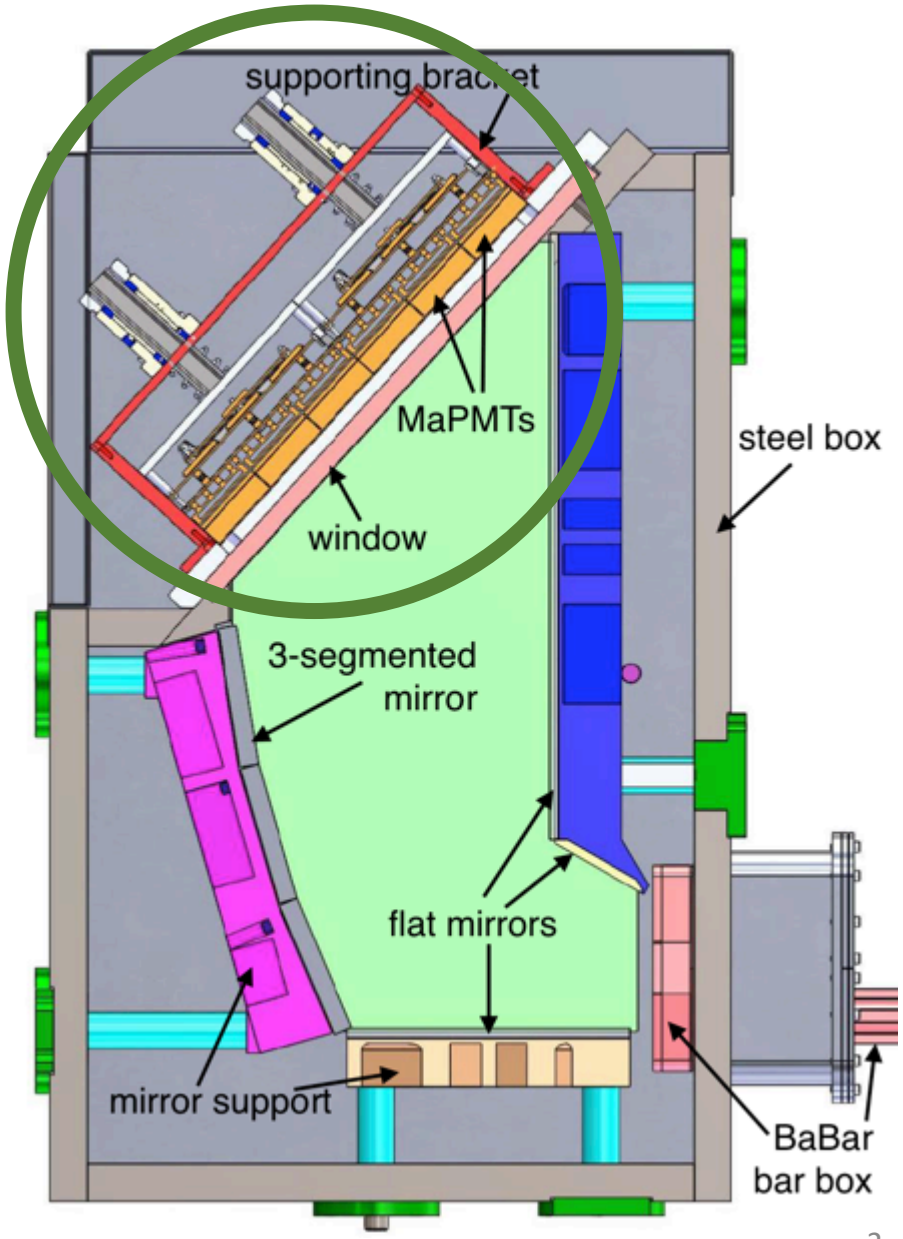
Optimization of the PMTs layout

Maria Patsyuk and Roman Dzhygadlo

Motivation

- We need 18 x **6** x 2 = 216 PMTs for full equipment of the GlueX DIRC
- We ordered 18 x **5** x 2 = 180 PMTs

- Simulation can show how to distribute those PMTs over the window of the optical box optimally
- In case some PMTs arrive later, we can equip first the most important part of the phase space

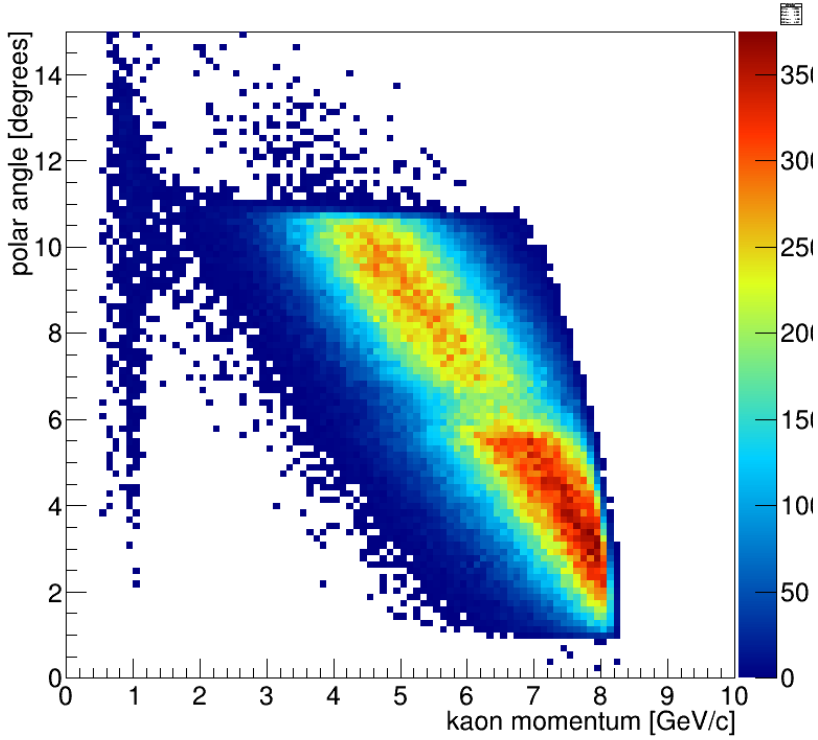


Simulation

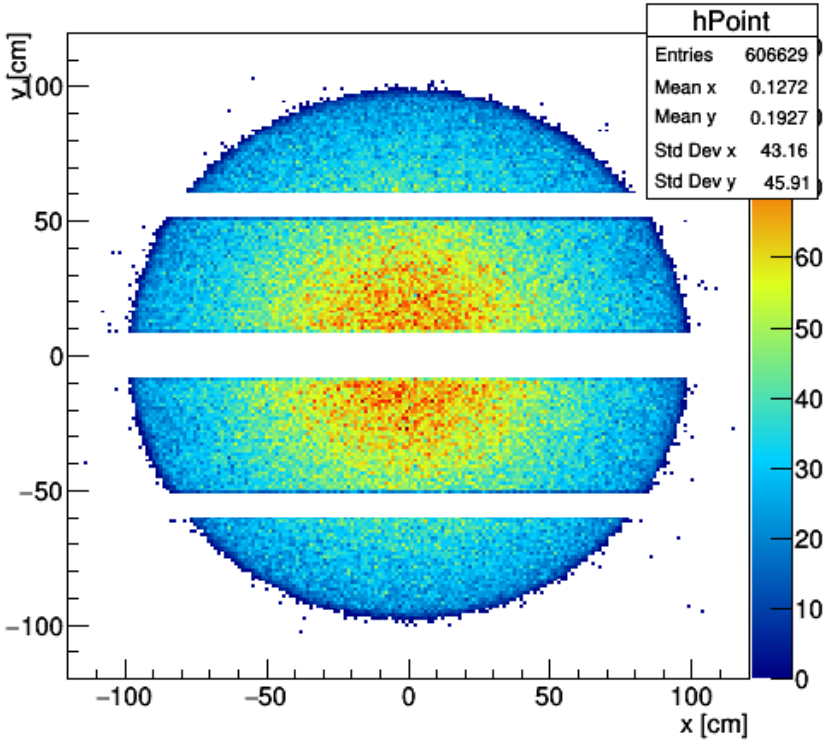
- DIRC eventually delivers PID likelihoods
- Reconstruction method is currently under implementation:
  - Does not reconstruct the shape!
  - Detector resolution is approximately 1/sqrt(Npho)
- Photon yield is an important observable:
  - Characterizes the detector resolution

