Optimization of the PMTs layout

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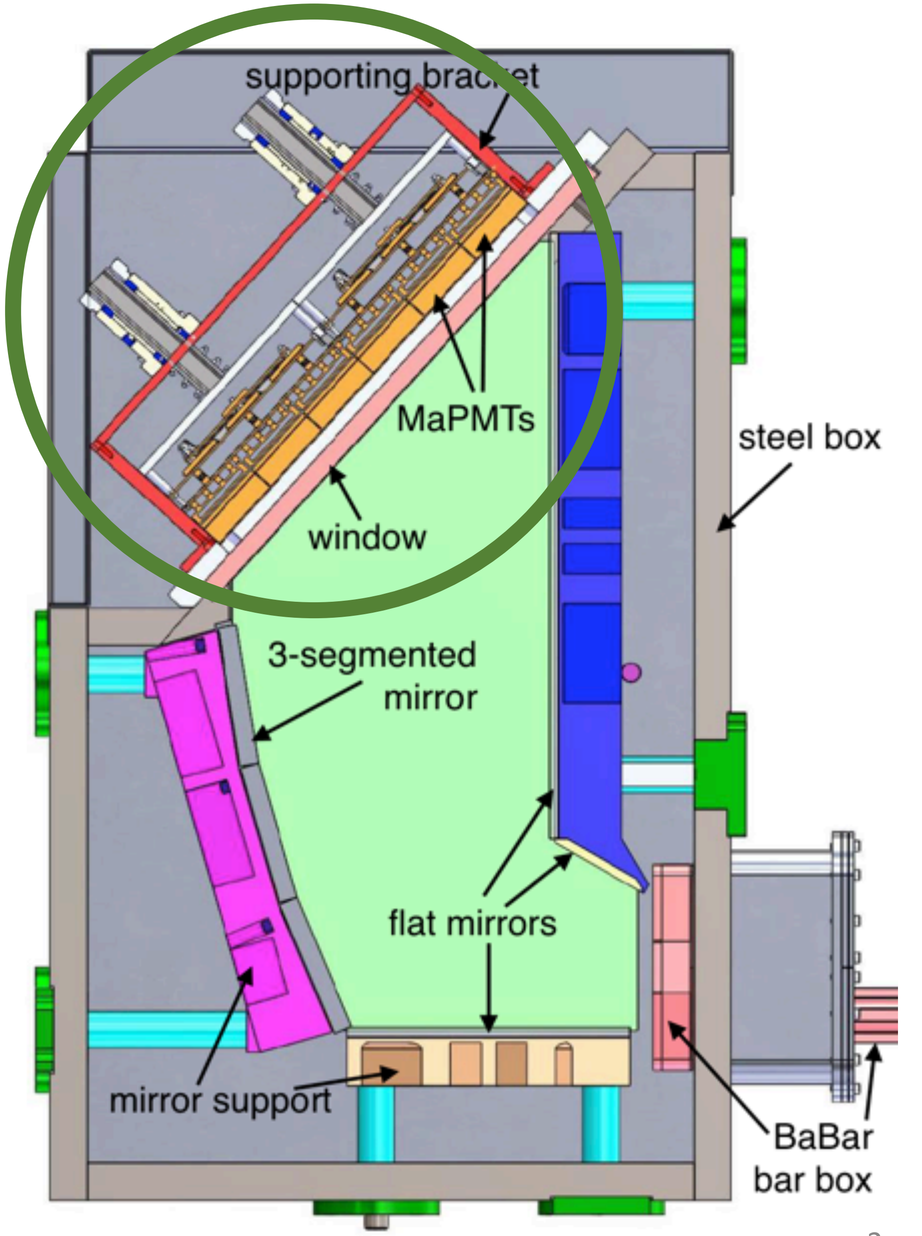
Motivation

- 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 (and we have 30 PMTs already)

- 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

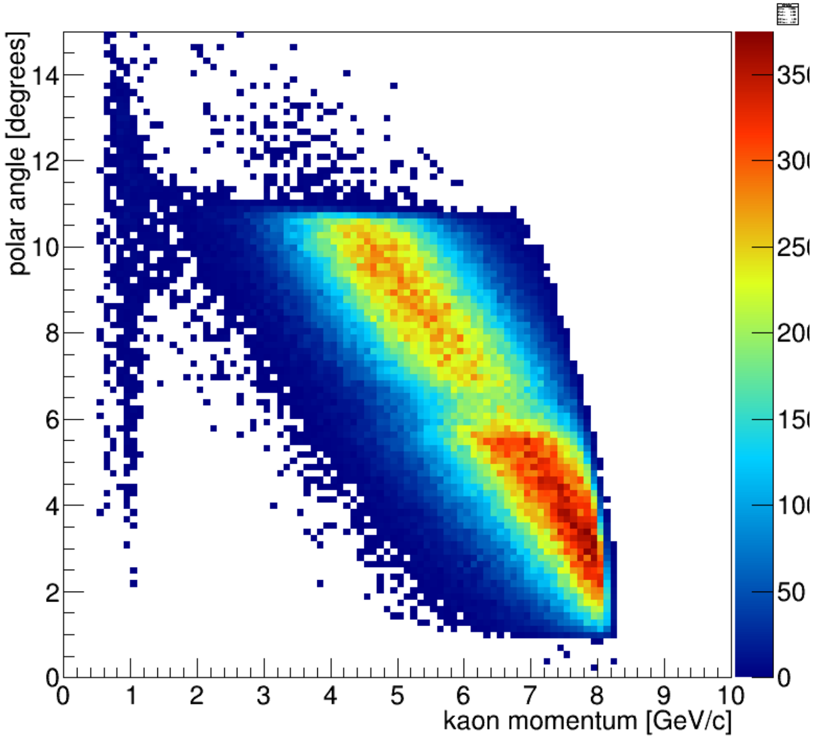


Simulation

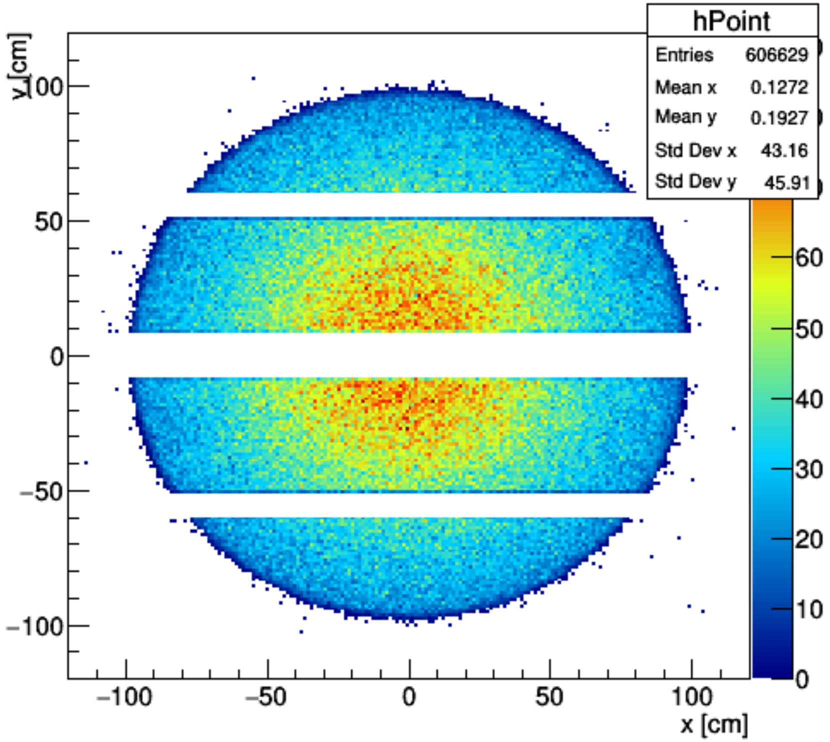
- DIRC eventually delivers PID likelihoods
- Reconstruction method is currently under implementation:
  - Does not reconstruct the shape!
  - Detector resolution is approximately 1/sqrt(Npho)
- Photon yield is an important observable:
  - Characterizes the detector resolution

