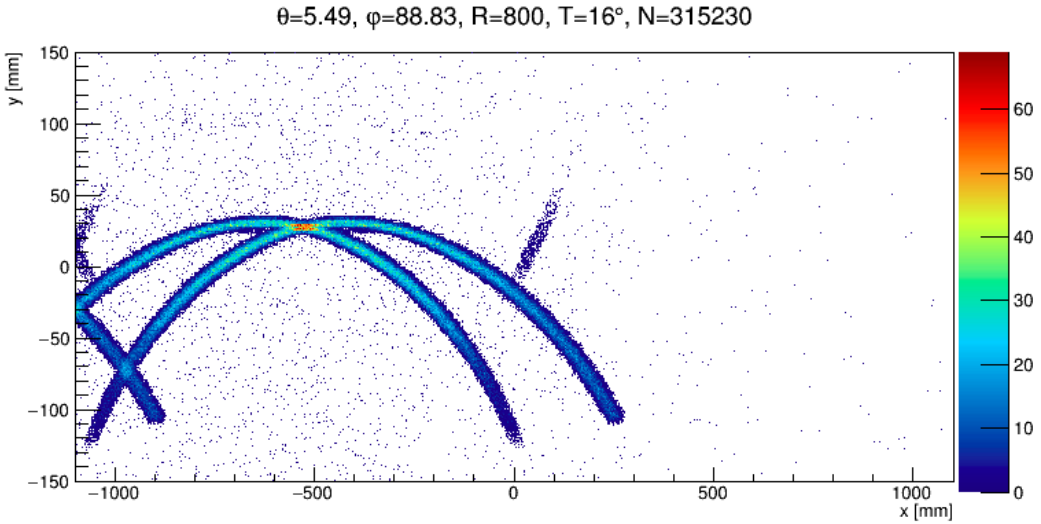


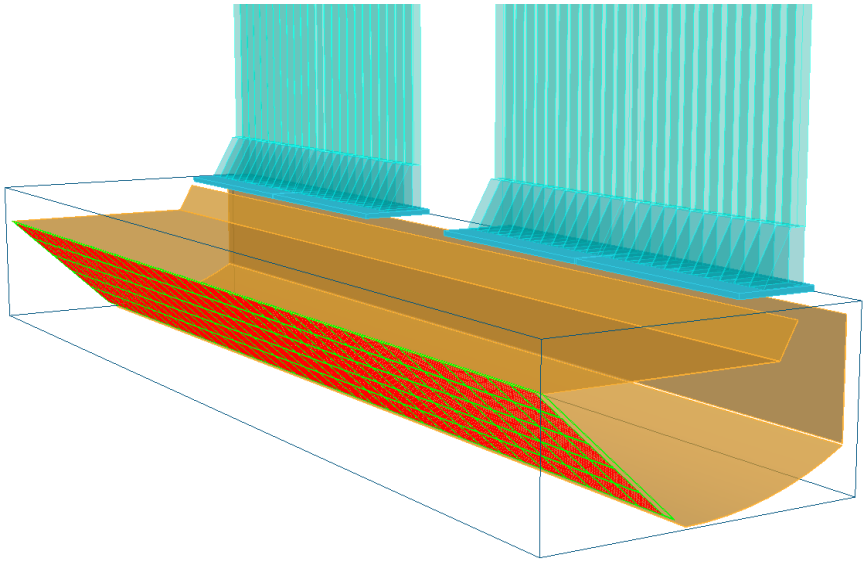
Cylindrical mirror
can be expensive to build