Simulated reaction: phi1850, 1 Mil events

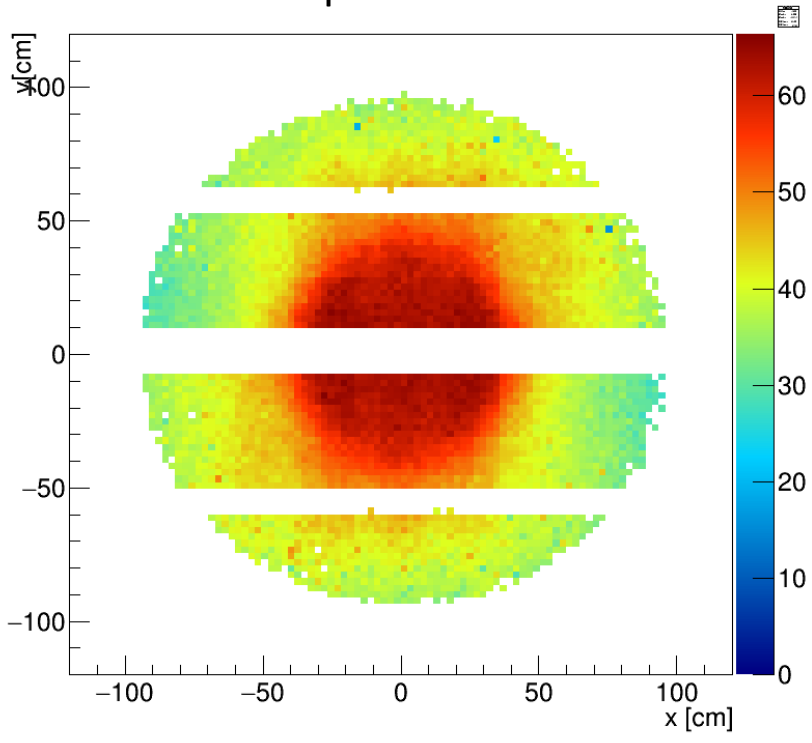
Momentum and polar angle of the detected kaons. Kaons with p > 2.5 GeV/c emit maximum number of Cherenkov photons per unit length