Simulated reaction: phi1850, 1 Mil events

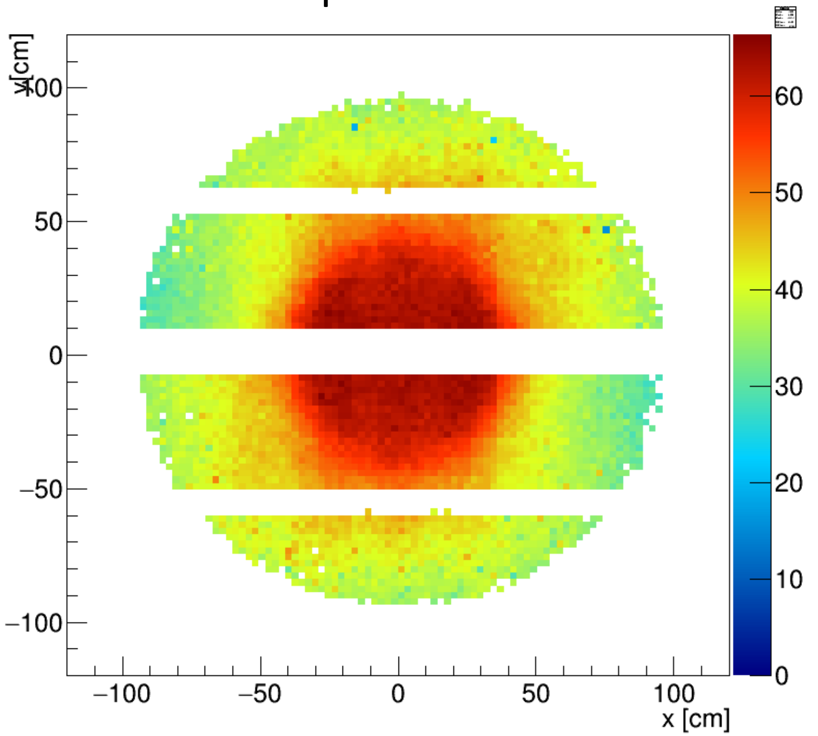
Momentum and polar angle of the detected kaons. Kaons with p > 2.5 GeV/c emit maximum number of Cherenkov photons per unit length



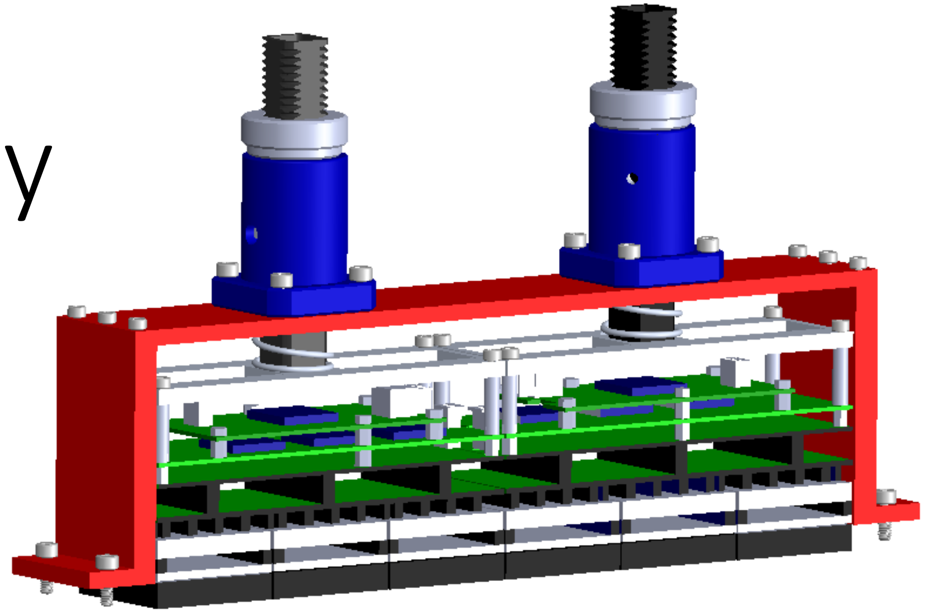
Distribution of kaons on the DIRC wall



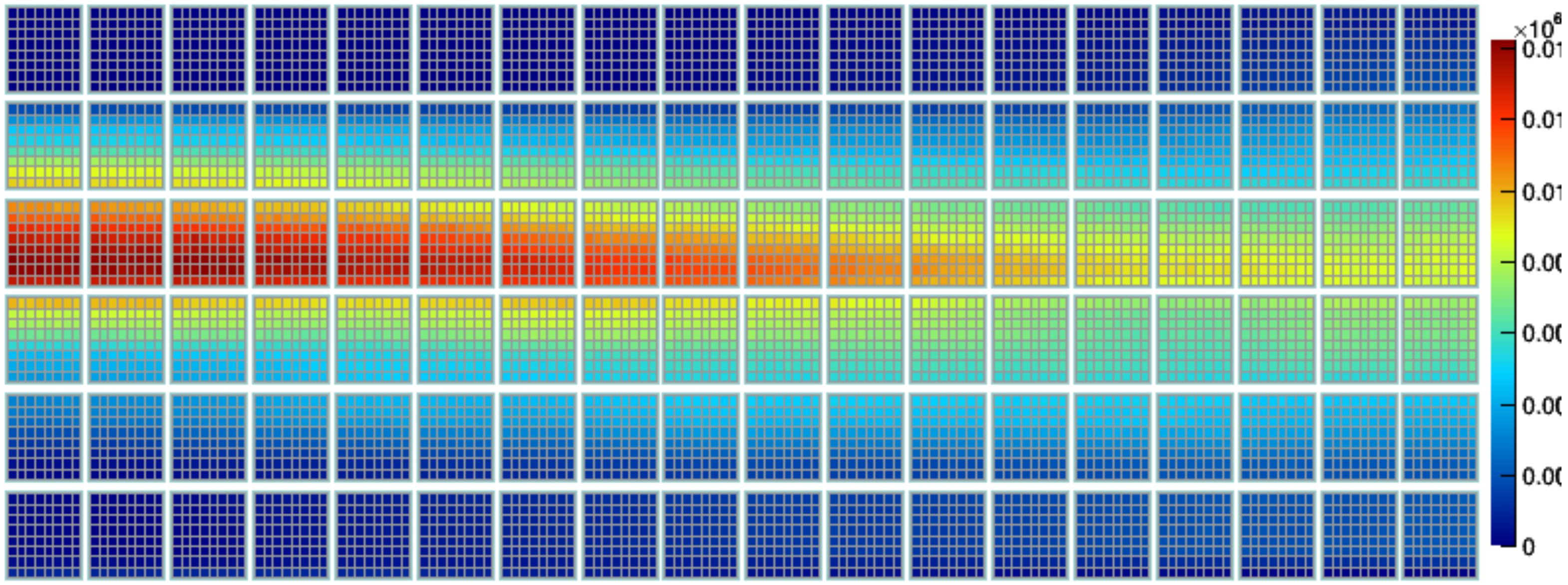
Photon yield per track for different parts of the DIRC wall