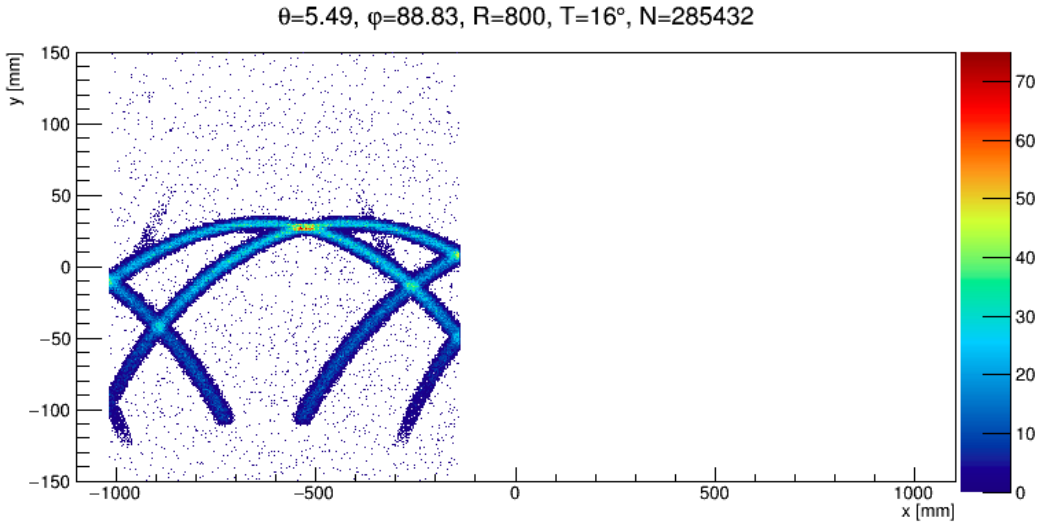


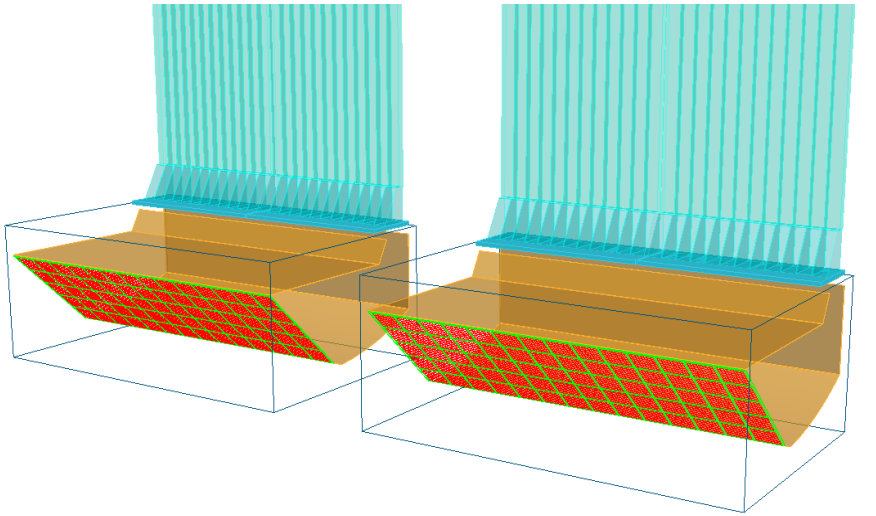
Segmented mirror
3 flat mirrors

Design Evolution: Optical Box



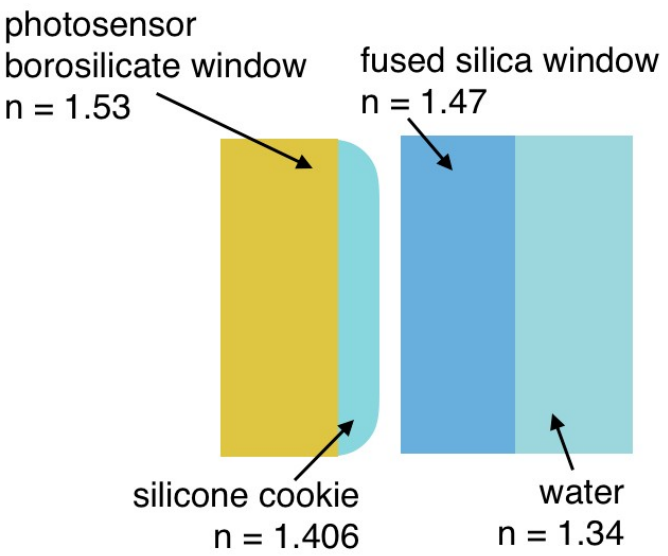