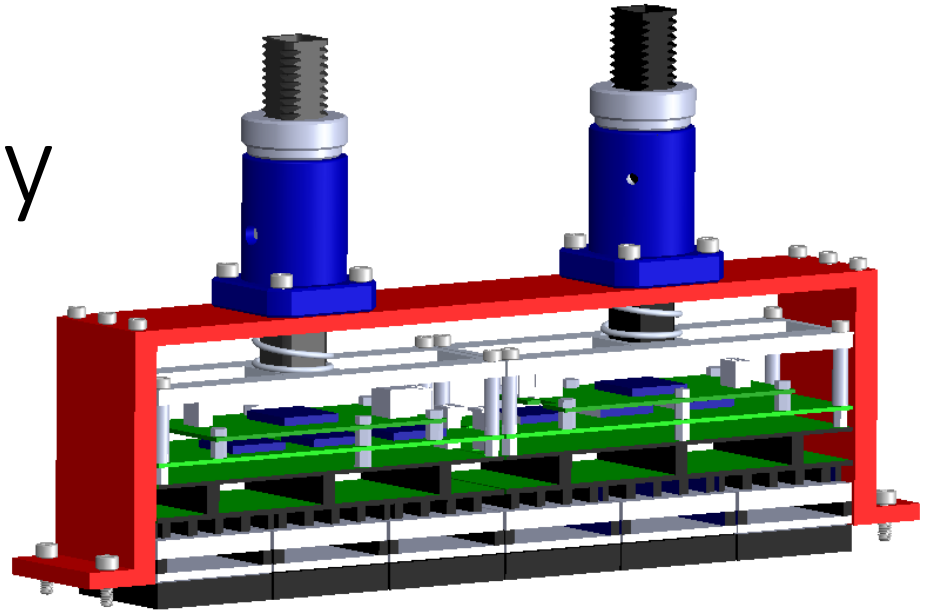
Distribution of kaons on the DIRC wall

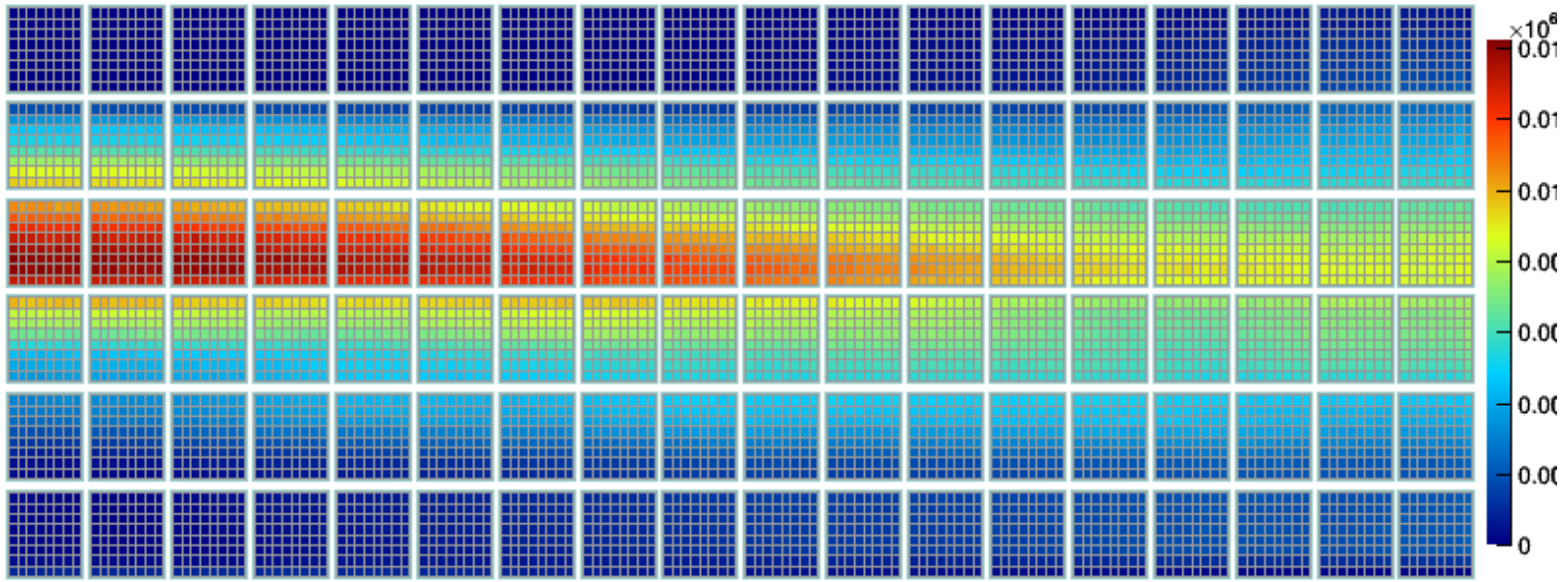


Photon yield per track for different parts of the DIRC wall



Cumulative photon occupancy



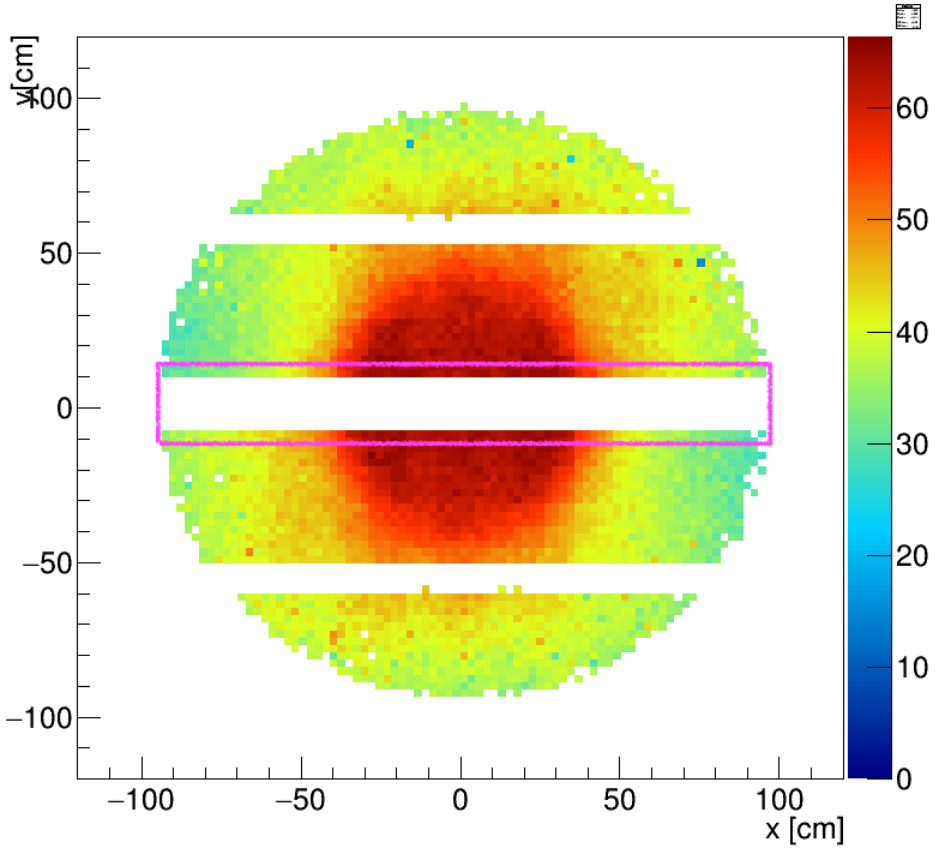


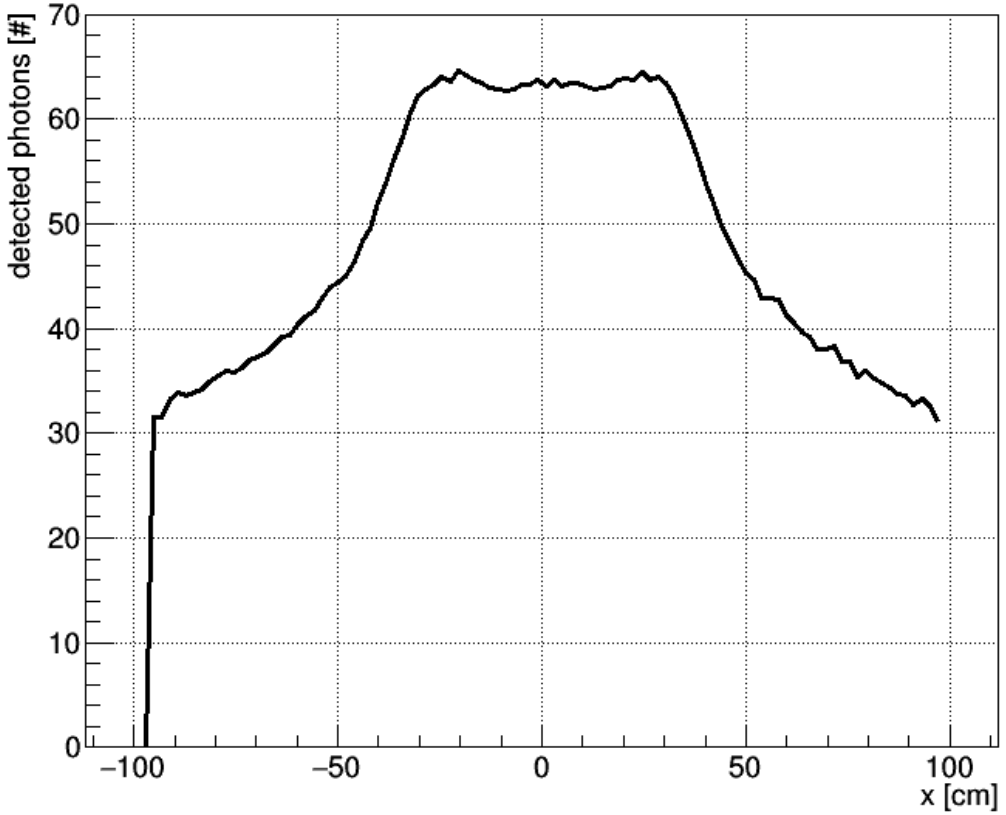
Baseline photon yield

65 photons / track for perpendicular incidence

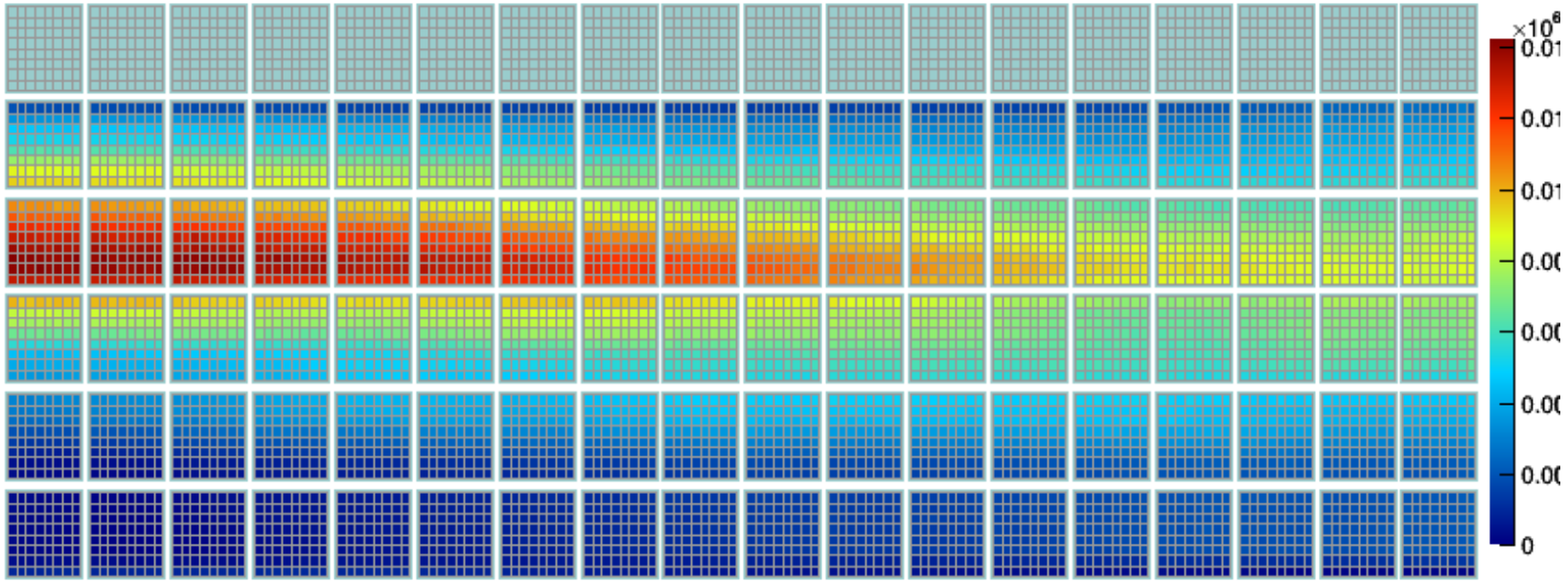
Estimation based on SuperB prototype: 32 photons / track

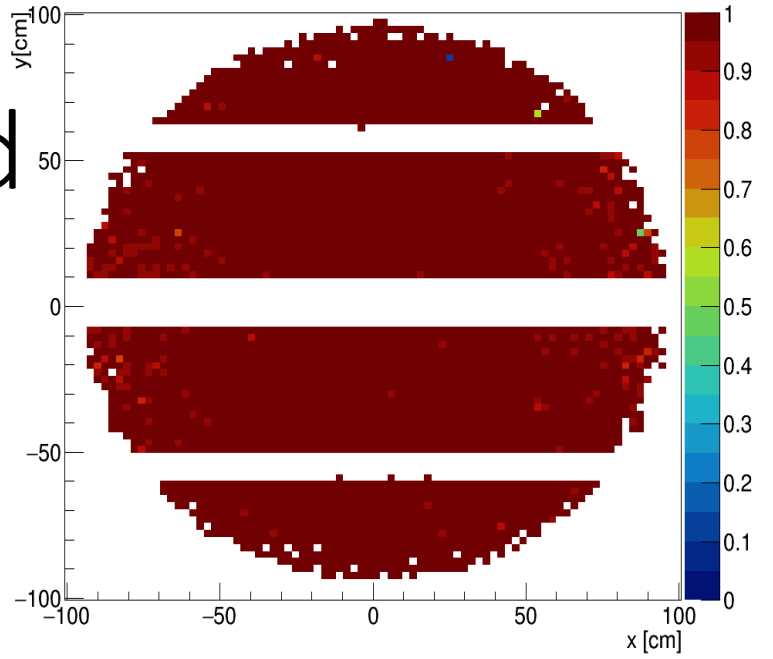
Estimation based on the PANDA Barrel DIRC prototype test beams: 65 photons /track