Cumulative photon occupancy



6 rows



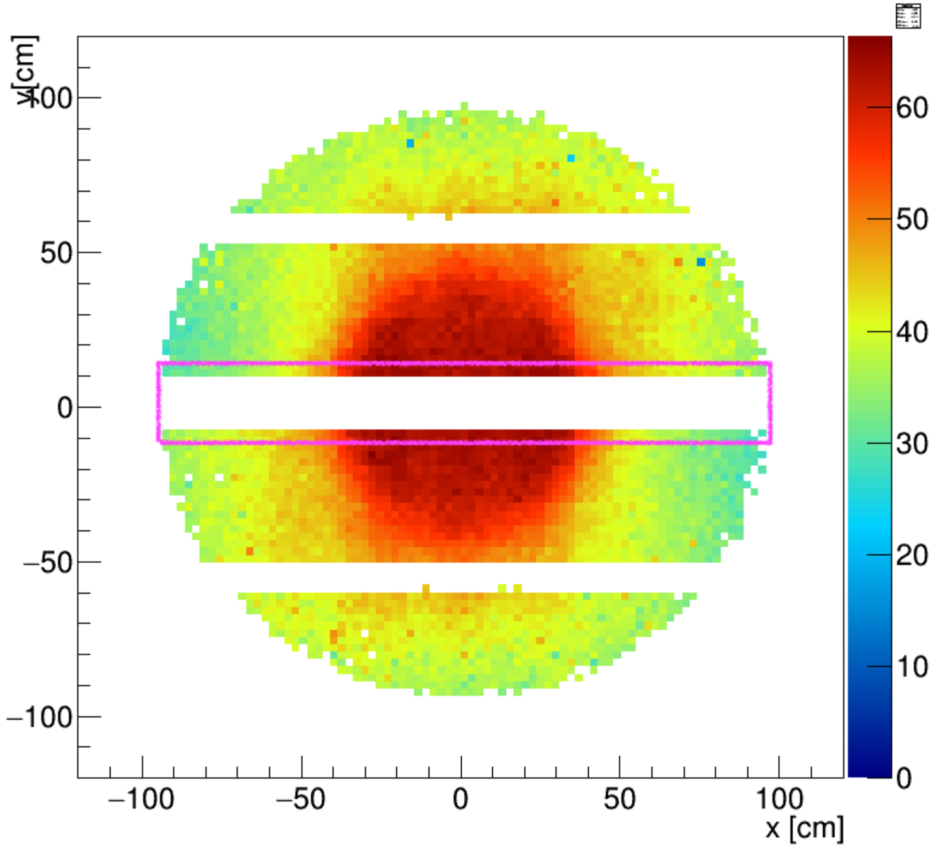
18 columns

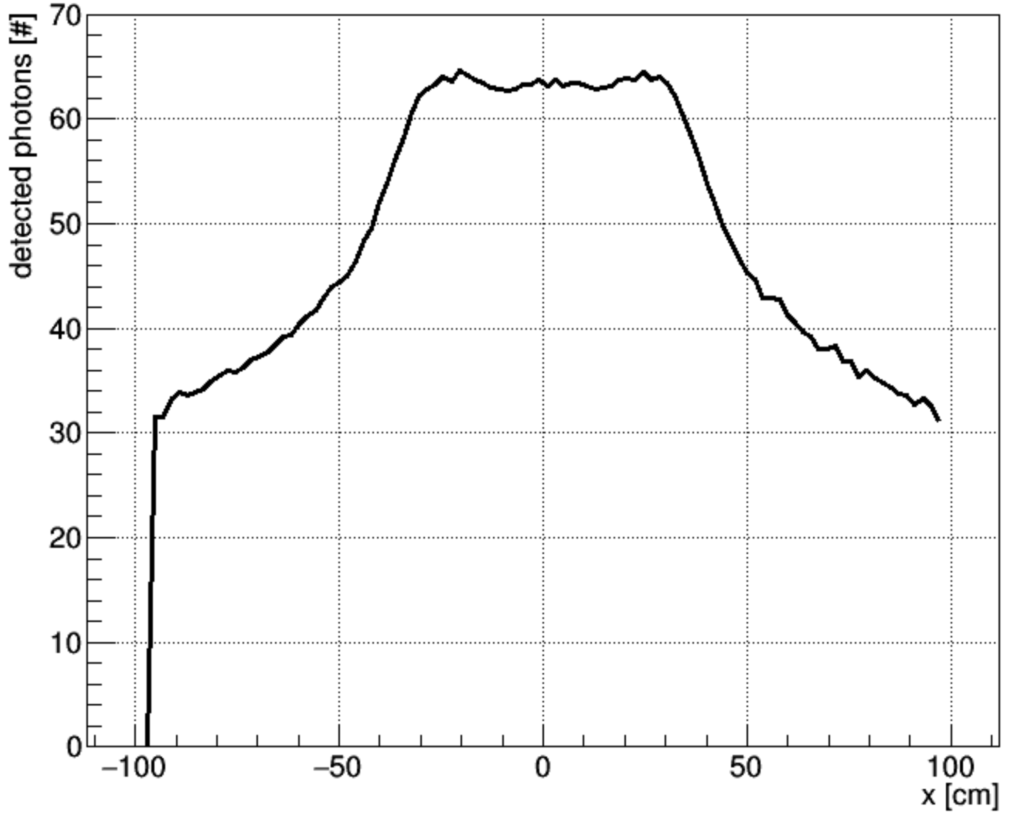
Baseline photon yield

65 photons / track for perpendicular incidence

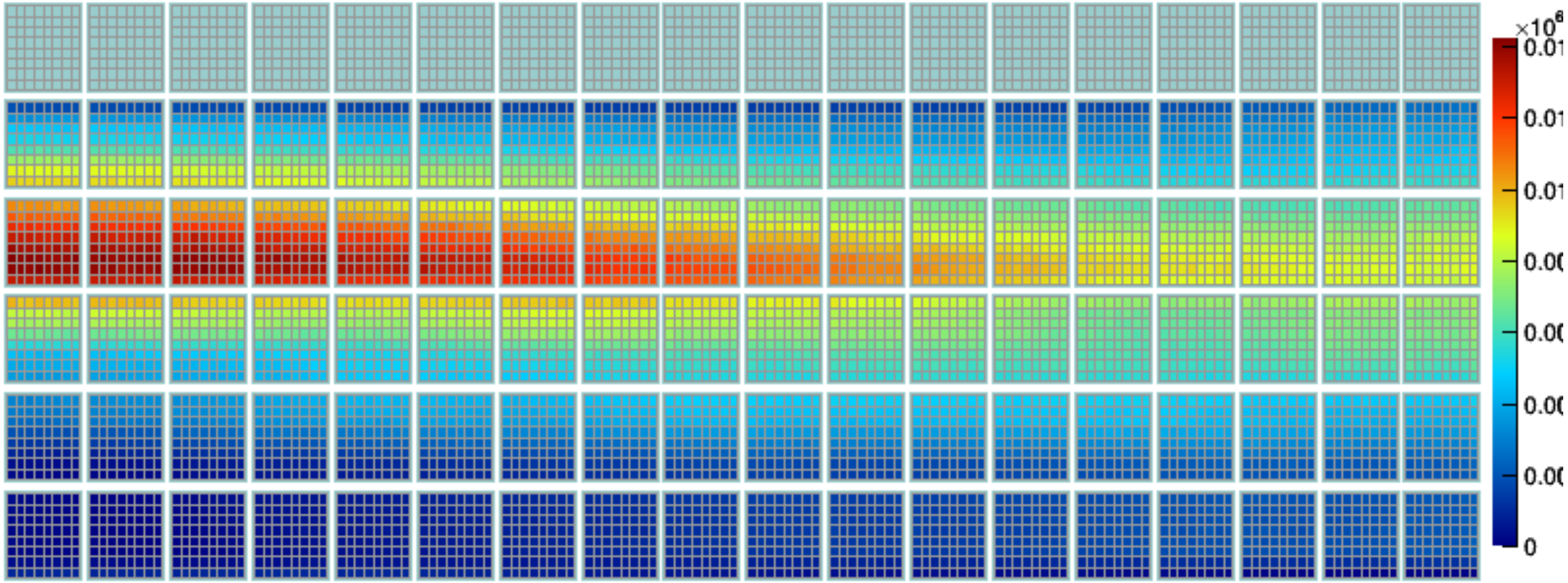
Estimation based on SuperB prototype: 32 photons / track

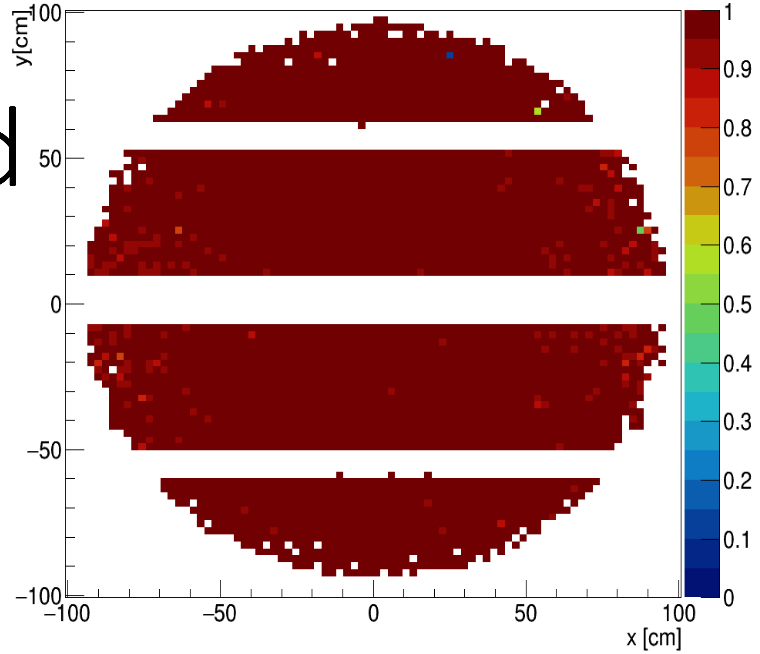
Estimation based on the PANDA Barrel DIRC prototype test beams: 65 photons /track