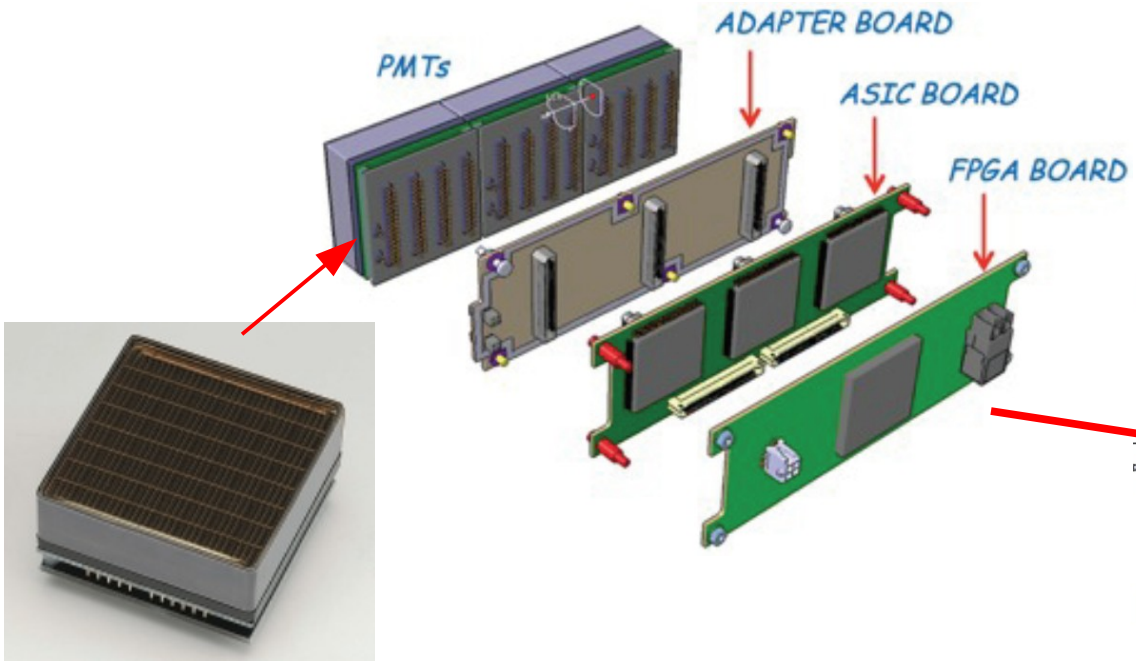


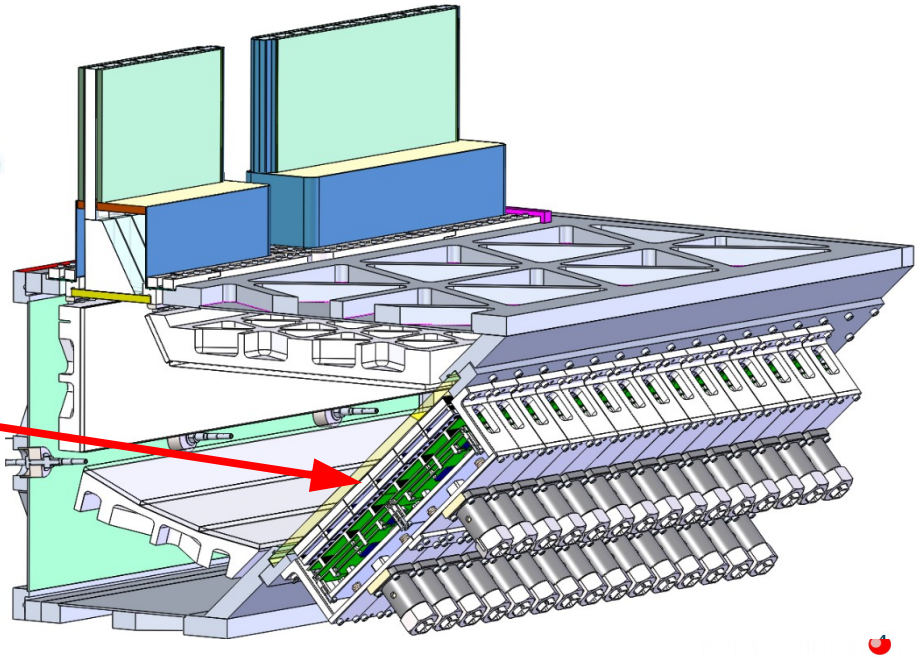


Photon Detection and Readout

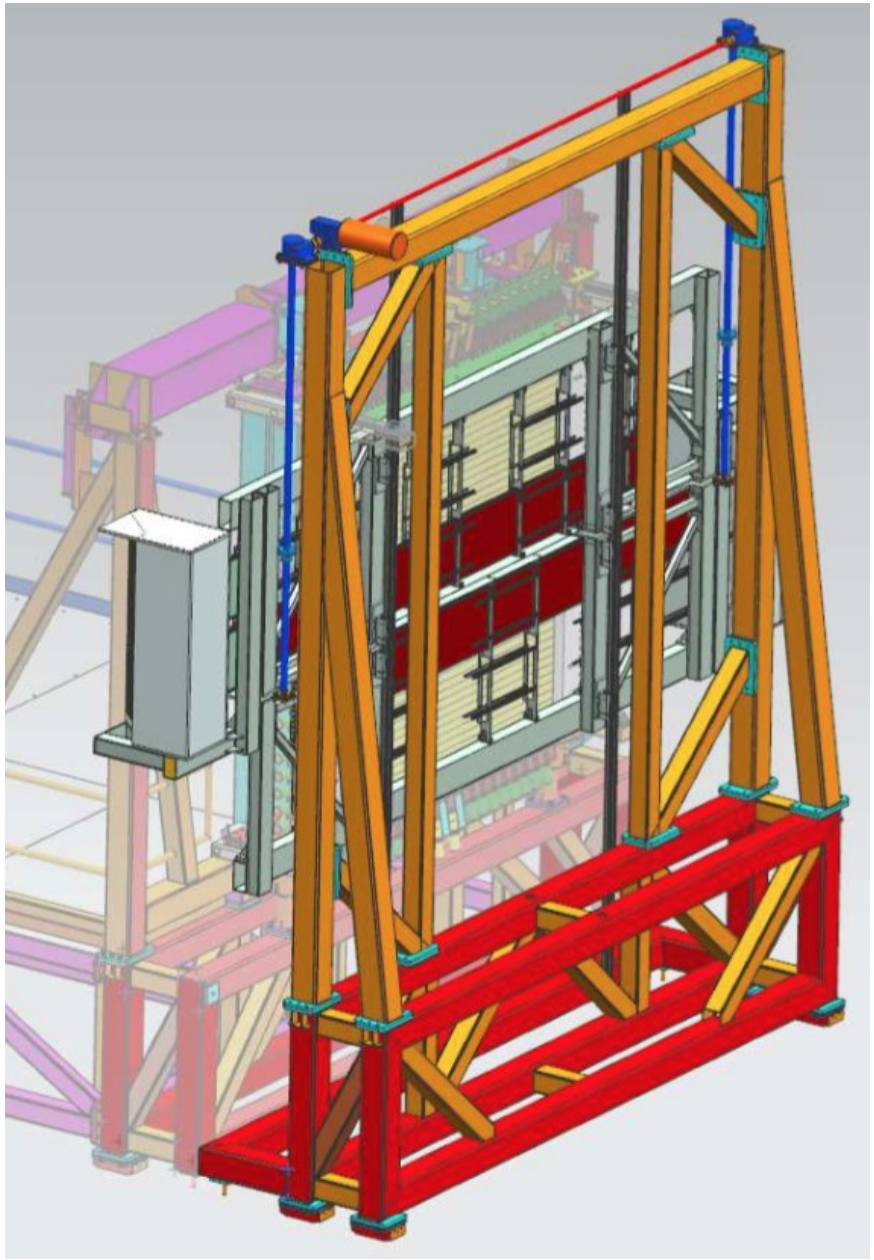
- Photosensors: 216 Hamamatsu H12700 MaPMTs (~14k channels) (timing resolution ~1 ns)
- Optical coupling: silicone cookies (only 2-4% photon loss vs. 25% with the air gap)
- Electronics: boards developed for CLAS12 RICH in HallB (JLab). Compatible with generic JLab DAQ