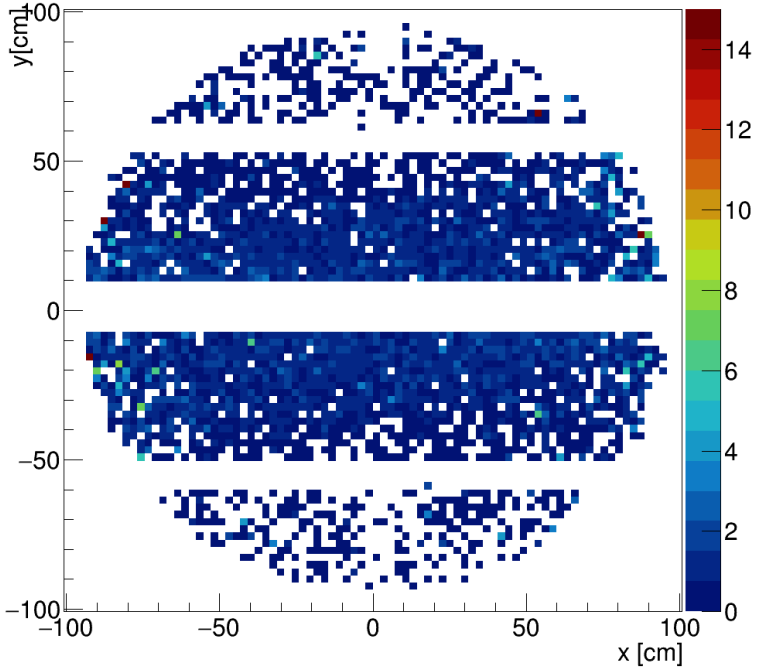




#1: 5 rows, upper row is not equipped

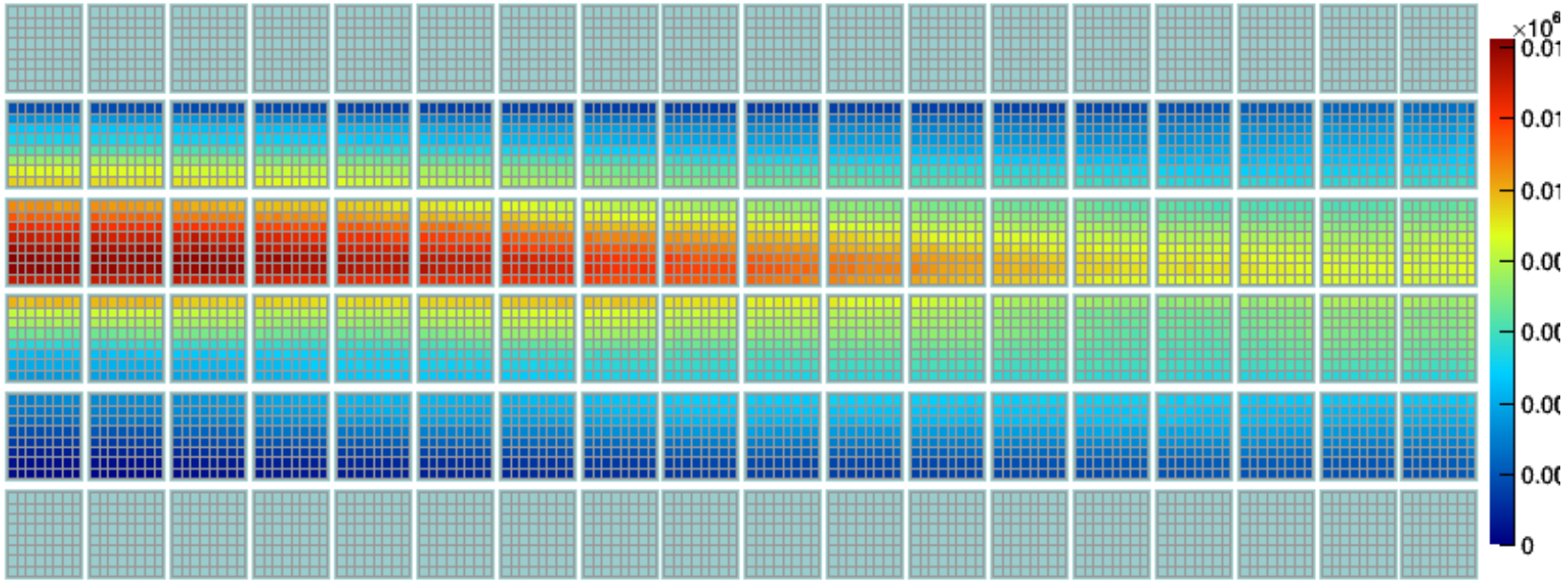


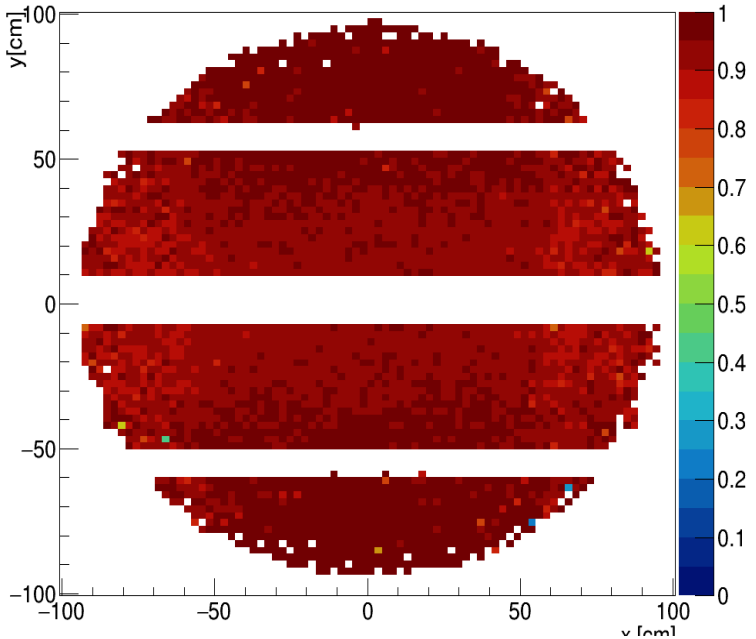


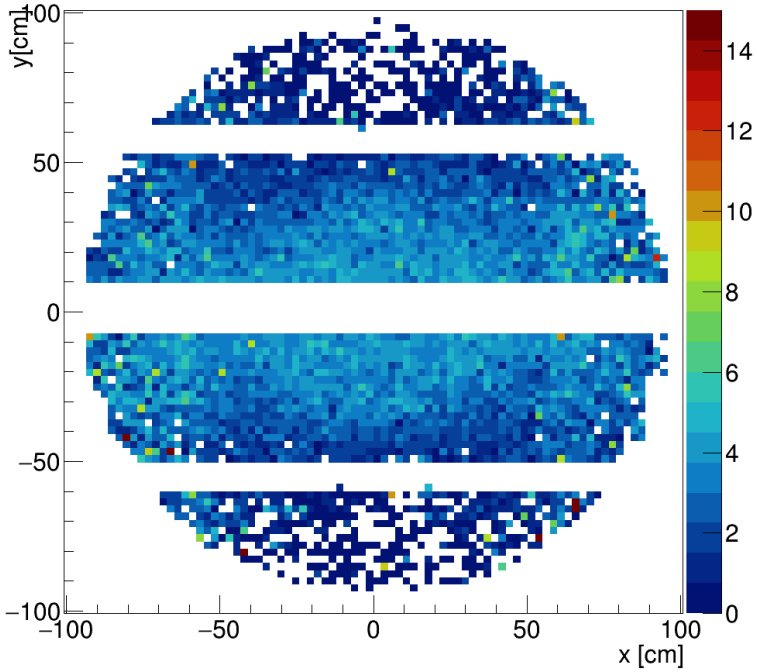


Photon loss is less than 5%, which is up to 3 photons/track

#2: 4 rows and 18 columns

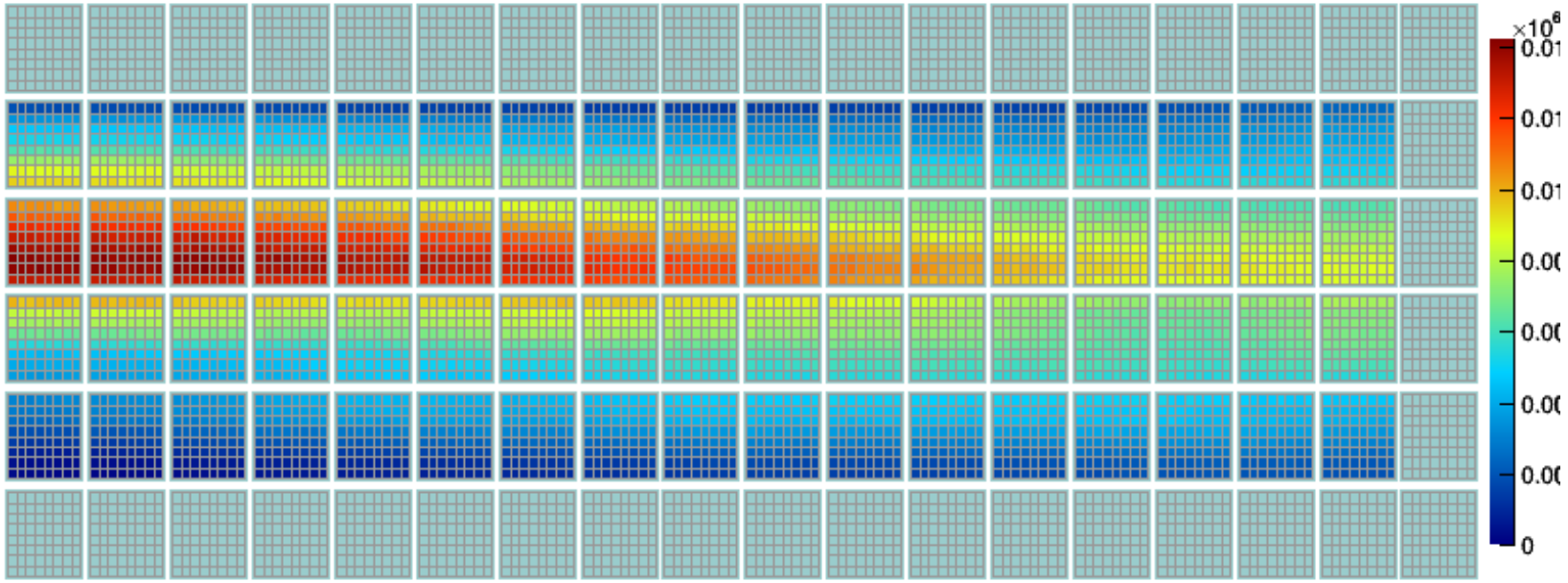


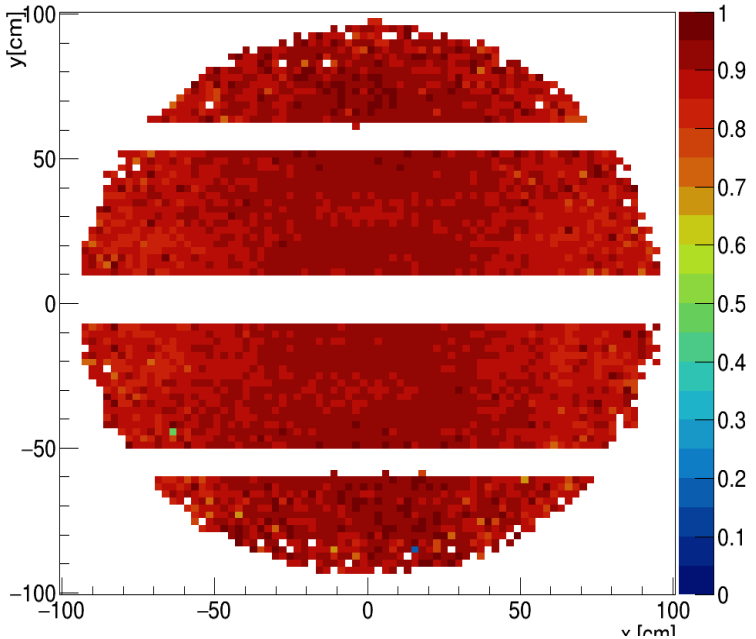