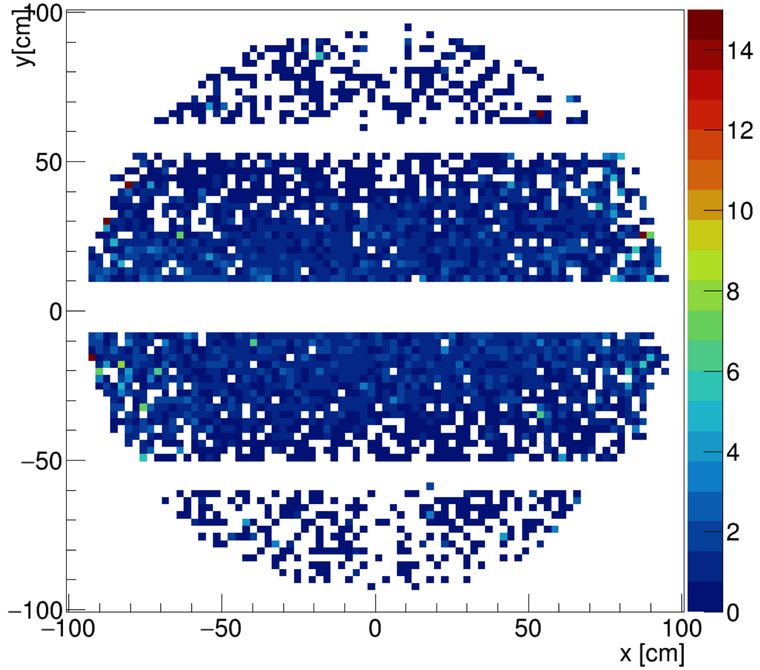




#1: 5 rows, upper row is not equipped

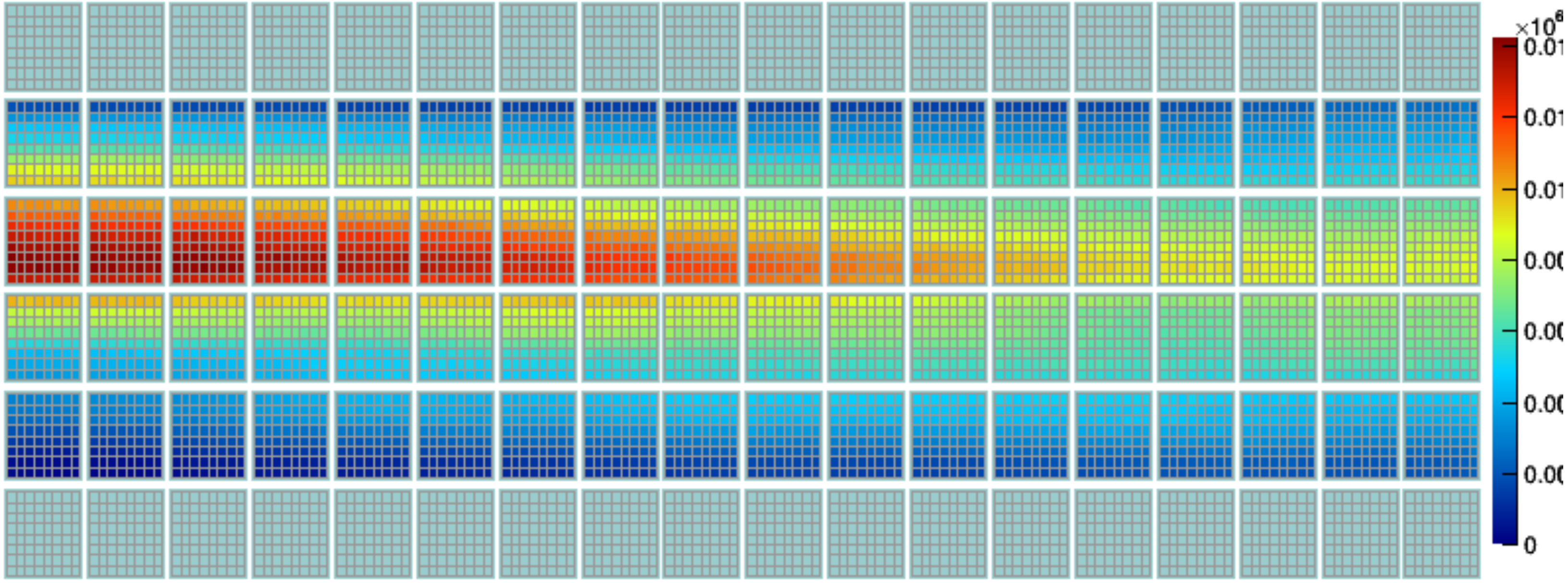


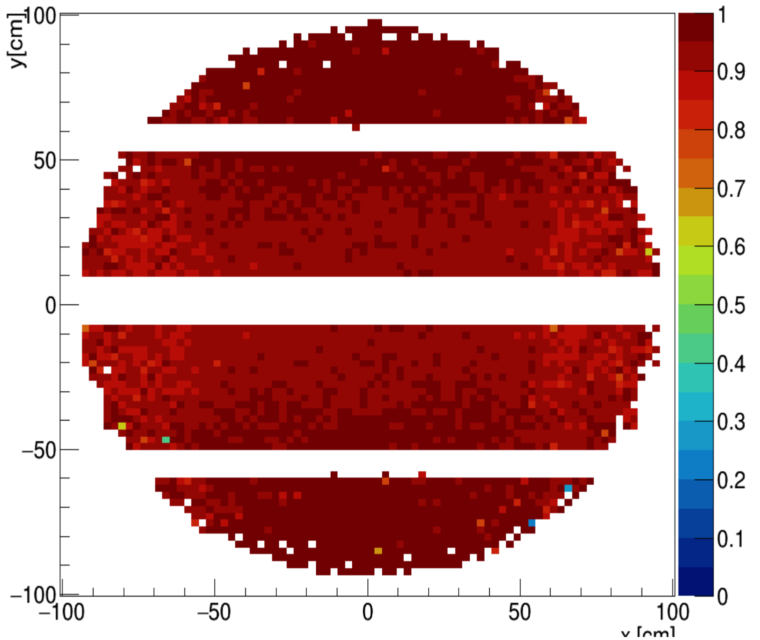


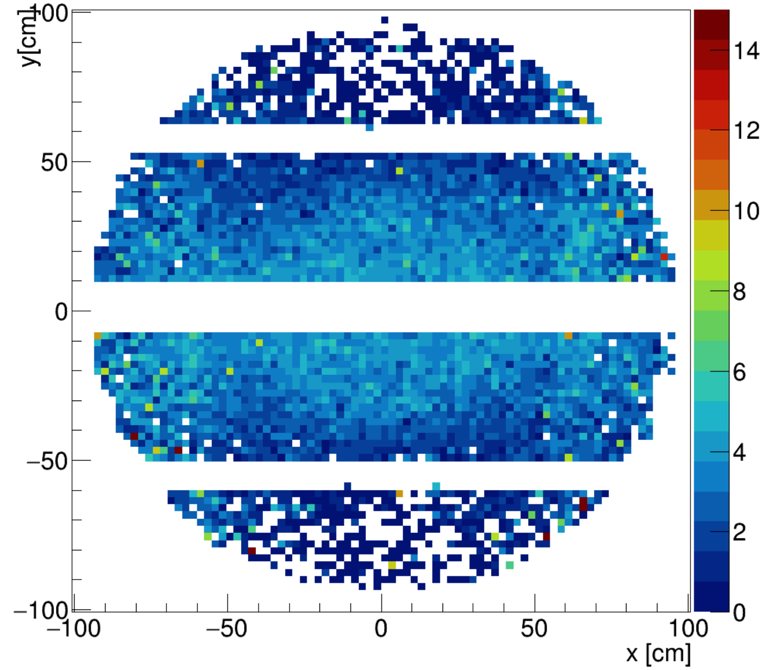


Photon loss is less than 5%, which is up to 3 photons/track

#2: 4 rows and 18 columns

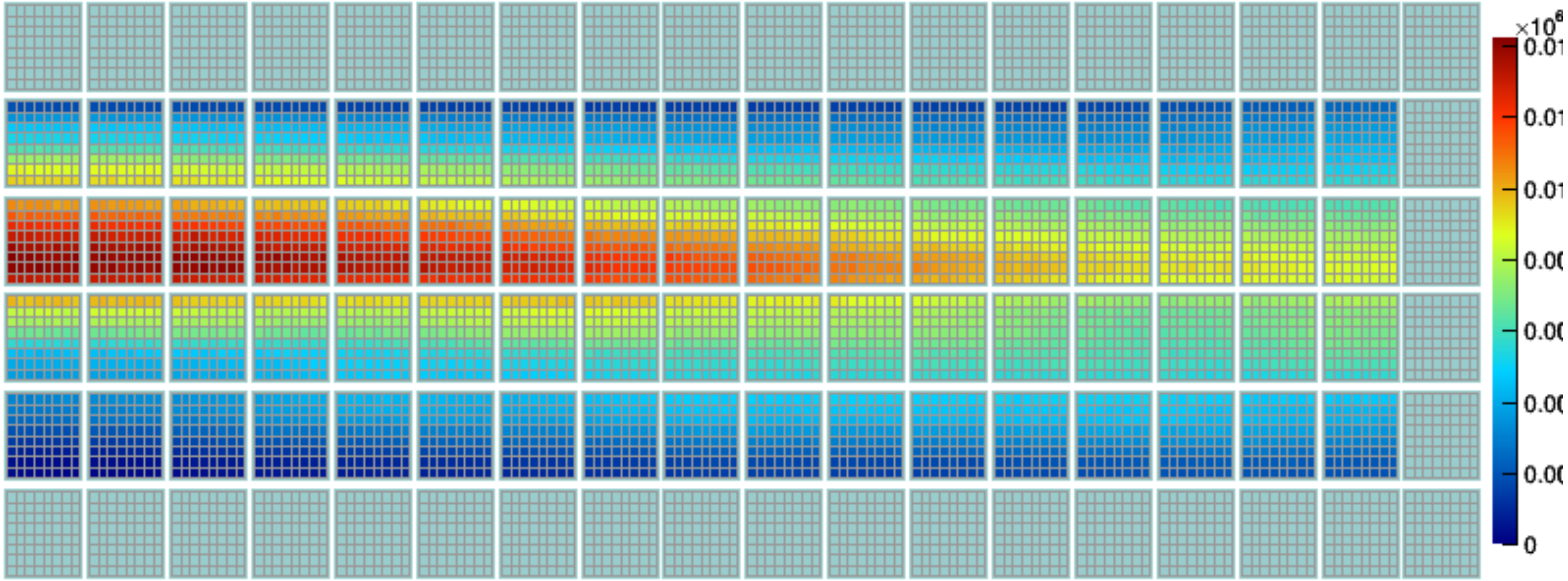