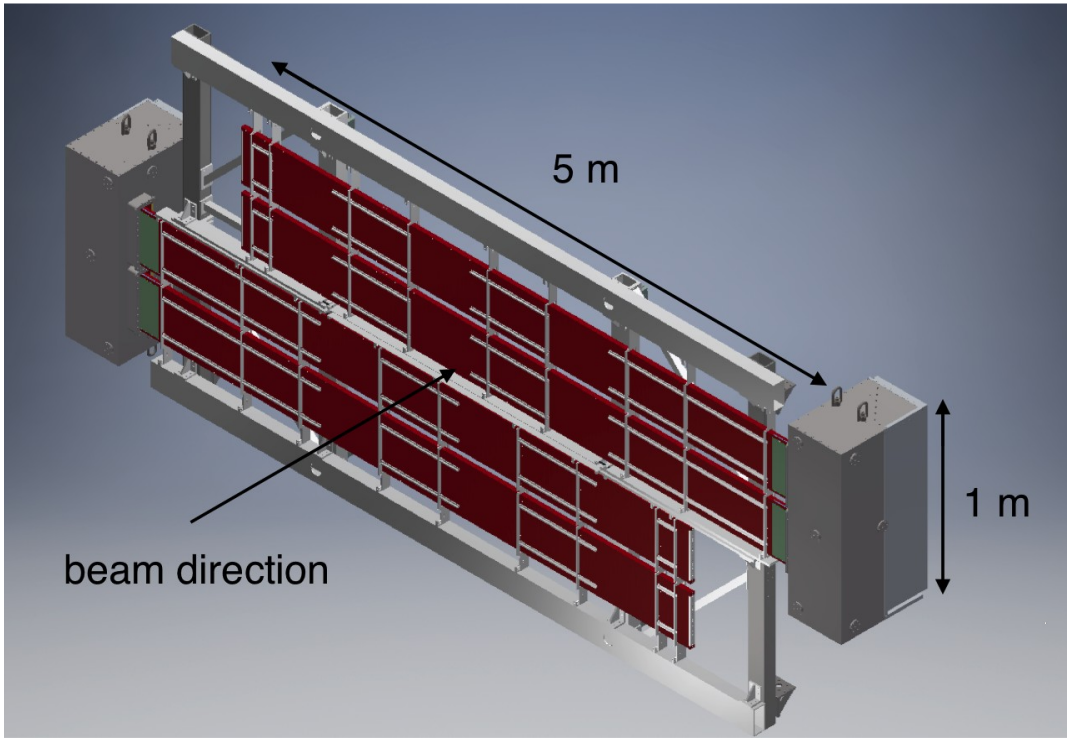






Support Structure



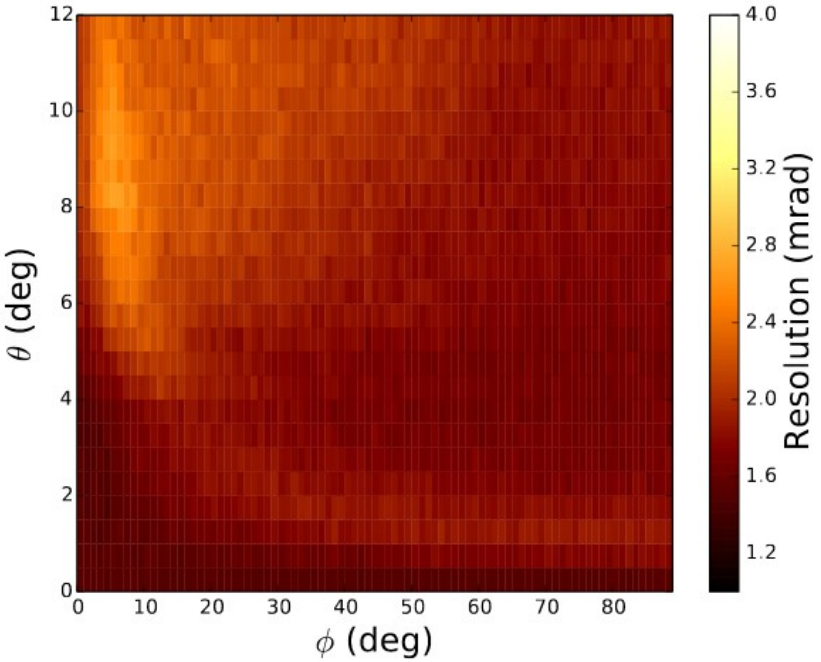


- Easily removable
- Good access to the optical boxes/electronics
- Even weight distribution

Reconstruction Methods

- Look Up Table
  - LUT creation: store direction at the end of the radiators for each fired pixel by full simulation using photon gun.
  - Reconstruction: direction from LUT for fired pixels are combined with charge track direction to determine Cherenkov angle.
- Kernel Density Estimation
  - Creating Probability Density Function based on hit patterns of different particles species.
  - Reconstruction: calculating likelihoods

  J.Hardin, M. Williams arXiv:1608.01180
- Time Imaging
  - Creating PDF based on propagation time of different particle species.
  - Reconstruction: calculating likelihoods



Summary and Outlook

- DIRC will extend the physics potential of the GlueX experiment by separating pions and kaons up to 4 GeV/c
- GlueX DIRC will reuse 4 BaBar bar boxes
- Construction is already started
- Three reconstruction methods are developed and constantly improved

- 2017
  - Shipping BaBar bar boxes from SLAC to JLab
  - Fabrication of support structure and first optical box
- 2018
  - Install and commission complete detector
  - Begin GlueX strangeness program

Thank you for the attention