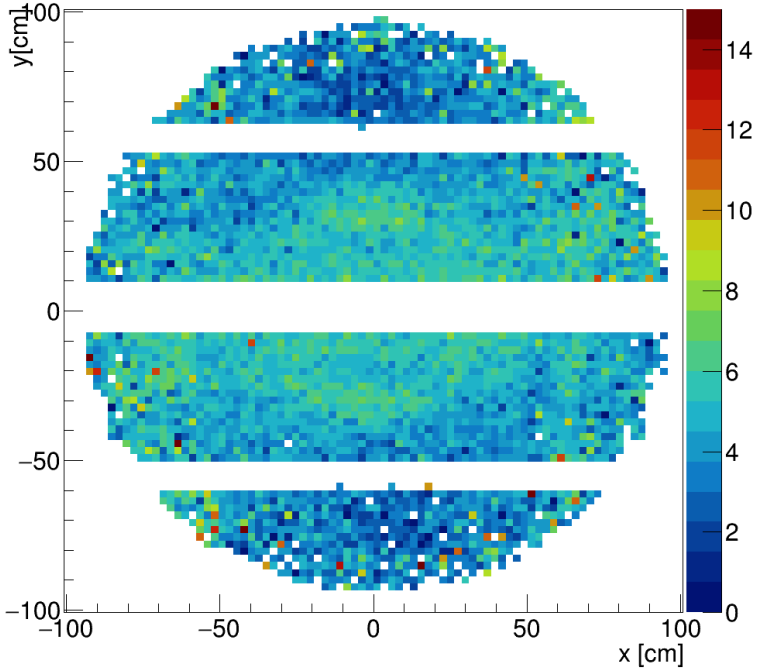


Photon loss is less than 10%, which is up to 5 photons/track

#3: 4 rows and 17 columns

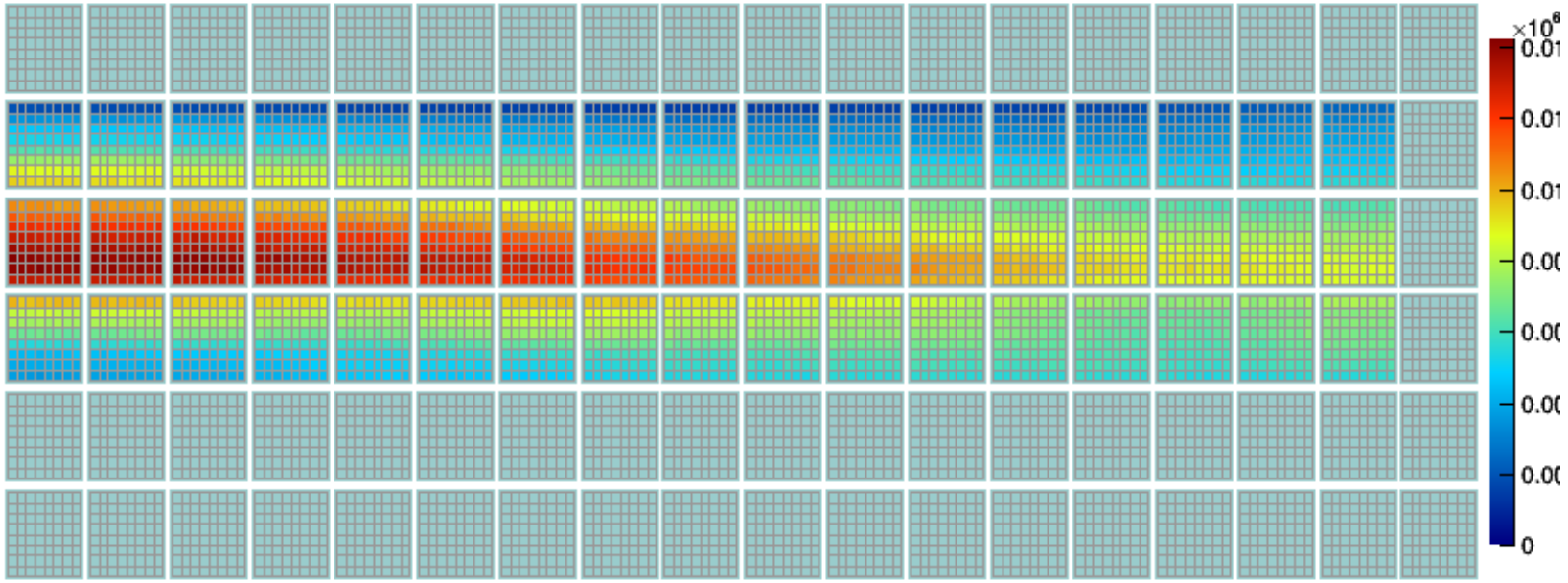


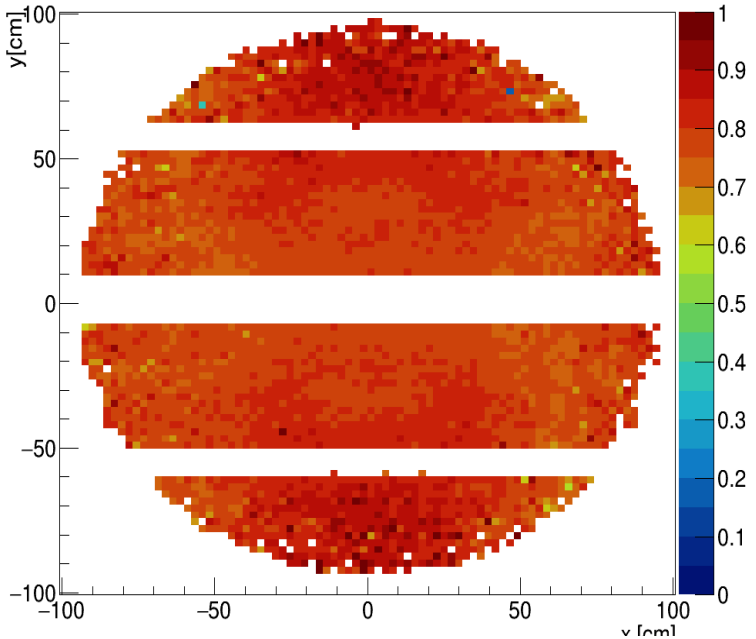


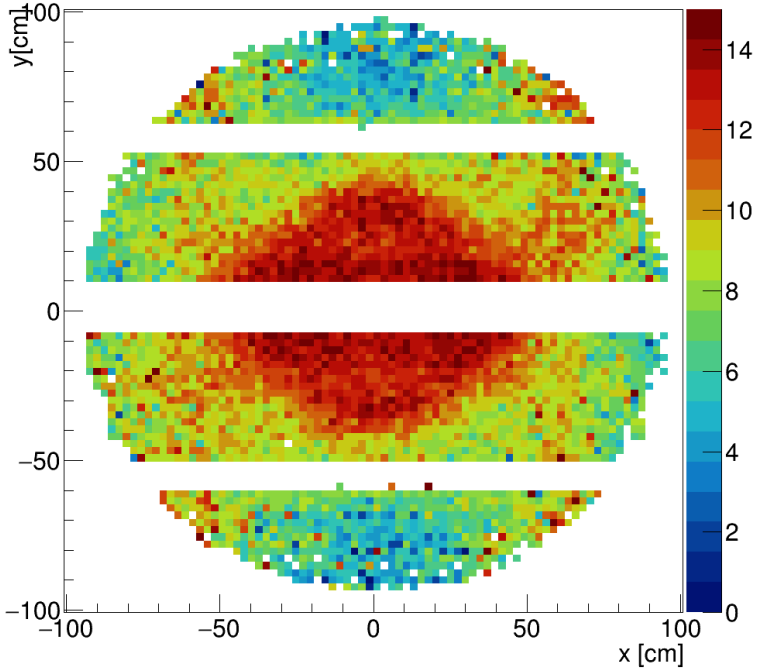


Photon loss is less than 15%, which is up to 7 photons/track

#4: 3 rows and 17 columns