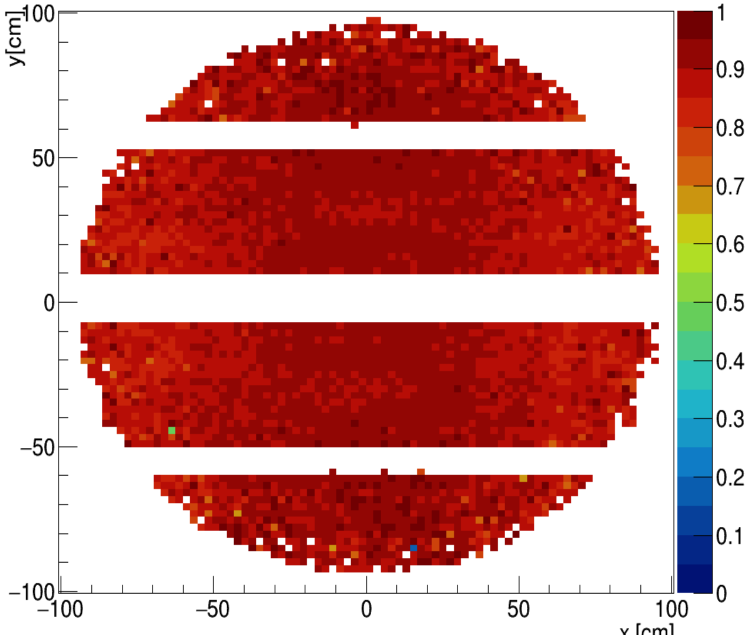


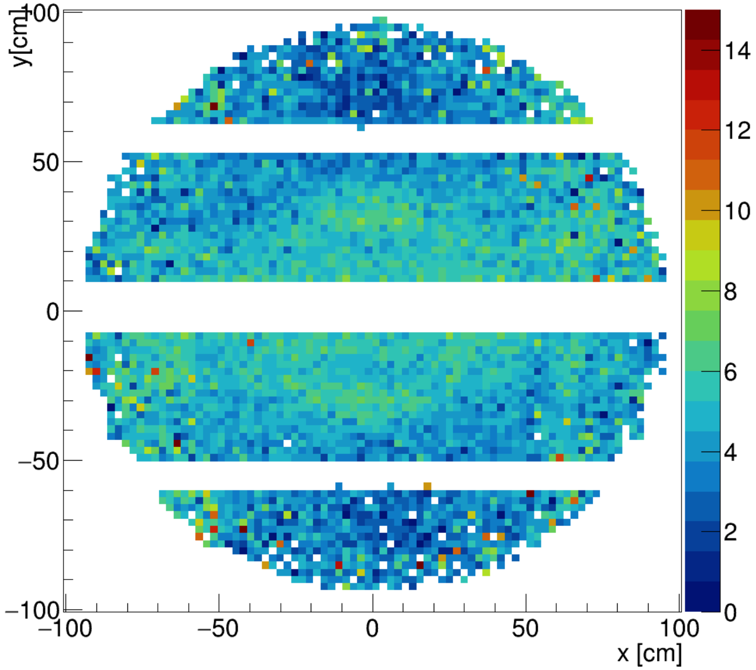


Photon loss is less than 10%, which is up to 5 photons/track

#3: 4 rows and 17 columns

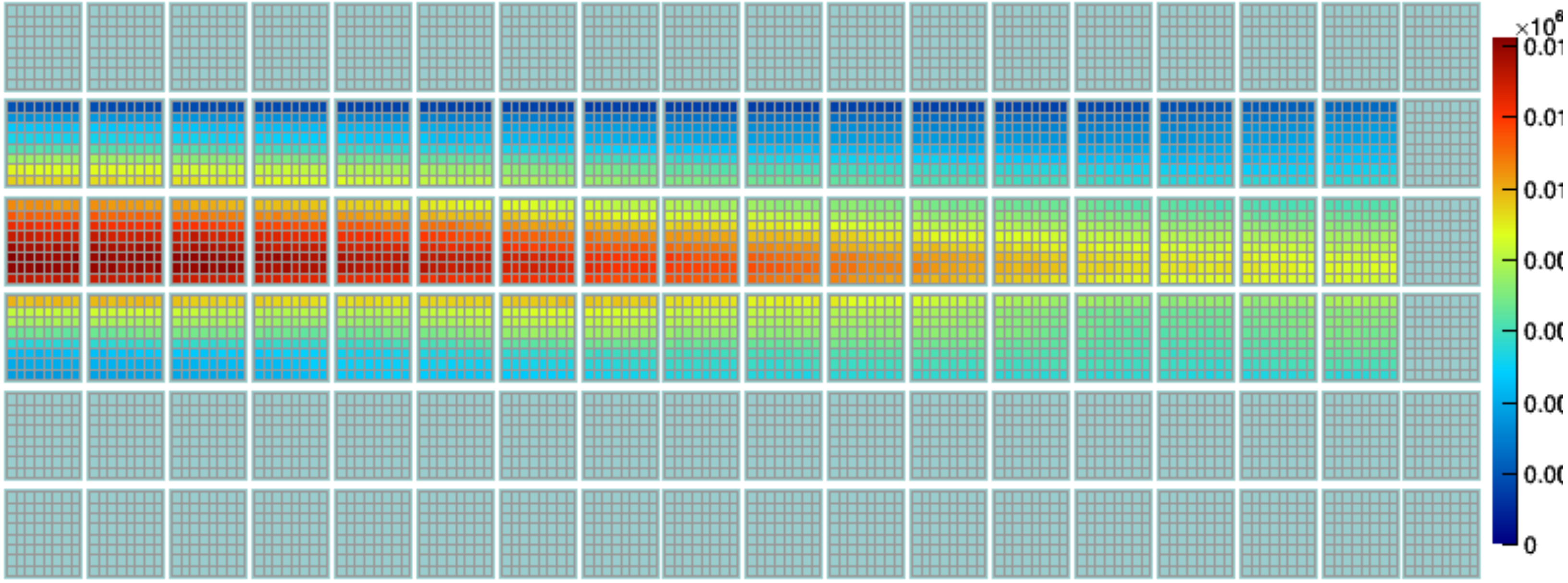


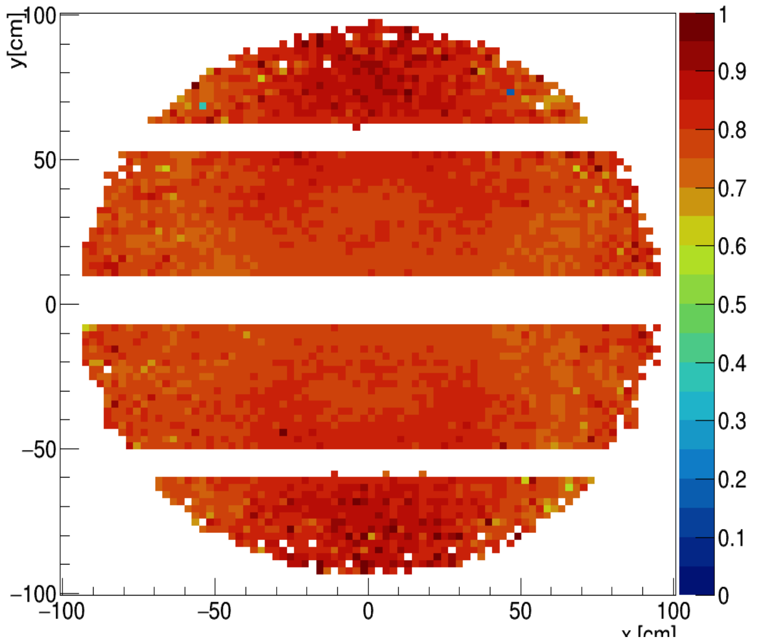


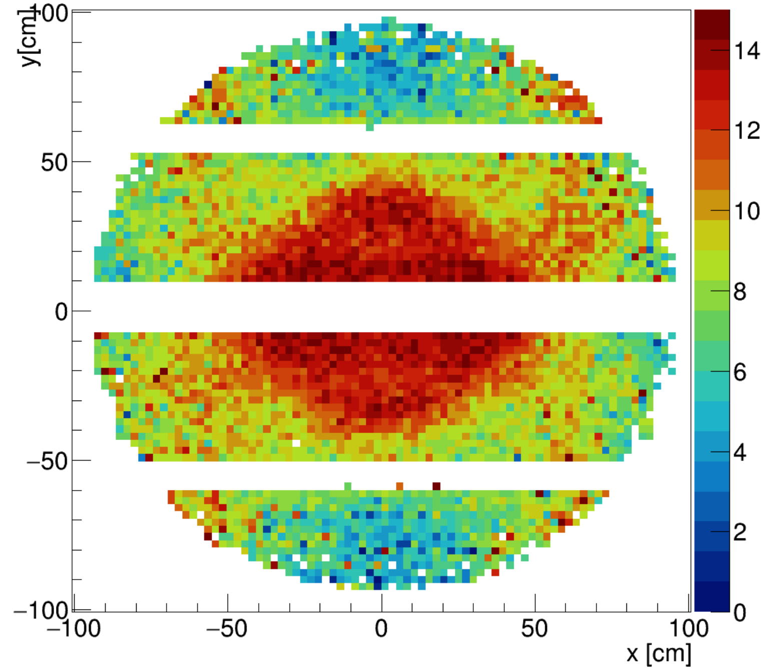