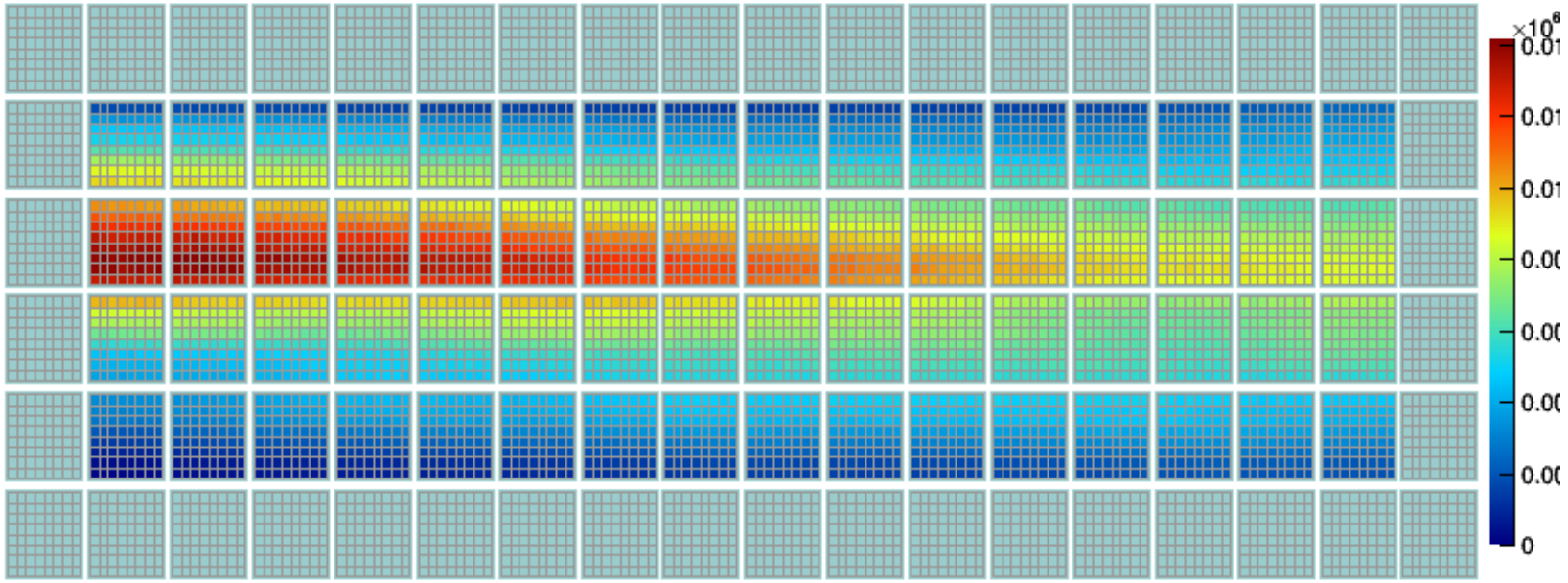


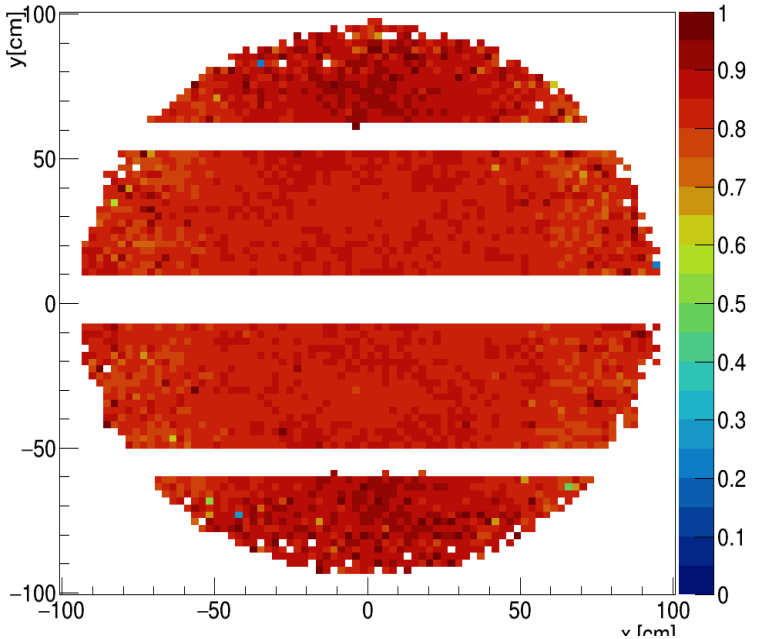


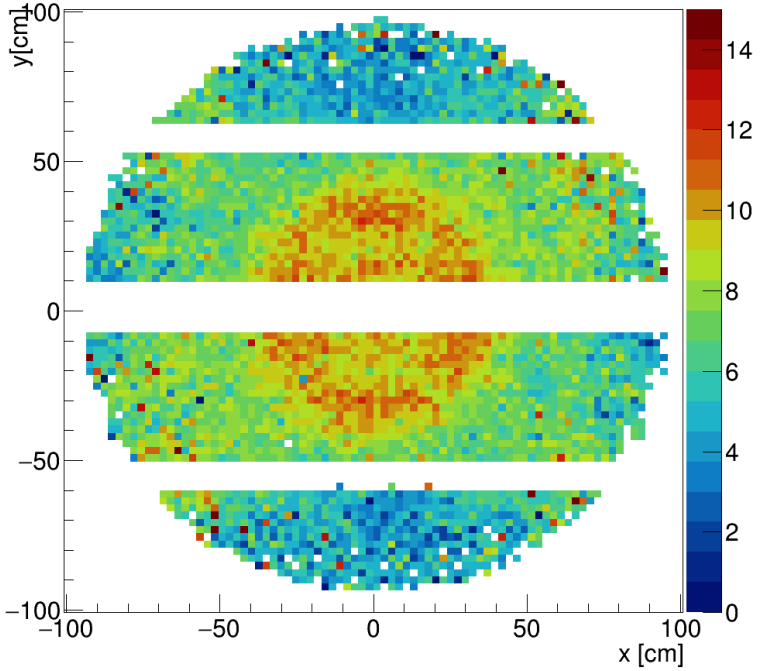


Photon loss is less than 40%, which is up to 15 photons/track

#6: 4 rows and 16 columns

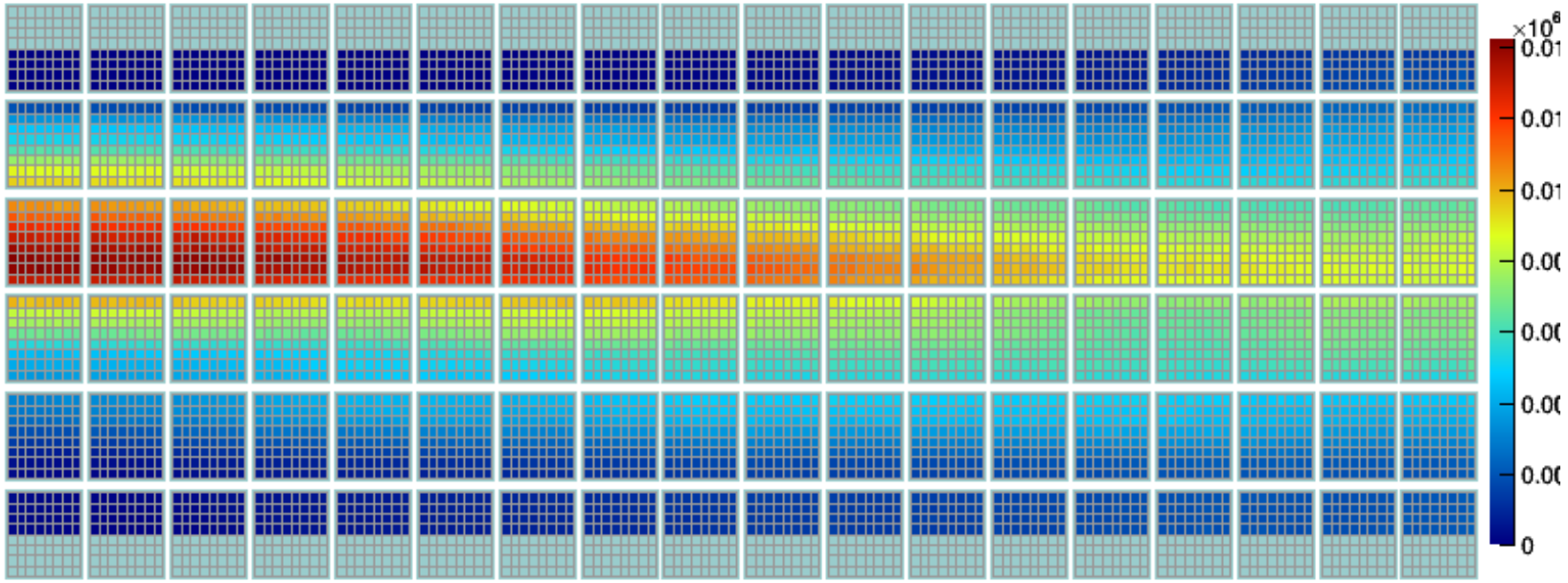


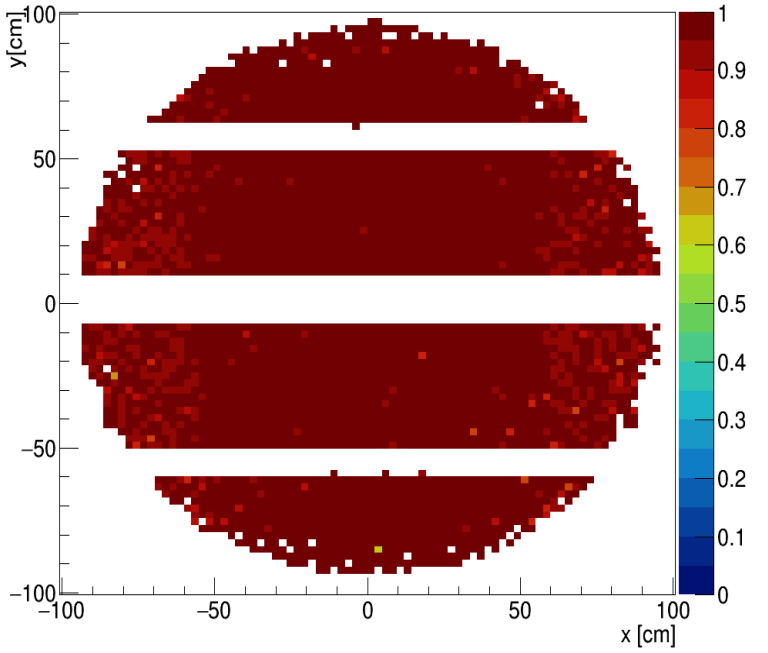


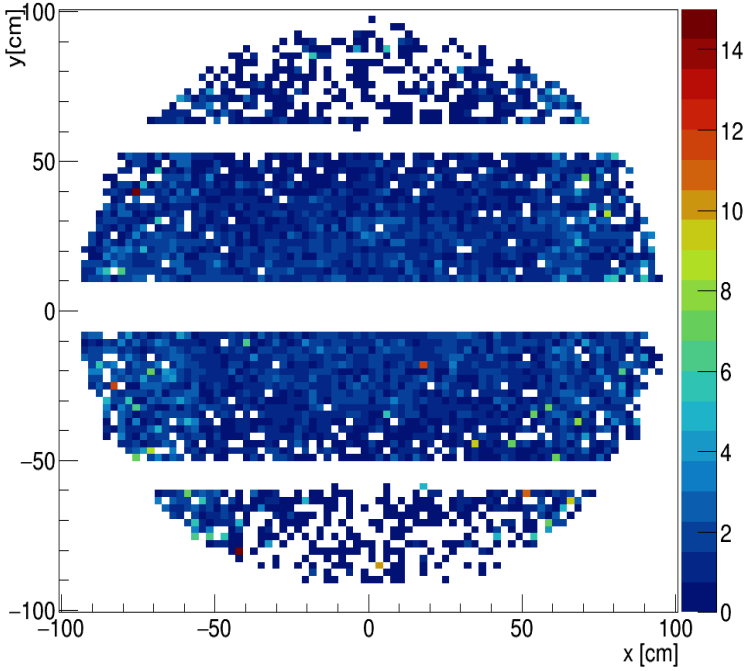


Photon loss is less than 30%, which is up to 13 photons/track

#7: 5 centered rows

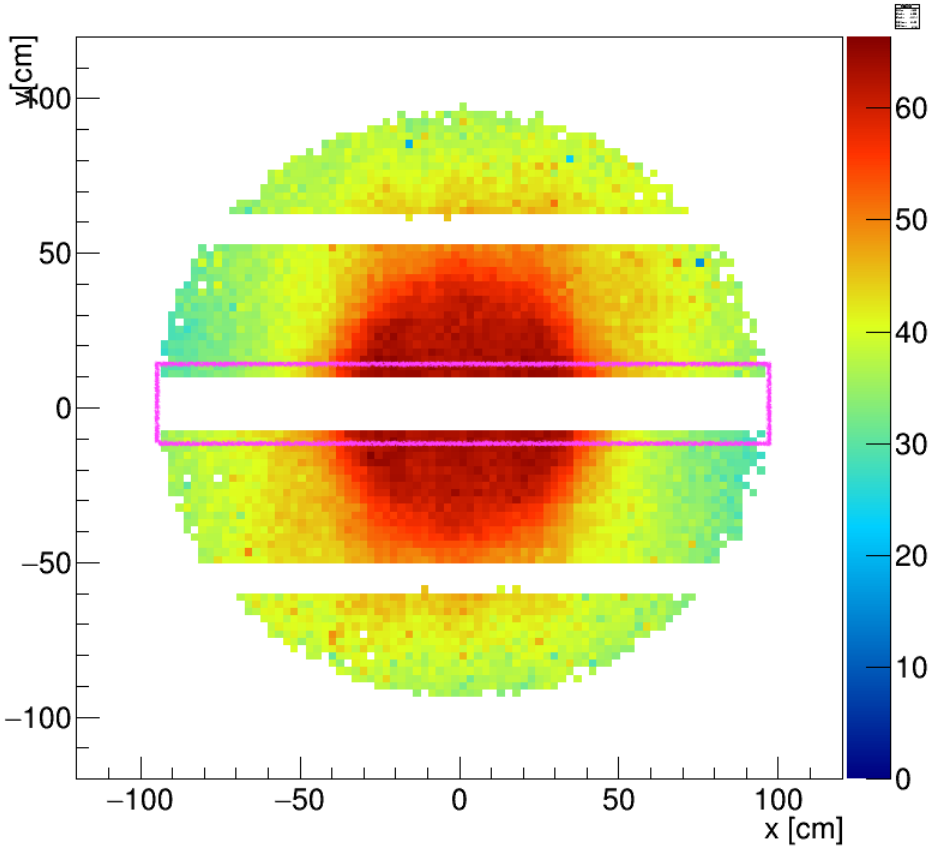


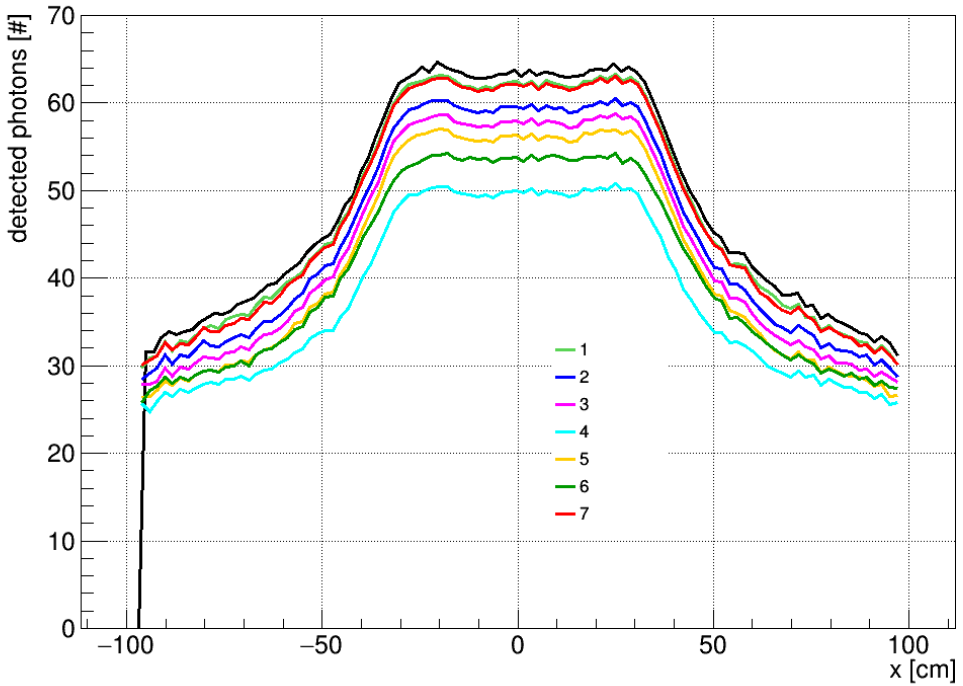


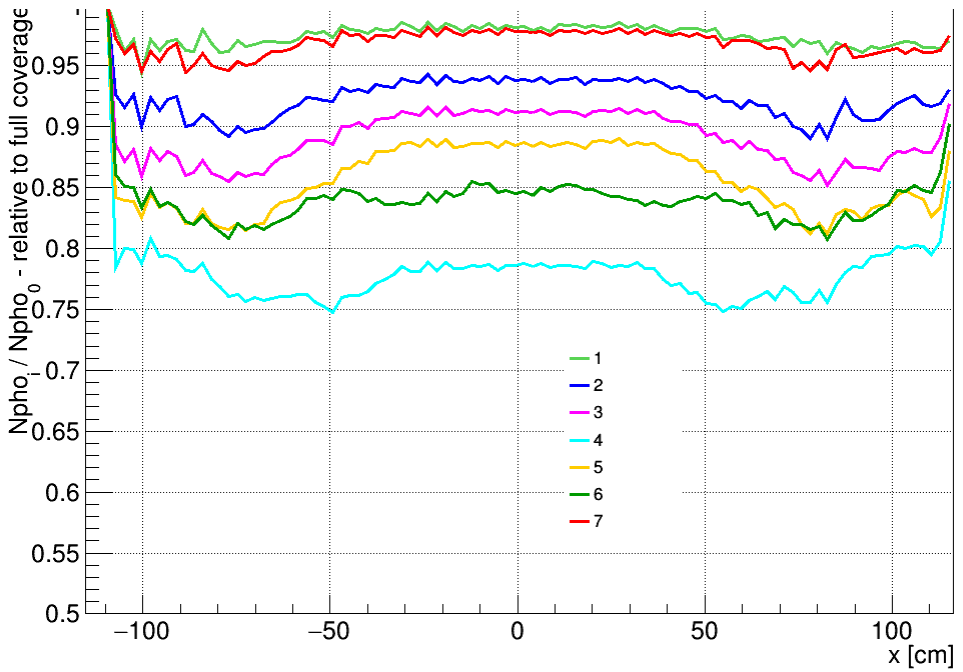


Photon loss is less than 5%, which is up to 3 photons/track (similar to #1)

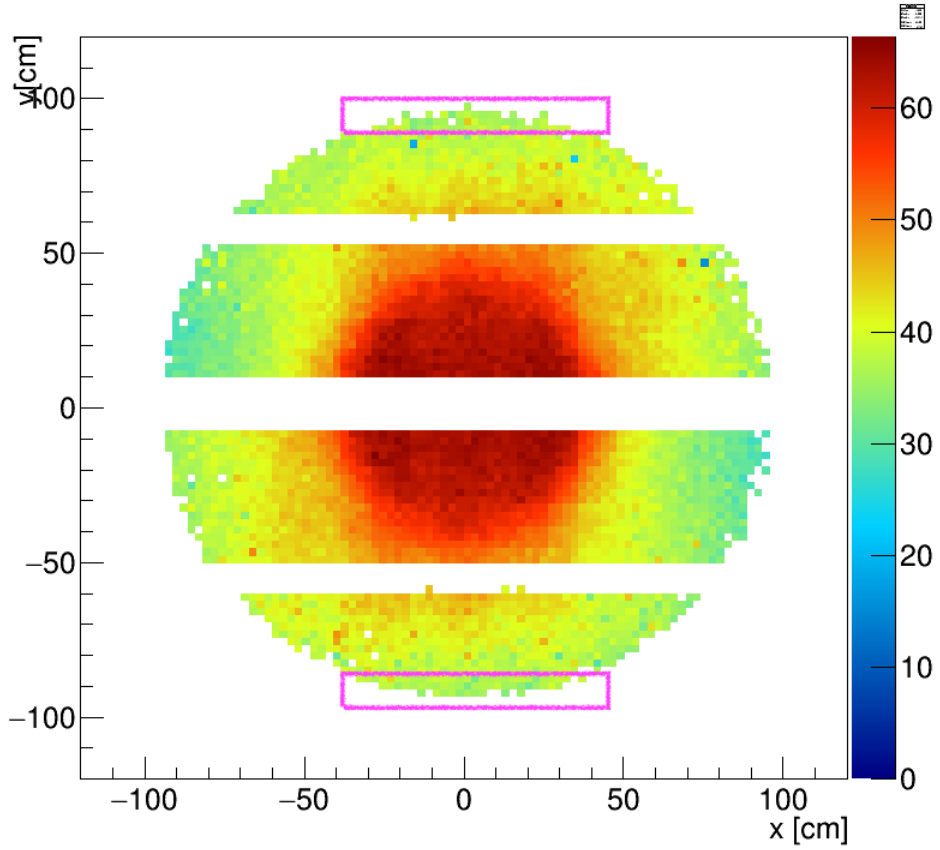
Photon yield for the middle bars

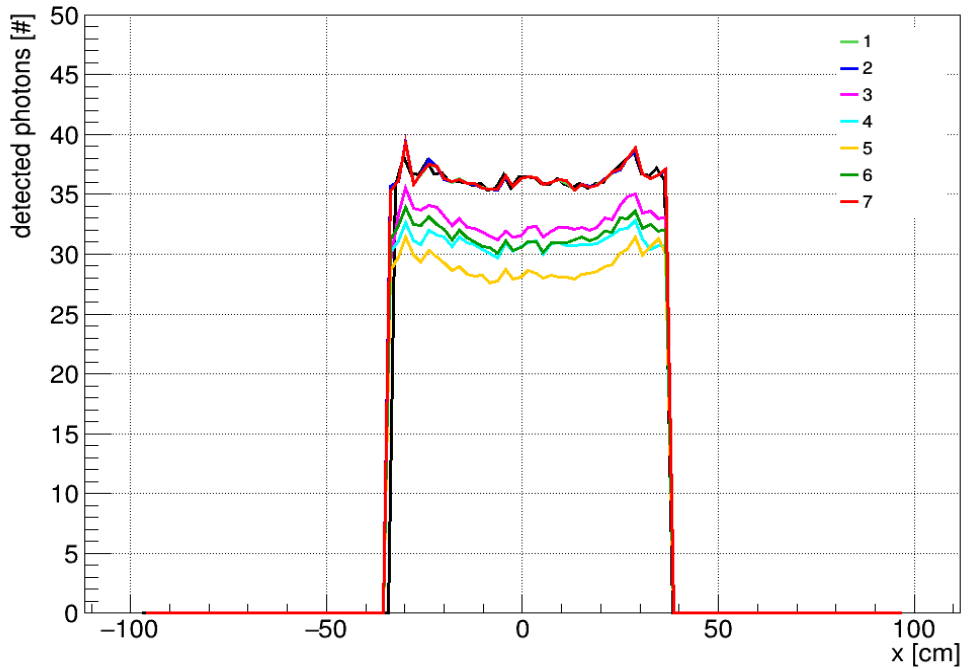