Photon loss is less than 15%, which is up to 7 photons/track

#4: 3 rows and 17 columns

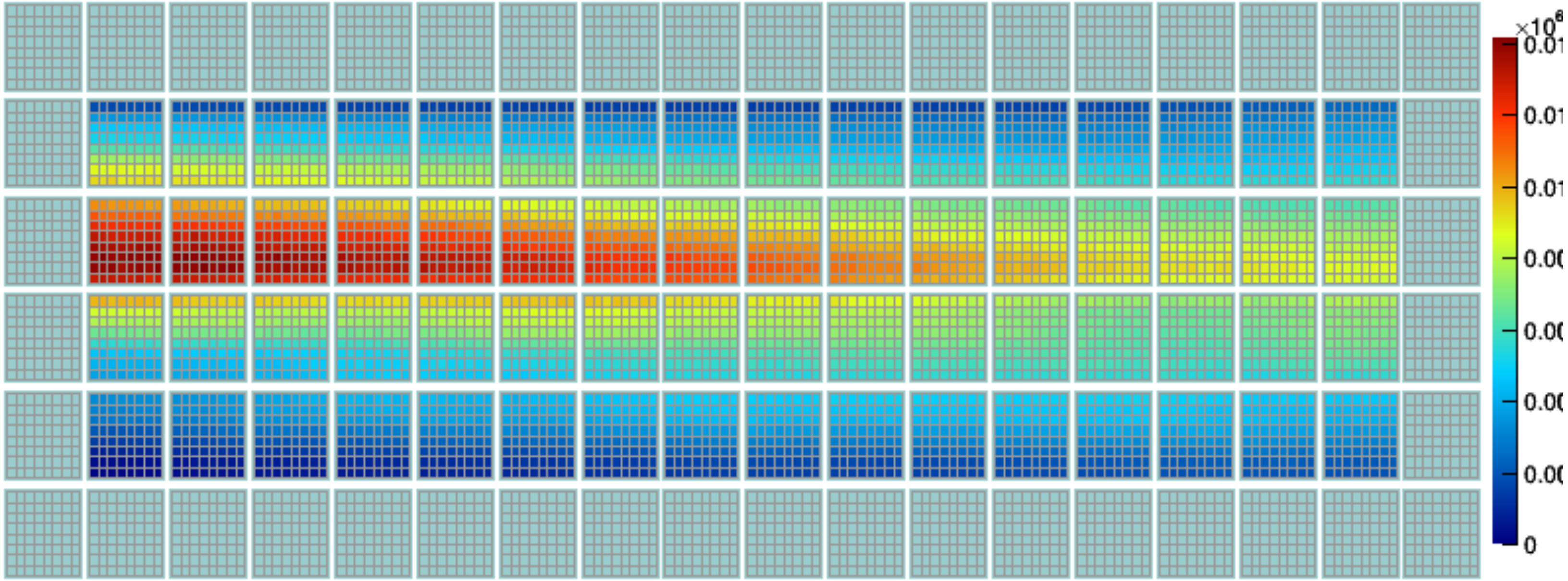


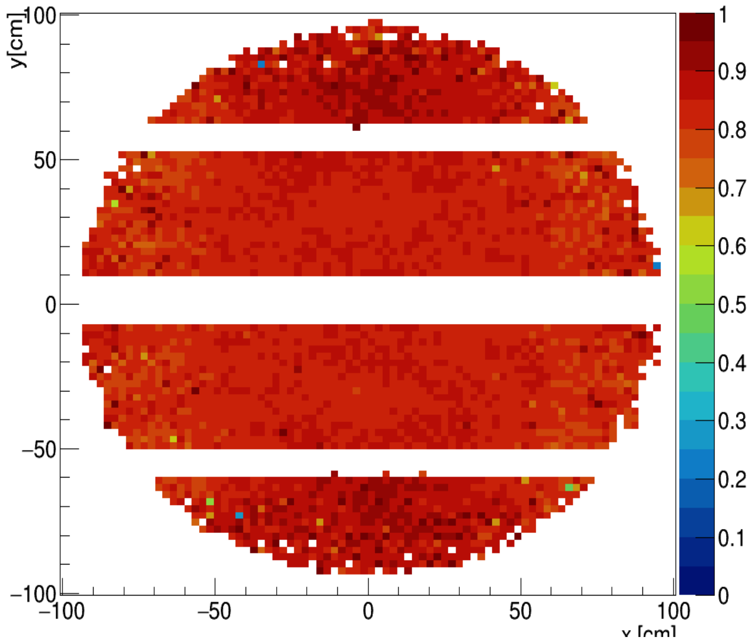


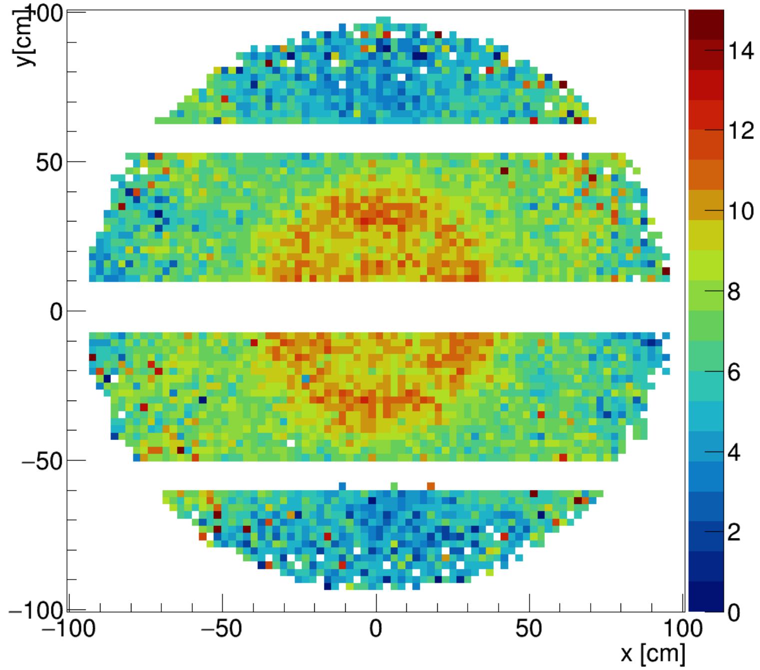


Photon loss is less than 40%, which is up to 15 photons/track

#6: 4 rows and 16 columns

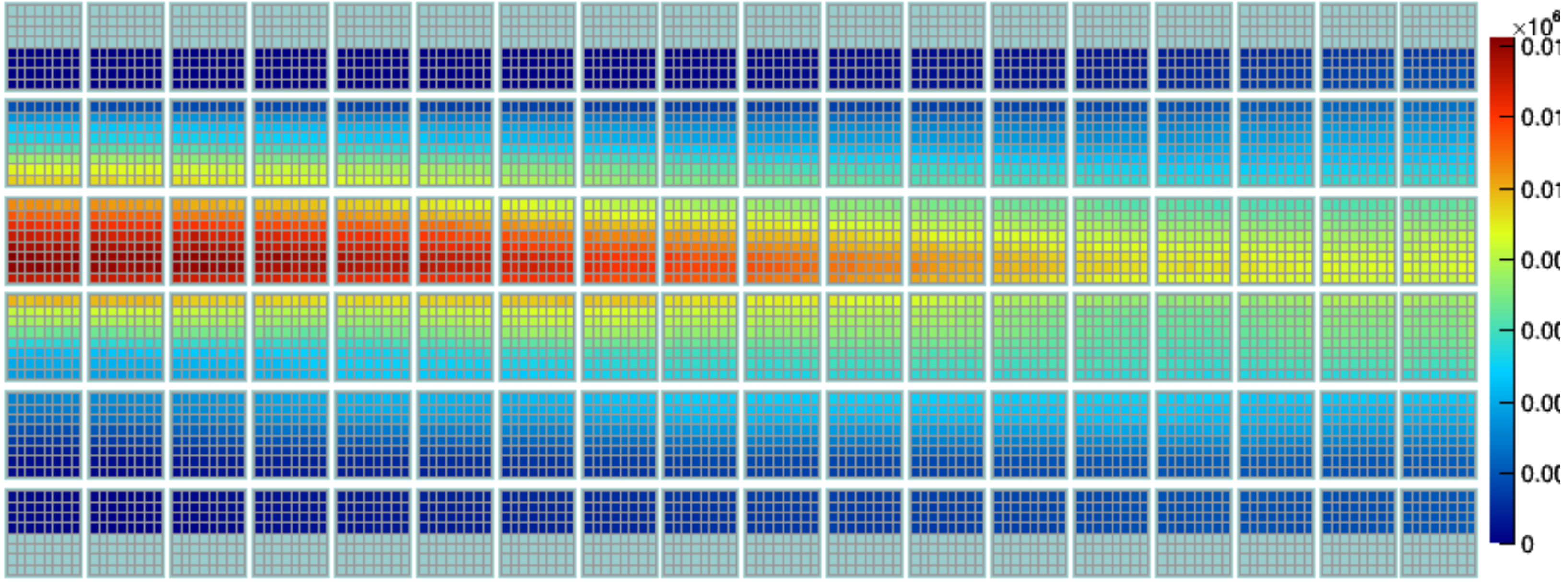