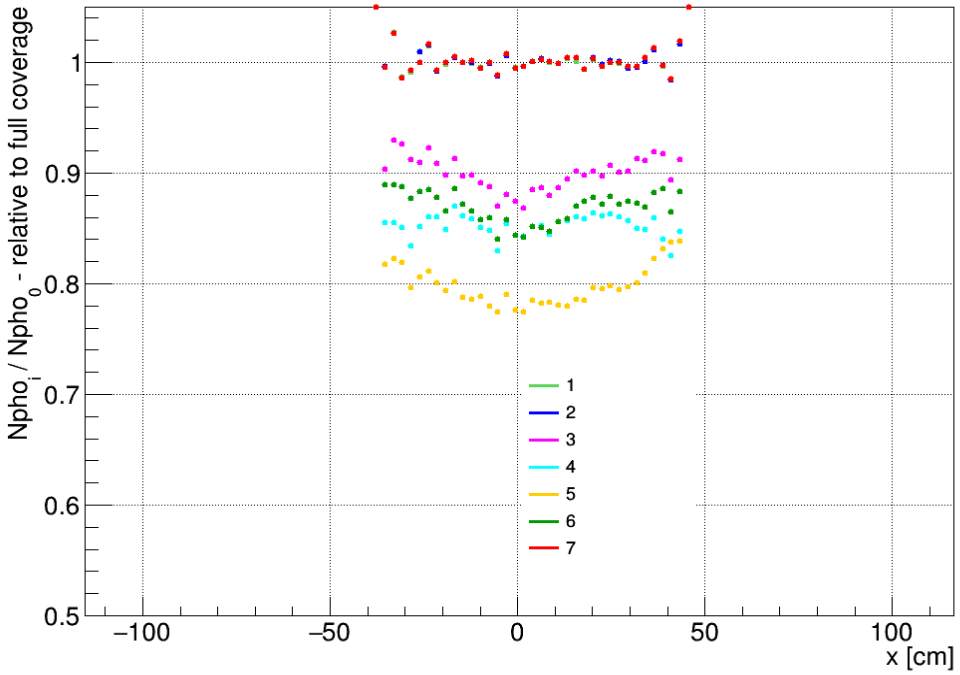




Photon yield for the edge bars







Conclusions

- 5 equipped rows are expected to provide ~98% photon yield compared to the full coverage
- It does not matter much: remove one edge row or center the remaining 5 rows

Next steps

- Check with kaon gun and other reactions of interest
- Check reconstruction → likelihoods