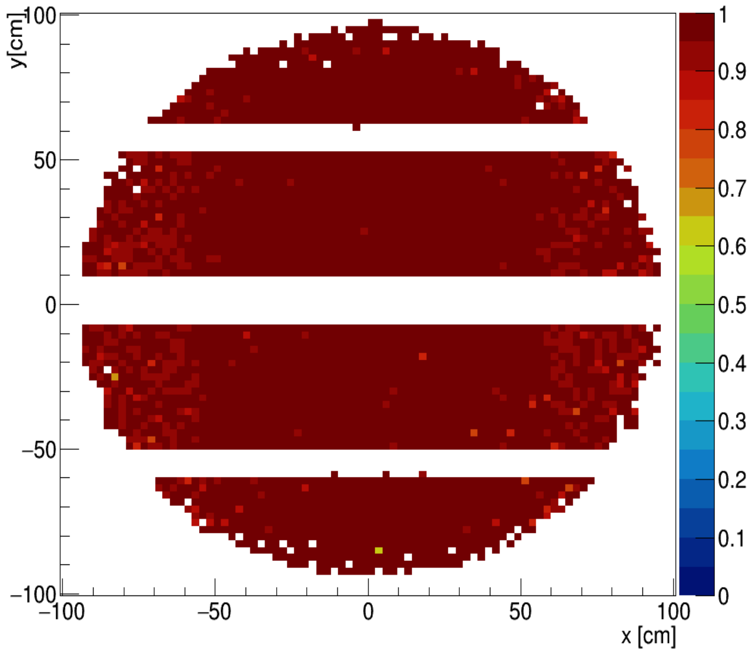


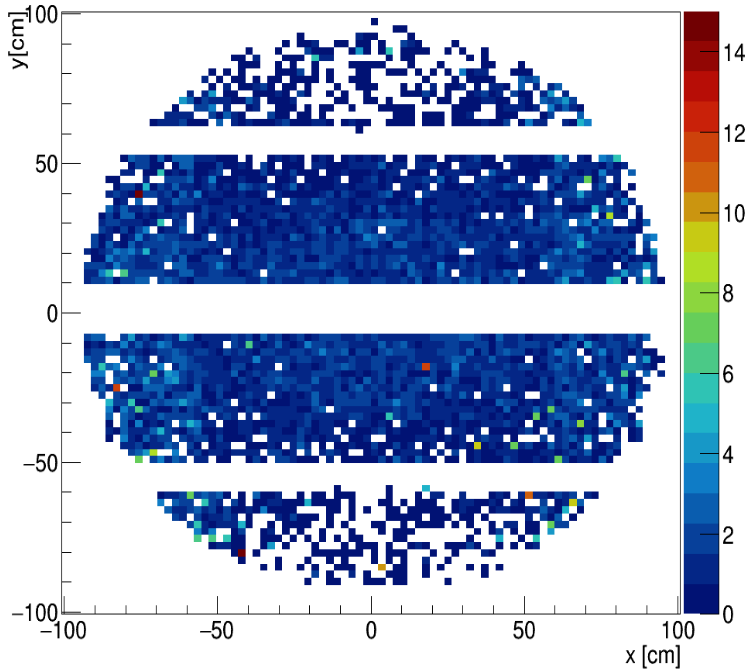


Photon loss is less than 30%, which is up to 13 photons/track

#7: 5 “centered” rows

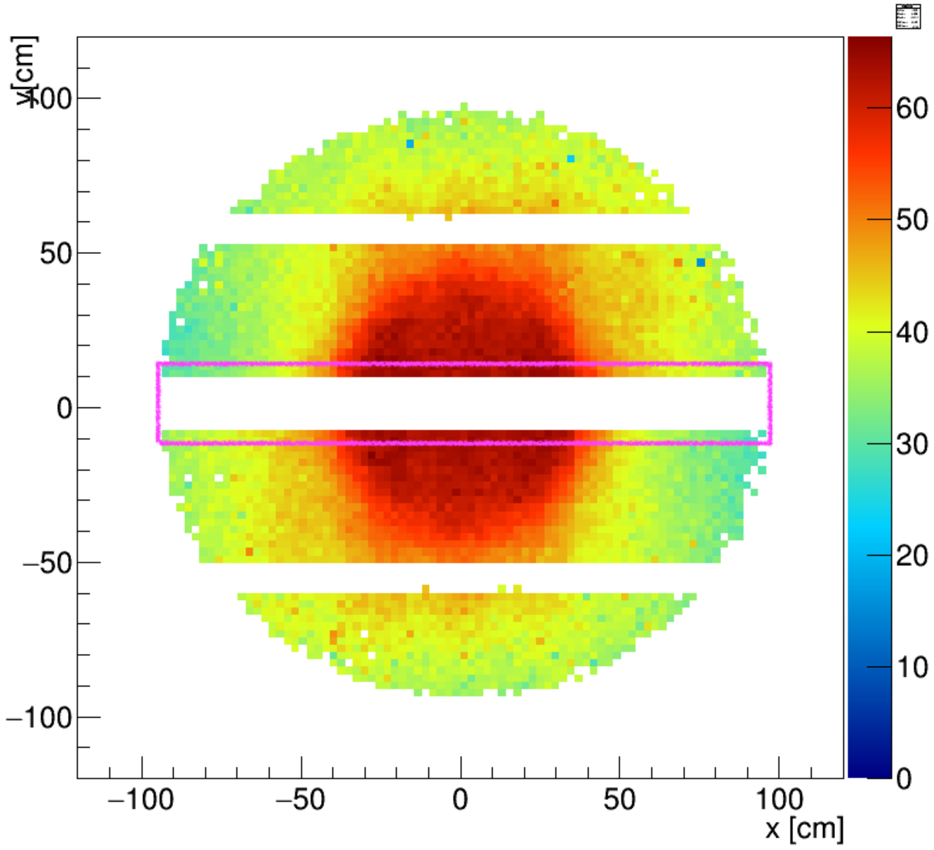


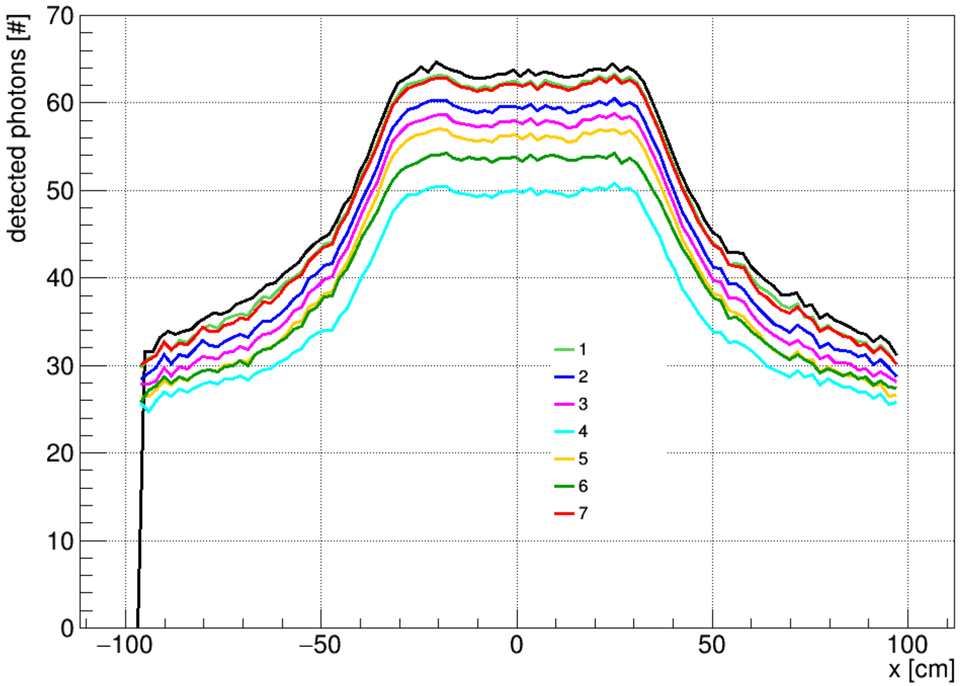


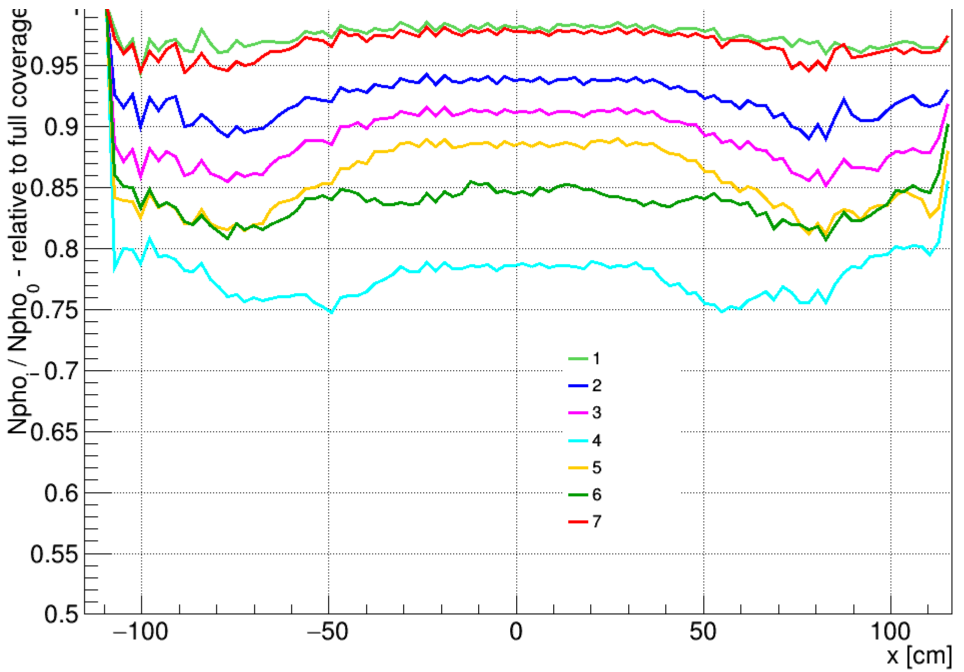


Photon loss is less than 5%, which is up to 3 photons/track (similar to #1)

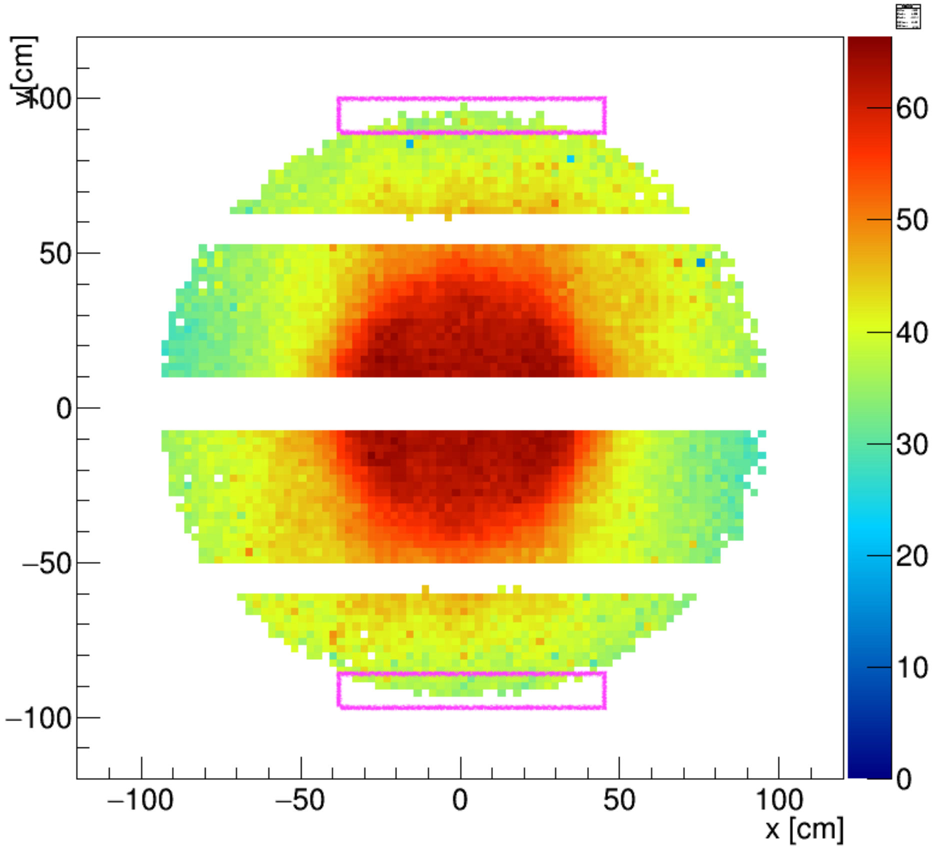
Photon yield for the middle bars

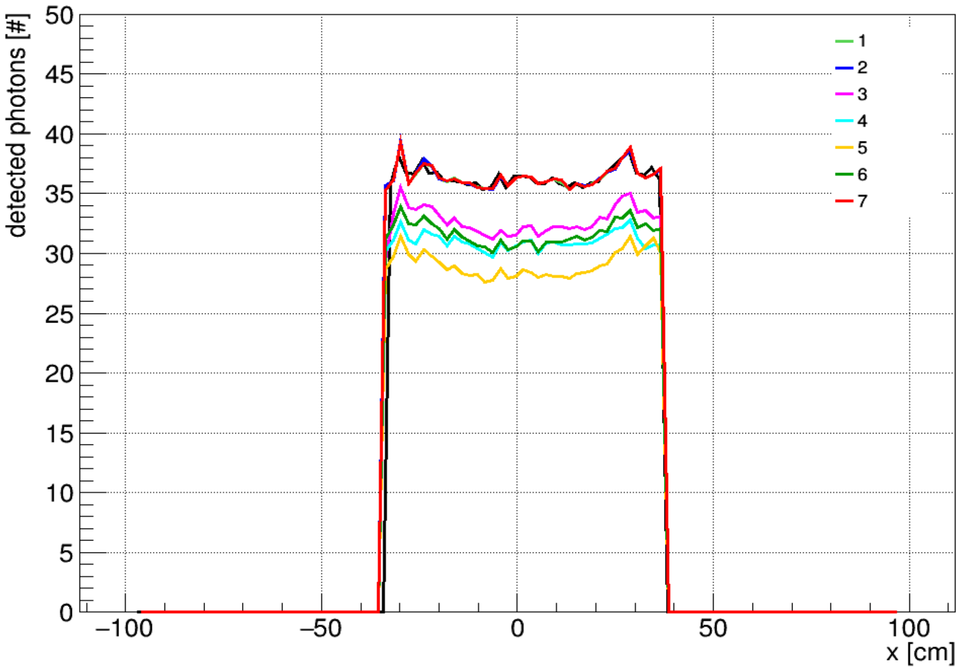


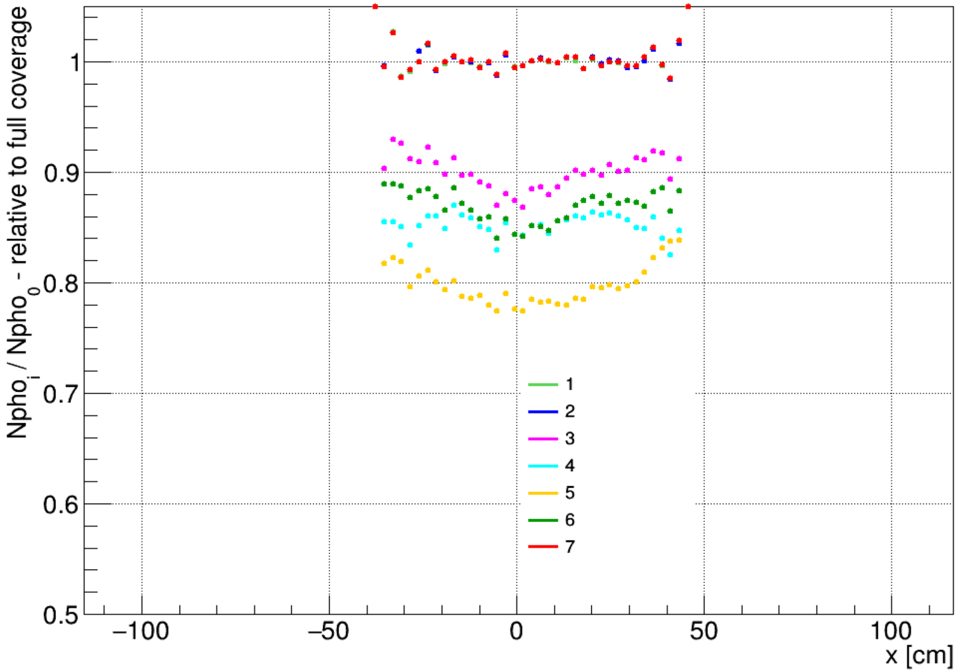




Photon yield for the edge bars







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
- Plot hit patterns